GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

INDIAN RAILWAYS
PERMANENT WAY MANUAL

(Corrected up to ACS – 11)

2024

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अनिल कुमार खंडेलवाल
ANIL KUMAR KHANDELWAL

सत्यमेव जयते

सदस्य इन्फ्रास्ट्रक्चर, रेलवे बोर्ड
एवं पदेन सचिव, भारत सरकार
रेल मंत्रालय

MEMBER INFRASTRUCTURE, RAILWAY BOARD
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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

FOREWARD

The **"Indian Railways Permanent Way Manual (IRPWM)"** was published in the year 2020. As new technologies are adopted and other issues keep on coming for improved maintenance, repair and relaying of track, the correction slips are issued as a regular practice. Around 22 such A & C slips had been issued in the last four years. IRPWM is an important document which is frequently referred by Track maintenance officials in the course of their day-to-day maintenance work. It becomes difficult for a practising field engineer, to connect the relevant correction slip issued separately, particularly when they are large in numbers. Therefore, it was considered necessary to update the manual by incorporating all the amendments issued after the last publication of manual. This re-printed edition incorporates all addendum & correction slips issued to the IRPWM up to the advance A & C No. 22.

It is expected that this updated Manual will be of immense use to the Permanent Way Personnel in easily accessing latest instructions related to track and thereby helping them in maintaining and upkeep of the track more effectively and efficiently in their day to day working.

26th Aug, 2024 **(Anil Kumar Khandelwal)**

PREFACE TO THE FIRST REPRINT 2024 TO IRPWM

The IRPWM 1986 was published and reprinted many times duly incorporating the Correction slips issued from time to time. The need for removing the obsolete paragraphs in the then existing IRPWM was felt and thus, the redrafted IRPWM was issued in 2020 with new and updated provisions pertaining to the maintenance of Permanent Way.

The last 4 years has seen rapid strides in improvement in the maintenance of Permanent Way and a total of 22 Correction Slips have been issued to this to this redrafted IRPWM 2020. Thus, it was considered necessary to reprint it duly incorporating all changes, so as to have a ready reference for use of the Permanent Way officials.

It is expected that this reprinted Manual will be helpful to the Permanent Way Personnel in accessing the updated and latest instructions related to P.Way and improve their efficiency so as to take Indian Railways forward.

(Sunil Kumar Jha)
Director General
IRICEN

Pune
August, 2024

FOREWORD TO REDRAFTED IRPWM (2020)

"Indian Railways Permanent Way Manual" was published in the year 1986, as per the recommendations of the 49th Track Standards Committee. Thereafter, it was reprinted on different occasions incorporating Advance Correction Slips issued from time to time.

There was need to issue updated Manual in view of various technological advancements which have taken place over the years. Description of obsolete materials like 90R Rails, Wooden Sleepers, Steel sleepers, etc. which are no longer in use have been removed. Meter Gauge and Narrow Gauge have been omitted in this IRPWM. For these, provisions of old IRPWM shall continue to hold. **Reference to all relevant drawings & specifications have also been provided in this manual, making it simple and more useful.**

The contents are reorganised, grouping similar topics in one chapter. In the beginning abbreviation and terminology has been added for ready reference. There is a total reduction of about 20% in volume.

The IRPWM and LWR manuals have been merged. Now in place of two manuals related to track, only one manual needs to be referred by field officials. All relevant provisions have been placed in logical sequence.

The redrafted manual has passed through several rounds of scrutiny by IRICEN faculty, two member committees for each chapter, deliberation in 88thTSC, sub-committee of six SAG officers, RDSO and Railway Board before its final approval.

It is hoped that this updated manual will help the Permanent Way men, in easy understanding the provisions and implementing them in the field in their day to day working.

(Vishwesh Chaube)
Member Engineering
Railway Board

New Delhi
June, 2020

PREFACE TO THE REDRAFTED IRPWM (2020)

The "Indian Railways Permanent Way Manual (IRPWM)" was first published in the year 1986 after recommendation of 49th TSC. It has been reprinted later in the years 1999 and 2004 to incorporate Advance Correction Slips issued from time to time. The third and the last reprint of this Manual in July 2019 was inclusive of the Correction Slips up to No. 149.

Railway Board vide letter No. 2013/CE-II/TK/IRPWM dated 24/09/2019 asked IRICEN to redraft IRPWM with a view to remove obsolete topics and material components which are not in use now and make it for only Broad Gauge by adding recent developments in P. Way for the guidance of field officials. Accordingly, Shri Ajay Goyal, the then Director, IRICEN along with a team of faculty members finalised the first draft of IRPWM keeping in view the mandate given by Railway Board. Thereafter Rly Bd vide letter No. 2013/CEII/TK/IRPWM dated 02/12/2019 nominated two members committee as under:

S. No.	Faculty from IRICEN Shri.	2nd Member Shri.	Chapter(s) assigned.
1	C. S. Sharma, SPT-1	S. C. Srivastava, PED/TM/RDSO	5
2	R. K. Bajpai, SPT-2	B. P. Awasthi, ED/TM/Rly Bd and Manoj Arora, CTE/WR	3 (welding), 4 and 6
3	Anil Choudhary, SPTM	P. K. Garg, CTE/CR and Submoy Mitra, CTE/SER	7 **&** 8
4	S. K. Agarwal, PB-1	J. Parida, CTE/ECoR and P. S. Gupta, ED/CE/G/Rly Bd	11 & 12
5	G. S. Yadav, PB-2	A. K. Jha, CTE/SCR	9, 10
6	P. Upadhyaya, PT-2	P. K. Garg, CTE/CR	1
7	N. K. Mishra, PT-1	P. S. Gupta, EDCE/G/Rly Bd	14
8	A. Siva Kumar, PW	A. M. Rizvi, ED/TR-2/RDSO and D. K. Pandey, CE/TMS	2,13 & Part 3 LWR portion

Each committee then finalised the nominated chapters which were compiled by IRICEN and presented to TSC meeting held in Jan, 2020 at PURI. On recommendation of TSC, Rly Bd nominated a sub Committee comprising of Shri R. K. Bajpai, Sr Professor Track-1/IRICEN (Member and Convenor), Shri P K Garg, CTE/CR, Shri A K Jha, CTE/SCR, Shri Ashish Bansal**,** CTE/NR, Shri S. Mitra, CTE/SER, and Shri A M Rizvi, ED Track-2/RDSO as members to examine and submit the final draft. The final draft after initial vetting by RDSO was sent to Railway Board. Rly Bd suggested certain changes which were examined and incorporated by IRICEN. After final vetting by RDSO the redrafted IRPWM is approved by Railway Board (Member Engineering). The provisions of the LWR manual have also been amalgamated herein to make this Manual, a one stop source for all P. Way related matters. The Chapters have been logically re-arranged so as to cater for the day-to-day needs of the field officials. For Metre Gauge and Narrow Gauge track one can refer old IRPWM which was reprinted on July 2019.

While revising the Manual, the provisions in the Indian Railway General Rules 1976, Indian Railways Code for the Engineering Department and Indian Railway schedule of Dimensions have been taken in to account. This redrafted edition incorporates all Advance Correction Slips up to No. 155 of the earlier Manual. The hitherto obsolete designations have been done away with and current designations of officials have been incorporated, viz. Gangman as Track Maintainer, Permanent Way Supervisor / Permanent Mistry (PWS/PWM) as JE(P.Way), PWI/PWI (In-charge) as JE/SSE(P.Way) Sectional or SSE(P.Way) In-charge**.** In a volume of this type, it is not possible to provide for every contingency that may arise during the course of the working, though every effort has been made to make the instructions comprehensive. The Principal Chief Engineers of Zonal

Railways may therefore supplement, where necessary, the practices and procedures contained herein with such further instructions/orders, as would suit local circumstances on their Railway. Such instructions must not of course contravene any of the provision in this manual, the codes of the various departments of the Railways, General Rules, or any of the statutory regulations in force.

It is expected that this updated Manual will be of immense use to the Permanent Way Personnel in easily accessing latest instructions related to track and thereby helping them in maintaining and upkeep of the track more effectively and efficiently. IRICEN will be glad to consider any comments and suggestion from Railway Administrations. Any errors or omissions found in this Edition may be brought to the notice of IRICEN.

(Santosh Kumar Agrawal)
Director General
IRICEN

Pune
June, 2020

CHAPTERS

CONTENTS

ABBREVIATIONS AND TERMINOLOGY

CHAPTER – 1

DUTIES OF PERMANENT WAY OFFICIALS

PART – A

Duties of Assistant Divisional Engineer (ADEN)

PART – B

Duties of Senior Section Engineer/P.Way in Overall Charge

PART – C

Duties of Junior Engineer/Senior Section Engineer/P.Way (Sectional)

PART – D

Duties of JE/SSE/P.Way (Other Than Sectional or In-Charge)

PART – E

Duties of Gang Mates, Keymen, Patrolmen, Gateman and Track Maintainer

CHAPTER – 2

TRACK STRUCTURE AND COMPONENTS

PART – A

Rail and Rail Fastenings

PART – B

Flash-Butt Welding of Rails

PART – C

Short Welded Rails

PART – D

Long Welded Rails

CHAPTER – 4

CURVES & TURNOUTS

PART – A - Curves

SECTION – I: General

SECTION – II: Re-Alignment of Curves

PART – B

Points & Crossings

CHAPTER – 5

TRACK MONITORING & TOLERANCES

PART – A
Track Monitoring

PART – B
Track Tolerances

CHAPTER – 6

MAINTENANCE OF PERMANENT WAY

PART – A
Regular Track Maintenance

PART – B
Handling and Maintenance of Rails, Sleepers, Fastenings & Other Misc. Items

PART – C

Works Incidental to Regular Track Maintenance

PART – D

Record Keeping

PART – E

Maintenance Of Track In Track Circuited Areas

PART – F

Maintenance of Track in Electrified Areas

CHAPTER – 7

PERMANENT WAY RENEWALS

CHAPTER – 8

ENGINEERING RESTRICTIONS & INDICATORS, WORKING OF TROLLIES, LORRIES & MATERIAL TRAINS

PART – A

Engineering Restrictions & Indicators

PART – B

The Working of Trollies, Motor Trollies And Lorries

PART – C

Working of Material Trains & Track Machines

CHAPTER – 13

TRACK MANAGEMENT SYSTEM

CHAPTER – 14

TRAINING, COMPETENCY & REFERENCES

CHAPTER – 15

EMERGING TRACK TECHNOLOGY ITEMS

ABBREVIATIONS

ADEN	–	Assistant Divisional Engineer
ART	–	Accident Relief Train
AT	–	Alumino Thermit
ATS	–	Actual Toe of Switch
BCM	–	Ballast Cleaning Machine
BFR	–	Bogie Flat for Rail
CAO(C)	–	Chief Administrative Officer (Construction)
CMS	–	Cast Manganese Steel
CMT	–	Chemical & Metallurgical Testing
CRS	–	Commissioner of Railway Safety
CTE	–	Chief Track Engineer
CWR	–	Continuous Welded Rail
DEN	–	Divisional Engineer
DRM	–	Divisional Railway Manager
DTS	–	Dynamic Track Stabilizer
ERC	–	Elastic Rail Clip
ETKM	–	Equated Track Kilometre
FBW	–	Flash Butt Weld / Flash Butt Welding
FWP	–	Final Works Programme
G&SR	–	General and Subsidiary Rules
GFN	–	Glass Filled Nylon
GK	–	Gate Keeper
GMT	–	Gross Million Tonne
GRSP	–	Grooved Rubber Sole Plate
HH	–	Head Hardened
IMR	–	Immediate Removal
IRBM	–	Indian Railways Bridge Manual
IRCA	–	Indian Railway Conference Association
IRPSM	–	Indian Railways Proposals & Sanction Management
IRPWM	–	Indian Railways Permanent Way Manual
IRS	–	Indian Railway Standards
IRSEM	–	Indian railways Signal Engineering Manual
IRSOD	–	Indian Railways Schedule of Dimensions
IRTMM	–	Indian Railway Track Machine Manual
JE	–	Junior Engineer

JOH	–	Junction of Heads
LL	–	Liquid Limit
LVDT	–	Linear Variable Differential Transducer
M&C	–	Metallurgical and Chemical (Directorate of RDSO)
MCI	–	Malleable Cast Iron
MCNTM	–	Manpower and Cost Norms for Track Maintenance
MM	–	Medium Manganese
MMG	–	Mobile Maintenance Gang
CBML	–	Condition Based Maintenance Limit (ACS – 4)
OHE	–	Over Head Equipment
OMS	–	Oscillations Monitoring System
P&C	–	Points & Crossings
P.Way	–	Permanent Way
PCE	–	Principal Chief Engineer
PL	–	Plastic Limit
PRC	–	Pre-stressed Reinforced Concrete
PSC	–	Pre-stressed Concrete Sleeper
RAW	–	Railway Affecting Works
RBMV	–	Rail Borne Maintenance Vehicle
RDSO	–	Research Design & Standards Organization
ROB	–	Road Over Bridge
RUB	–	Road Under Bridge
RVNL	–	Rail Vikas Nigam Limited
S&T	–	Signal & Telecommunication
SD	–	Standard Deviation (Statistics)
SKV	–	Short Preheat Welding
SL	–	Shrinkage Limit
SM	–	Station Master
SR	–	Speed Restriction
Sr. DEN (Co)	–	Senior Divisional Engineer (Co-ordination)
Sr. DOM	–	Senior Divisional Operating Manager
Sr. DSTE	–	Senior Divisional Signal & Telecommunication Engineer
SSE	–	Senior Section Engineer
SWR/SWP	–	Short Welded Rail/ Short Welded Panel
TMS	–	Track Management System
TQI	–	Track Quality Index
Track Manual	–	Indian Railways Standard Track Manual (Volume I and II)

TRC	–	Track Recording Car
TRD	–	Traction Distribution Department
TTM	–	Tie Tamping Machine
TVU	–	Train Vehicle Unit
TWS	–	Thick Web Switch
UIC	–	International Union of Railways
UML	–	Urgent Maintenance Limit
USFD	–	Ultrasonic Flaw Detection
UTS	–	Ultimate Tensile Strength
WCMS	–	Weldable Cast Manganese Steel
WILD	–	Wheel Impact Load Detector

TERMINOLOGY

(1) *Alignment (AL) (of rails) –*

It refers to deviation of rails in horizontal plane, from its original/intended position, measured individually for each of the rail with reference to a chord of specified length.

(2) *Anchor Length (l_a) –*

The length of track required to resist the pull exerted on rails by the rail tensor at temperature (t_p). For practical purposes, it is taken as equal to 2.5 metre per degree Celsius of ($t_o - t_p$). If t_0 is not known, t_d can be assumed as t_0.

(3) *Blanket –*

The layer of granular material provided between ballast and sub grade/ Formation on full width of Formation.

(4) *Breathing Length –*

The length at each end of LWR/CWR, which is subjected to expansion/contraction on account of temperature variations.

(5) *Buckling of Track –*

Sudden or Gradual shifting of Track in lateral or vertical direction due to unbalanced thermal stress in rail/track is called Buckling.

(6) *Cant deficiency –*

Cant deficiency occurs when a train travels around a curve at a speed higher than the equilibrium speed. It is the difference between the theoretical Cant required for such higher speed and actual Cant provided.

(7) *Cant excess –*

Cant excess occurs when a train travels around a curve at a speed lower than the equilibrium speed. It is the difference between the actual Cant and the theoretical Cant required for such a lower speed.

(8) *Cant gradient and Cant deficiency gradient –*

It indicates the amount by which Cant or deficiency of Cant is increased or reduced in a given length of transition e.g., 1 in 1000 means that Cant or deficiency of Cant of 1 mm is gained or lost in every 1000 mm of transition length.

(9) *Catch Sidings –*

Catch Siding is a safety siding, taking off from the main line and of a suitable length, provided with devices such as rising variable grades and sand drags to fully absorb the Velocity Head attained by an inefficiently controlled train or part of train being pulled up therein, without being wrecked. It is essentially a gravity catch siding provided on long steep grades between stations, where curves are designed for a lower speed than may conceivably be attained by a train or part of a train, which for one cause or another, may have got out of control and when it is necessary to protect a station from uncontrolled trains or parts of trains liable to enter it.

At any station situated in the immediate neighborhood of an incline steeper than 1 in 80 falling towards the station, a Catch Siding should be provided, if necessary. The takeoff points to a catch siding should normally be set and locked for the siding, except where required to the trailed through.

(10) *Centrifugal force –*

The outward force acting on a vehicle while moving on a curved track. Its magnitude depends upon the velocity of vehicle, mass and radius of curvature.

(11) *Cold Weather Patrol –*

The patrolling of track carried out during the period (in winter) when rail temperature is significantly lower than stress-free/de-stressing temperature.

(12) *Consolidation of Track –*

The process of building up ballast resistance to the tendency of movement of sleeper either initially before laying LWR/CWR or making up subsequent loss of resistance.

(13) *Cross level –*

It is the level difference between two rails, on a sleeper, of a track. For the measurement of cross level, one of the rails is taken as reference to define the level of other rail.

(14) *Crossing angle –*

It is the angle contained between the gauge lines of the crossing. Usually defined by the number of crossing, which is cotangent of angle of crossing.

(15) *Cross Over –*

A device to connect two lines by using two turnouts and straight or curved track in between.

(16) *Degree of curvature –*

The angle subtended at the centre, of the circular curve, by a chord of 30.5 metres.

(17) *De-stressing –*

An operation undertaken with or without rail tensor to secure stress free conditions in the LWR/CWR at the desired/specified rail temperature.

(18) *Equilibrium speed –*

The speed at which the centrifugal force developed during the movement of the vehicle on a curved track is exactly balanced by the Cant provided.

(19) *Gauge –*

It is the shortest distance between the gauge faces of rails of a track between two rails. It is usually measured at a level between 13 to 15 mm below the rail top.

(20) *GMT –*

The total traffic carried on a line, expressed as the Gross Million Tonnes of Traffic (GMT), recorded and advised by the Statistical branch of each Zonal Railway as on 31st March of every year is called the GMT of the line.

(21) *Hot Weather Patrol –*

The patrolling of track carried out during the period (in summer) when rail temperature is significantly higher than stress-free/de-stressing temperature.

(22) *Lead curve or the turn out curve –*

The curve beginning (usually from the toe of curved switch) and extending up to toe of crossing.

(23) *Machined Joint –*

These joints are fish plated joints, which are provided where zero gap is required between rail ends.

(24) *Maximum permissible speed of the curve –*

The highest speed which may be permitted on a curve taking into consideration the radius of the curvature, actual cant, Cant deficiency, Cant excess and the length of transition.

(25) *Rail Failure –*

A rail is said to have failed if it has fractured in track or it is considered necessary to remove it from track on account of defects other than those due to accidental damages due to buckling, kinking, derailments, abnormal wheel burns etc.

(26) *Rail Temperature –*

Temperature of the rail as recorded by an approved type of rail thermometer at site. It differs from the ambient temperature, which is the temperature of air in shade at that place, as reported by the Meteorological Department.

Indian Railways have been divided into four rail temperature zones. **Fig. 3.7 of Chapter 3** is a map showing the four temperature zones and the annual mean rail temperatures at all important places are shown in the map.

(a) *Destressing Temperature (t_d) –*

The average rail temperature during the period of fastening the rails to the sleepers after de-stressing LWR/CWR without the use of rail tensor. If rail tensor is used, t_d for all practical purposes is equal to t_0. The Range of t_d or t_0 shall be within the limits of rail temperature shown below:

Temperature Zone	Rail Section	Range
I, II, III	All Sections	t_m to t_m+ 5° C
IV	52 kg/m & heavier	t_m+5° C to t_m+10° C

(b) *Installation Temperature (t_i) –*

The average rail temperature, during the process of fastening the rails to the sleepers, at the time of installation of SWR/LWR/CWR.

(c) *Mean Annual Rail Temperature (t_m) –*

The average of the maximum and minimum rail temperature recorded during the year. t_m is fixed locally wherever rail temperature records are available for a reasonable period of five years.

Where rail temperature records are not available, t_m can be read from the rail temperature map **(Fig. 3.7 of Chapter 3)**

(d) *Prevailing Rail Temperature (t_p) –*

The rail temperature prevailing at the time when any operation connected with LWR such as de-stressing etc., is carried out.

(e) *Stress-Free Temperature (t_0) –*

The temperature of Rail in LWR/CWR at which the rail is free of thermal stresses.

(27) *Rail Tensor –*

A hydraulic or mechanical device used for stretching the rail physically.

(28) *Rate of change of Cant or rate of change of Cant deficiency –*

It is the rate at which Cant or Cant deficiency is increased or reduced per second, at the maximum permissible speed of the vehicle passing over the transition curve, e.g., 35 mm. per second means that a vehicle when traveling at a maximum speed permitted will experience a change in Cant or deficiency of Cant of 35 mm in each second of travel over the transition.

(29) *Sand Hump –*

A sanded track, which works as an isolation, provided after loop lines to avert collision with main line vehicles.

(30) *Shift –*

An introduction of transition curve, laid out as a cubic Parabola, causes main circular arc to move inwards by an amount called the “Shift”.

(31) *Slip Siding –*

These are shorter length sidings located on the lower side of a station on steep grade, where there is a risk, whether owing to gradients or due to high wind velocity, of uncontrolled vehicles running out of stations from stand still or during shunting, fouling the main line. These sidings take off from the main line, outside all points, to prevent wagons breaking away from the station, entering into the block section.

At any station situated in the immediate neighbourhood of an incline steeper than 1 in 100 falling away from the station, a Slip siding should be provided, if necessary, in a suitable position. The takeoff points to a slip siding should normally be set and locked for the siding, except where required to the trailed through.

Whenever, for any cause. it is found necessary to lay a slip siding off the main line or off the through loop line, so that there is risk of whole trains getting trapped, the design of such a slip siding must be identical with that of catch sidings as already defined.

(32) *Stock Rail Joint (SRJ) –*

The joint of stock rail with the running rail at the approach.

(33) *Super-Elevation (SE) –*

Super-elevation is the amount by which one of the rail is raised with reference to the other rail of a track.

(34) *Switch Expansion Joint (SEJ) –*

An expansion joint installed at each end of LWR/CWR to permit expansion/contraction of the adjoining breathing lengths due to temperature variations.

(35) *Symmetrical Split –*

These are the turnouts where centre line of track coincides with bisector of crossing angle. The radius of lead curve of Symmetrical split turnout is twice the radius of ordinary turnout.

(36) *Transition Curve –*

An easement curve which has curvature change throughout its length

(37) *Turn-in Curve –*

The connecting curve starting after the heel of the crossing leading up to the adjacent track.

(38) *Turnout –*

It is a device to allow movement of train from one track to another track. The turnout consists of sub-assemblies of Switch, Crossing and Lead. Depending on the side to which the train gets diverted, a turnout may be called left or right hand.

(39) *Twist –*

Twist is Parameter, calculated by using cross level values at two locations separated by a specific distance (base). It is also defined as the rate of change of cross levels (in mm/m) over a given base.

(40) *Unevenness (UN) (of Rails) –*

It refers to deviation of rails in vertical plane, from its original/intended position, measured individually for each of the rail with reference to a chord of specified length.

(41) *Versine* –

Versine is the perpendicular distance measured at the midpoint of a chord from the arc of curved track.

(42) *Vertical curve* –

A circular curve in vertical plane.

(43) *Welded Rails* –

(a) *Continuous Welded Rail (CWR)* –

A LWR, which continues through station yards including points and crossings.

(b) *Long Welded Rail (LWR)* –

A welded rail, the central part of which does not undergo any longitudinal movement due to temperature variations.

(c) *Short Welded Rail (SWR)* –

A welded rail that contracts and expands, throughout its length, due to temperature variations.

CHAPTER – 1

DUTIES OF PERMANENT WAY OFFICIALS

PART – A

Duties of Assistant Divisional Engineer (ADEN)

101 General –

The Assistant Divisional Engineer (ADEN), in-charge of a sub-division, is generally responsible for the inspection, maintenance and safety of all way & works including bridges in the sub-division; for the accuracy, quality and progress of new works and control over all expenditure in relation to budget allotment.

102 Knowledge of Rules and Regulations – *(Back to **Para** 105)*

ADEN should have knowledge of Rules and Regulations as laid down in:

(1) The Indian Railways Act;

(2) Indian Railways (Open Lines) General Rules and Subsidiary Rules;

(3) Indian Railways Schedule of Dimensions 1676 mm Gauge (BG);

(4) Indian Railways Permanent Way Manual;

(5) Indian Railways Standard Track Manual (Volume I and II);

(6) Manual for Flash Butt Welding of Rails;

(7) Manual for Fusion Welding of Rails by the Alumino Thermic Process;

(8) Manual for Glued Insulated Rail Joints;

(9) Manual for Reconditioning of Medium Manganese (MM) Steel Points & Crossings, Switch Expansion Joints (SEJs) and Cast Manganese Steel (CMS) Crossings;

(10) Manual for Ultrasonic Testing of Rails and Welds;

(11) Indian Railway Track Machine Manual;

(12) Indian Railways Small Track Machine Manual;

(13) Indian Railways Bridge Manual;

(14) Indian Railways Works Manual;

(15) Indian Railways Code for the Engineering Department;

(16) Other Departmental Codes & Manuals;

(17) Latest correction slips, Instruction, and circulars issued from time to time, relating to aforesaid;

ADEN shall have up-to-date copies of these codes and manuals with all correction slips etc. He should be well versed with the various modules of the Track Management System (TMS). He shall ensure that all the staff under him are acquainted with the relevant rules and working methods connected with their duties.

103 Duties of ADEN –

(1) *Inspection and maintenance of Track in a satisfactory and safe condition* – He shall conduct inspection as per the Schedules laid down ***(Table-1A)*** by the Administration from time to time. He shall enter the inspection details in Track Management System (TMS), and shall ensure compliance of the instructions within a reasonable period.

ADEN shall:

(a) Bring to the notice of the DEN/Sr.DEN, any work pertaining to track, which is considered beyond the capacity of ADEN to deal with and any other item considered necessary for safe functioning of track.

(b) Ensure that the staff are fully conversant with their respective responsibilities with regard to laying and maintenance of track.

(c) Ensure that all remedial action for LWR/CWR showing unsatisfactory behaviour are taken in time.

(d) Issue certificate once in a year before summer, i.e., in the month of February, that all the LWR/CWR in his jurisdiction are behaving satisfactorily and send it to DEN/Sr.DEN.

(2) *Track Machines* - Monitoring and ensuring quality and output of all the track machines working in the sub-division. ADEN shall:

(a) Ensure all prerequisites, pre-block, during block and post-block activities for quality output;

(b) Ensure sufficient lighting during night working and arrange Fuel/oil well in advance;

(c) In the eventuality of breakdown of a machine, ADEN shall take all possible actions to clear the block section expeditiously, if the machine cannot be repaired during the line-block;

(d) Inspect the track machines as per the prescribed schedule and check the items/ checklist laid down in Indian Railways Track Machine Manual;

(3) Preparation of plans and estimates for works and submission of detailed proposals with justifications to Division for sanction of works. ADEN shall also prepare special conditions, if any, specific to site for execution of work(s)/part of the work(s).

(4) Execution and monitoring of works as per the tender conditions and approved plan & schedule of the work. Every work should be efficiently organized and programmed to progress speedily and completed within the specified period. ADEN shall ensure timely measurements and preparation of bills with prescribed test checks for ensuring quality and quantity;

(5) Measurement of Ballast – ADEN may either measure and record the measurements of ballast or carry out 100 % check on quality and quantity, if measurements are recorded by the SSE/P.Way (In-charge) or SSE/Works (In-charge) as per the practice prevailing in Railway

(6) Co-ordination with Officials of other Departments as warranted;

(7) Reviewing and monitoring of inspections, works and other records of subordinate officials. The ADEN shall also scrutinize the inspection entries made by SSE/P.Way (In-charge) and JE/SSE/P.Way (Sectional) in Track Management System (TMS), and shall ensure compliance of the items, within a reasonable period. He shall also review and cross-verify the selected inspections in the field, particularly those related to points and crossings, LWRs, and level crossings.

(ACS – 10)

(8) Inspection and test check of USFD-Checking of work of JE/SSE/P.Way (USFD) at least once during each month or as specified by higher authority;

(9) Inspection of Office and Stores of all SSE/P.Way (In-charge) at least once a year. When checking stores, particular attention should be paid to the availability and proper distribution of Imprest materials, upkeep and working of small track machines, Engineering indicators, protection equipment and other important items in stores and records in offices;

(10) *Accompanying Inspection by Higher Officials* – ADEN shall accompany higher officials on their inspections and shall carry following records: *(Back to **Para 106 (12)**)*

(a) All relevant manuals (soft / hard copy) duly updated,

(b) List of Permanent and Temporary speed restrictions,

(c) TMS Information Dump of Assets and Inspections (section details, track diagram, TRC/OMS records, fracture details and analysis, inspection details of various assets, etc.) in tab / laptop;

(d) Important registers and other relevant records;

(e) List of sanctioned works and their status;

(f) Inspection notes of higher officers with compliance reports;

(g) Working time table; and

(h) Other specific papers and plans that are likely to be discussed should also be carried for reference.

(11) Accompanying Track Recording/OMS runs and take down notes regarding the spots needing attention and ensure rectification of the defects. (ACS – 3)

(12) *Control over Expenditure* – ADEN shall exercise due care in passing requisitions for materials and tools and in the execution of new and maintenance works, ensuring in all cases that the expenditure is within the allotment or provision available in the sanctioned estimate.

(13) *Training of Probationers* – ADEN shall take interest and impart training of all probationers deputed for training according to the specified programme. ADEN should also periodically examine the training notes prepared by probationers.

(14) *Material under Trial* – ADEN shall be responsible for monitoring performance of 'material under trial' in his section and ensure that the required details for the same are collected as per the trial scheme and submitted to divisional office through TMS.

(15) *Dealing with staff matter* – ADEN shall ensure that:

(a) Strict discipline is maintained within the framework of the rules;

(b) Service and leave records are maintained correctly and up-to-date;

(c) Appeals and representations are dealt with promptly;

(d) Selection for the various posts like Mates and Keymen are made in time and the posts promptly filled up;

(e) All Senior Section Engineer and other staff working under him receive proper training in maintenance practices, safety and protection rules at appropriate stages.

(f) Timely supply of uniform, winter jackets, safety shoes, torches etc. to the staff as per the stipulated criteria.

(16) *Action in case of Emergencies* – In case of an accident, including a breach, affecting the running of trains, he should proceed to the site by the quickest available means. On the way, he should ascertain the requirements of materials and men at site and arrange for the same. He should also order for the Accident Relief Equipment as necessary. He should take all possible measures to restore the traffic quickly.

(17) *Ensuring preparedness for action during extreme weather condition:*

(a) ADEN shall ensure that preparatory works have been completed and due precautions have been taken well before the onset of monsoon, summer and winter;

(b) ADEN shall keep the List of Railway affecting Works with brief history and List of vulnerable locations, where stationary watchmen are to be posted;

(c) ADEN shall ensure availability of required equipment and proper training/

counselling of patrolmen and stationary watchmen according to the extreme weather and remedial action requirement;

(d) ADEN shall ensure patrolling of track as per the instruction and patrol chart issued from division.

(18) Inspection of on-going works, of construction and other organizations (like RVNL, RITES, DFCCIL etc.) or authorized agencies, in the section as much as possible during Foot plate/Trolley inspections to check quality of work and ensuring safety of the running trains.

(19) Inspection of Railway Affecting Works (RAW)/Railway Affecting Tanks (RAT) just before monsoon jointly with concerned state authority.

(20) *Relinquishment/transfer of charge* – ADEN shall follow the Instructions on “Transfer-of-charge” contained in **Para 143 to 147** of the *Indian Railways Code for the Engineering Department.*

Table-1A (Para 103)

Inspection Schedule of Assistant Divisional Engineer

Sl. No.	Type of Inspection	Schedule of Inspection
1	Foot Inspection/Push Trolley Inspection ***Note:*** Items to be checked: *1. Condition of track including track drainage, cuttings and formation. Specific items such as completeness and condition of fittings, greasing of ERC, toe load of ERC, soundness and squareness of PSC sleepers, creep in LWR track etc. and other scheduled inspections listed in the Table.* *2. Attendance of Gang, gang work, equipment, gang chart/ diary, and books with reference to prescribed schedule of track maintenance.* *3. Work done by minimum one gang in each SSE/P.Way (In-charge) jurisdiction every quarter and record the result of inspection.* *4. Review and cross-verification of a few selected entries made by subordinates in TMS, particularly those related to points and crossings, LWRs, and level crossings.* *5. Review of trespassing locations and adequacy of protection measures thereof to prevent unauthorized crossings.* *(ACS – 10)*	(i) **Routes having speed above 110 Kmph and Multiple Line Routes:** Entire section once in 4 months by Foot Inspection/Push Trolley. (ii) **Other Routes:** One block section per SSE/P.Way (In-charge) each quarter by Foot inspection. Entire section including loops and yard once in 3 months by Push Trolley **Note:** *(i) In case of double/multiple lines running closely parallel, inspection of all the lines would be covered in one push trolley/foot inspection as applicable; else, separate push trolley/foot inspection as applicable will be required for each group of such lines.* *(ii) For routes having speed above 110 Kmph and Multiple Line Routes, inspection by push trolley would preferably be under block protection. In case adequate numbers of blocks are not available, stipulated schedule of inspection would be completed predominantly through conduct of Foot Inspection.*
2	(Deleted)	(Deleted)
3	Fast Train Inspection	Once in a month - Entire sub-division to be covered by either Engine or Rear Window of fast train
4	Level Crossing	Once in Six months - All level crossings.
5	Curves	Inspect the curves based on results of TRC/OMS/FP and inspection details of JE/ SSE/P.Way
6	Points & Crossings	Once a year - All P & C on passenger running lines and 10 % of P & C on other lines. All P&C on mainline shall be inspected as per Proforma at Annexure 4/3 & other P&C shall be inspected as per Proforma at Annexure 4/3A.
7	LWR / SEJ	Once in six months- All LWR / SEJs (Preferably in hottest and coldest months)
8	Track on Bridges	The track on Girder Bridges should be inspected as a part of the annual Bridge inspection, besides normal track inspections. Channel sleepers Once in a year along with bridge inspection
9	AT welding site	At least one welding team under each SSE/P.Way (In-charge) in a month

10	USFD Test check	Monthly- Minimum two hours during regular trolley inspection
11	Monsoon Patrolling	When introduced; should check the work of Patrolmen at night once in a month either by Train/Push trolley/Motor Trolley
12	Hot Weather Patrolling	When introduced; should check the work of Patrolmen during day time (preferably between 12:00 to 16:00 hrs.) once in a month either by Train/Push trolley/Motor Trolley
13	Night foot plate inspection	Once in a month - To check alertness of Gateman/ Station staff, Patrolmen, Stationary watchmen, observance of speed limits by Loco Pilots, visibility of signals/engineering fixed signals / hectometre posts, riding quality etc. (Inspection should preferably be done between 00.00 hrs. to 04.00 hrs.)
14	Bridge Inspection	Once in a year (after monsoon) – All bridges including ROB/RUB (Bridges whose condition warrant special attention to be inspected more frequently) as per the procedure and instructions given in Indian Railways Bridge Manual.
15	Tunnels	Once in a Year - All tunnels before monsoon (Tunnels, condition of which, warrants special attention to be inspected more frequently) as per the procedure and instructions given in Indian Railways Bridge Manual.
16	RAW / RAT	Every year before monsoon jointly with state authority as per the procedure and instructions given in Indian Railways Works Manual.
17	Cuttings	Once in a Year before onset of Monsoon as per the procedure and instructions given in Indian Railways Bridge Manual.
18	Private Siding	Once in a Year.
19	Land Verification	Once in a Year as per the procedure and instructions given in Indian Railways Works Manual.
20	Side drains, catch water drains, bridge waterways	Once in a Year before onset of Monsoon
21	Office and store of SSE/P.Way	Once in a Year.
22	Small Track Machine	Once in Six Months
23	Track Machines	Fortnightly : TEXP, CSM, DTS, WST, UNIMAT, BCM,SBCM, PCCM, TLE, RGM and TRT Once during deployment: MPT, BRM. UTV and all others not included above. (*Note: Inspection shall be done as per the Items and inspection checklist given in IRTMM)*
24	Work of Other Organization like RVNL, RITES, DFCCIL, Construction etc.	As much as possible during Foot plate/Trolley inspections. Inspection to check quality of on-going work and safety of the running trains on adjacent lines.

Note:

1. *Availability of a reasonable level of road access in the section is required for enabling substitution of trolley inspection by On-foot inspection. On some of the routes, which would mainly be situated in Ghat sections, this condition may not get fulfilled. Trolley inspection and On-foot inspection as per frequency for **"Other Routes"** would be followed on all such routes even in the category of **"Routes having speed above 110 Kmph and Multiple Line Routes".** These sections would be identified and approved by PCE. While identifying these sections, the lowest unit would be a complete section of an SSE/ P.Way (In-charge).*

2. *It would be desirable that in the absence of trolley, UTV/Rail Borne Maintenance Vehicle (RBMV) supplement the movement by road utility vehicle. This would be particularly useful for some of the work sites, such as AT welding work, and for repairs in emergency. Availability of UTV/RBMV would enable efficient utilization of the available manpower. Steps would be taken for early induction of UTV/RBMV on these routes.*
3. *Implementation of inspection as per schedule* ***1 (i) and 2 (i)*** *would be decided by PCE taking into consideration availability of infrastructure for required mobility. Till the time inspection as per schedule* ***1 (i) and 2 (i)*** *is implemented, inspection would be done as per schedule under* ***1 (ii) and 2 (ii)*** *for all the routes.*
4. *For personal safety during on-foot inspection, inspecting officials, along with their assistants, should be accompanied by additional Trackman/Trackmen specially to alert officials from approaching train and have Personal Protective Equipment, which needs to be prescribed. They should also carry Approaching train warning system. Zonal Railways should prioritize its availability for higher speed routes and Ghat section.*
5. *Push Trolley shall progressively be replaced with Rail-cum-Road Inspection Vehicle (RCRIV). Inspection by RCRIV would be done under block protection.*

PART – B

Duties of Senior Section Engineer / P.Way in Overall Charge

104 General – The Senior Section Engineer/P.Way in overall charge, abbreviated as SSE/P.Way (In-charge), is generally responsible for:

(1) Maintenance and inspection of track in a satisfactory and safe condition for traffic.

(2) Efficient execution of all works incidental to track maintenance, including track relaying works.

(3) Accountal and periodical verification of stores and tools.

(4) Maintenance of land boundaries between stations and at unimportant stations as may be specified by the administration.

(5) Compliance of Inspection notes of higher officers in reasonable time.

105 Knowledge of Rules and Regulations – *(Back to **Para*** **108, 111)**

(1) Every SSE/P.Way (In-charge) shall have in his possession up-to-date copies of the codes and manuals etc. with all correction slips up-to-date as per ***Para 102***.

(2) SSE/P.Way (In-charge) shall be well acquainted with the rules, regulations and procedures concerning the work and duties as enjoined in these codes, manuals etc. He shall keep himself in touch with the instructions and circulars issued by higher authorities from time to time and efficiently act upon them.

(3) SSE/P.Way (In-charge) shall ensure that all the staff are well acquainted with the relevant rules and working methods and efficiently perform assigned duties.

(4) SSE/P.Way (In-charge) shall be well conversant with the various modules of the Track Management System.

106 Duties of SSE/ P.Way (In-charge) are detailed as below**:**

(1) Inspection and maintenance of track in a satisfactory and safe condition.

SSE/P.Way (In-charge) shall conduct inspection in his jurisdiction as per the Schedules laid down *(**Table-1B**)* by the Administration from time to time, enter the inspections details in TMS, and ensure compliance within a reasonable time as per the guidelines.

SSE/P.Way (In-charge) being directly responsible for the safety of the track, shall

(a) Devote sustained attention to Permanent way as regards safety, smooth running, economy and neatness.

(b) Be vigilant to locate all faults/irregularities in the Permanent Way and ensure prompt remedy.

(c) Observe the behaviour of track under passing trains to detect inadequate packing during routine inspections.

(d) Travel on the footplate of Engine / Rear brake-van/last Vehicle of fast trains, take down notes of bad running locations, and get them rectified.

(e) Immediately bring the defects, which are beyond powers to remedy, to the notice of Assistant Divisional Engineer and obtain advice.

(f) Ensure timely removal / cutting of trees in proximity to and liable to foul the track during a storm.

(g) During routine inspections, independent of detailed periodical inspections, watch for any signs of weakness in bridges and structures affecting track and promptly report any matter demanding the attention of Assistant Divisional Engineer.

(2) SSE/P.Way (In-charge) of section should have a thorough knowledge of important pre-requisites for proper functioning of LWR/CWR and the limitations and precautions laid down for work on LWR/CWR and ensure that the maintenance instructions are strictly followed by all the staff dealing with maintenance of LWR/CWR. *(Back to **Para 110(5)**)*

(a) SSE/P.Way (In-charge) of section shall- *(Back to **Para 109(2)**)*

(i) Supervise all track maintenance work for which they are responsible and authorised.

(ii) Make arrangements for patrolling of track in hot and cold weather and post mobile watchmen as and when required and ensure that patrolmen and mobile watchmen are issued proper equipment for carrying out patrolling.

(iii) Responsible for repairs and restoration of traffic in case of accident, derailment, buckling, wash-away, rail fracture etc.

(iv) Responsible for greasing of ERCs, effectiveness of all fittings, soundness and squareness of sleepers, track drainage etc.

(v) Responsible for carrying out de-stressing, welding and other maintenance operation correctly and complete them within the block period for which block has been taken.

(vi) Record rail temperatures, de-stressing temperature, minimum and maximum rail temperatures and also periodically check the rail thermometers used for recording rail temperature with reference to standard thermometer.

(vii) Ensure imposition of necessary speed restriction, in case the temperature exceeds t_d + 20°C after the maintenance work has been completed on LWR/ CWR for the period of consolidation.

(viii) Ensure proper ballast section of the track and shall arrange to recoup the ballast, as per standard ballast profile, before the onset of summer.

(b) SSE/P.Way (In-charge) of section shall be responsible for:

(i) The procurement of the permanent way materials and the equipment required for the maintenance of LWR/ CWR for all the staff working under him.

(ii) Maintenance of a permanent record of each LWR/CWR as per the proforma and shall be responsible for keeping the records up-to-date.

(3) *Inspection and maintenance of Bridges: SSE/P.Way (In-charge) shall*; *(Back to **Para 109(3)**)*

(a) Inspect the track and approaches of all the bridges including footpath (and runoff frame if any) once a year during the prescribed months prior to monsoon (**Para-1101** *of IRBM*).

(b) Inspect the track and approaches at every tunnel and cutting before monsoon or as specified, and take the remedial action if required for safety of track. SSE/P.Way (In-charge) shall be responsible for clearing the drains before monsoons in tunnels and cuttings.

(c) Follow instructions given in relevant manuals and the local instructions of higher authority while maintaining the track in Ghat section, in cuttings, on high banks or any other vulnerable section.

(4) *Track Machines* - SSE/P.Way (In-charge) shall monitor and ensure progress and quality output of various track machines working in the section, and shall

(a) Ensure all prerequisites, pre-block, during block and post-block activities according to track machine and for quality output.

(b) Be responsible for temporary storage and timely arrangement and transportation of HSD oil from the depots to various machines working in his jurisdiction.

(c) Be responsible for making lighting arrangement during night working.

(d) Ensure transportation of tamping tools to be reconditioned and bringing back reconditioned tamping tools to the machine.

(e) Be responsible for protection of the site of work and adjoining track wherever necessary.

(f) Be responsible for arranging adequate precautionary measures for the protection of the site of work and adjoining track wherever necessary along with the safety of staff working with machine in the block section against danger of trains on the adjoining line(s).

(g) Arrange for track protection and provide look out men for safety at site.

(h) Be responsible to ensure that the machine(s) are stabled in suitable sidings and at such stations as to minimize idle run of the machines as well as wastage of block hours in entering and clearing of the block section.

(i) Arrange for protecting and watching of stabled machines and also ensure that no sick vehicles etc. are pushed into the same siding affecting the taking out of the machines to avail blocks.

(j) Co-ordinate with other departments like Traffic, OHE and S&T in the field to facilitate smooth working.

(k) Take all possible actions to clear the block section expeditiously, in the eventuality of breakdown of machine, once it is known that it cannot be repaired during block.

(l) Inspect the track machines as per the prescribed schedule ***(Table-1B)*** and items / check lists as per *IRTMM*;

(5) Preparation of plans and estimates of various track works and submission of proposals to ADEN for further action.

(6) Execution and monitoring track works as per the tender conditions and approved plan & schedule of the work. SSE/P.Way (In-charge) shall ensure timely measurement and bill preparation with proper test check and ensuring quality. *(Back to **Para 109 (5)**)*

(a) *Special works*: Before commencing any work, SSE/P.Way (In-charge) shall ensure that all necessary materials and tools are in possession.

(b) SSE/P.Way (In-charge) should programme the works by organizing the labour in an efficient manner; and maintain detailed accounts of materials received and issued to the work.

(c) SSE/P.Way (In-charge) shall ensure that Engineering Signals are exhibited at the specified distances according to rules and Flagmen are posted with necessary equipment; and should exercise as much as possible checks but minimum once in a month on quality and quantum of work and submit progress reports on works periodically as may be prescribed.

(d) *Quality of welding and avoidable fractures* – The direct responsibility for quality of AT welding being done in the section shall rest on the SSE/P.Way (In-charge) of the section. He will ensure that the equipment available with the welding team are complete and are in good condition.

(e) The responsibility for avoidable fractures taking place in the section shall also rest with the SSE/P.Way (In-charge) of the section, except in cases where the USFD testing was done and found good up to three months before the fractures.

(f) SSE/P.Way (In-charge) shall ensure to arrange for the repairs and maintenance of small track machines available with him.

(g) Other P-Way maintenance works: SSE/P.Way (In-charge) shall ensure that all the P.Way maintenance works like casual sleeper / rail /fittings renewal, de-stressing, bad spot attention, overhauling at level crossings, oiling and greasing of joints and ERCs, fracture attention, glued joint / SEJs/ Switches / Crossings replacement, rails / sleepers transportation through rail dolly, handling of material trains like ballast / rails/ sleepers unloading in block etc. are being done as per the stipulated provisions of *IRPWM / G&SR* and with proper safety of running trains and working staff.

(7) *Material Under Trial:* SSE/P.Way (In-charge) shall be responsible for monitoring performance of 'material under trial' in his section and ensure that the required details for the same are collected as per the trial scheme and submitted to ADEN through TMS.

(8) *Measurement of Ballast:* SSE/P.Way (In-charge) will measure the ballast, if so directed by the ADEN, and record measurements. SSE/P.Way (In-charge) will also keep proper records of training out and spreading of ballast in the track.

(9) *Co-ordination with Works, Bridge and Staff of other Departments* – SSE/P.Way (In-charge) should keep close co-ordination with the Works, Bridge, Operating, Signalling and Electrical Staff, when they are required to work jointly.

(10) *Inspection and test check of USFD -* SSE/P.Way (In-charge) shall check the work of SSE/P.Way/USFD at least once in each round of testing or as specified by higher authority. SSE/P.Way (In-charge) shall also ensure the USFD testing of AT welds within the earliest possible time and as per the specified period/frequency.

(11) *Dealing with store:* SSE/P.Way (In-charge) is the in-charge of store depot and shall be accountable of each item of P.Way in the jurisdiction. SSE/P.Way (In-charge) shall

(a) See to the security of rails, sleepers, fastenings and other materials and ensure that unused materials are stacked properly clear off the line, so as not to interfere with the safe running of trains.

(b) Be responsible for submitting the requisition/indent for the procurement of various materials as per the need well in advance to avoid critical situation especially of safety items like fittings, gang tools and other safety equipment etc.

(c) Be responsible for ensuring availability of various materials like Imprest rails, CMS crossings, switches, SEJs, Glued joints, etc. at nominated locations in the section in order to avoid the delay in attention of emergency repairs/replacement.

(d) Be responsible for offering the scrap and unused materials for their timely disposal.

(e) Keep the records of every transaction of each material from and to the store.

(f) Keep his store in neat and tidy condition and will cooperate in verification of stores with stock verifier.

(12) *Accompanying Inspection by Higher Officials*: In addition to the compliance to ***Para-103 (10),*** SSE/P.Way (In-charge) shall arrange to carry the following measuring devices/equipment for these inspections –

(a) Gauge-cum-level.

(b) Flange way gauge.

(c) Fishing cord.

(d) Tape.

(e) Metric steel scale (30 cm).

(f) Tapered gauge & Feeler gauge.

(g) Magnifying glass and mirror.

(h) Versine measuring equipment.

(i) Inspection hammer etc.

(j) Rail Thermometer.

(13) SSE/P.Way (In-charge) shall accompany Track Recording / OMS runs in the jurisdiction and take down notes regarding the spots needing attention, and take appropriate actions to rectify the defects/irregularities. (ACS – 3)

(14) Training of P.Way officials – SSE/P.Way (In-charge) should take interest in all P.Way officials sent to him for training and see that the training is given according to the specified programme.

SSE/P.Way(In-charge) should also ensure that all the P.Way supervisors and staff are undergoing refresher courses / mandatory and other trainings as per the schedules laid down; and instructions of higher authorities.

SSE/P.Way (In-charge) shall also be responsible for counselling of Trackmen, Gateman, Keyman, Patrolman and Stationary Watchman for their specific duties, safety and protection rules at the appropriate stage, better maintenance practices, and also examine/check at frequent interval during routine trolley and other inspections.

(15) *Dealing with staff matter: SSE/P.Way (In-charge) shall ensure that:*

(a) Strict discipline is maintained within the frame work of the rules;

(b) Service and leave records of staff are maintained correctly and up-to-date;

(c) All staff are sent for medical examination and are fit for the medical standards, as per the relevant instructions in force, before appointment or promotion.

(d) Ensure that the staff under him are sent for periodical medical examination as laid down in the relevant rules.

(e) Supply of uniform, winter jackets, safety shoes, torches etc. to the staff are made timely as per the stipulated criteria.

(f) The relevant provisions of the *Payment of Wages Act, Workmen's Compensation Act, Hours of Employment Regulations* etc., as amended from time to time are followed and complied with.

(g) Issue of passes, preparation of pay bills etc., as may be allotted by the administration is being done promptly.

(h) Selection of proper Gatemen and Patrolmen are carried out from the existing Track Maintainers and train them in their duties.

(i) Prompt processing for filling up of the vacancies of Keyman, Gang Mate and artisans etc.

(j) Appeals and representations are dealt with promptly;

(16) *Action in case of Emergencies* – In the case of an accident, including a breach, affecting the running of trains, SSE/P.Way (In-charge) should proceed to the site by the quickest available means. *(Back to **Para 109 (9)**)*

On the way, SSE/P.Way (In-charge) should ascertain the requirements of materials and men at site and arrange for the same.

SSE/P.Way (In-charge) should also order for the Accident Relief Equipment as necessary and take all possible measures to restore the traffic quickly.

(17) *Ensuring preparedness for action during extreme weather condition: SSE/P.Way (In-charge) shall-* *(Back to **Para 109 (10)**)*

(a) Keep the List of Railway Affecting Works with brief history and List of vulnerable locations, where stationary watchmen are to be posted.

(b) Ensure that preparatory works have been completed and due precautions have been taken well before the onset of monsoon, summer and winter.

(c) Ensure proper watch at vulnerable locations as per the requirements;

(d) Arrange for patrolling (hot weather, cold weather and monsoon) of track as per the instruction and patrol chart issued from division.

SSE/P.Way (In-charge) shall ensure availability of patrol book and required equipment with them. Before deploying trackmen for patrolling, proper training / counselling of patrolmen should be done. Stationary watchmen at vulnerable locations according to the extreme weather should be deployed with necessary equipment to ensure safety of track.

(18) *Inspection of on-going works of construction and other organization like RVNL, DFCCIL etc*. – SSE/P.Way (In-charge) should inspect the ongoing works in the section as much as possible during Foot plate/Trolley inspection to check quality and safety of the running trains.

(19) *Upkeep of Station Yards* – SSE/P.Way (In-charge) shall ensure cleanliness of station yards. Under- growth should be cleared every year, usually in the month, before the seeds has ripened. At stations where it is proposed to stack engineering or contractor's materials, the stacking area should be carefully selected and clearly demarcated. The materials should be stacked methodically in a tidy manner.

(20) SSE/P.Way (In-charge) shall be responsible for maintaining the land boundaries intact and free from encroachment by outsiders in his jurisdiction. SSE/P.Way (In-charge) should keep watch and take immediate necessary action for removal of any type of encroachment, if noticed.

(21) *Maintenance and up keep of Correspondence and records* – SSE/P.Way(In-charge) shall keep all correspondences up-to-date and see that the TMS records, office records, registers and stores ledgers are maintained systematically and posted regularly and as required.

SSE/P.Way (In-charge) shall update the data in TMS timely in appropriate fields relating to all types' inspections, all kinds maintenance works and all casual/scattered/planned renewal activities etc. for all the assets.

(22) *Relinquishment of charge* – SSE/P.Way (In-charge) shall follow the Instructions on "Transfer-of-charge" contained in **Para 143 to 147** of *the Indian Railway Code for the Engineering Department*.

(23) The SSE/P.Way (In-charge) shall review and cross-verify the selected inspections in the field, particularly those related to points and crossings, LWRs, and level crossings.

(ACS – 10)

PART – C

Duties of Junior Engineer/Senior Section Engineer/P.Way/(Sectional)

107 General Responsibilities – The Junior Engineer/Senior Section Engineer /P.Way, working as sectional and abbreviated as JE/SSE/P.Way (Sectional) is generally responsible for:

(1) Inspection and maintenance of track in the sub-section in a safe and satisfactory condition for traffic, lorrying out of material, including execution of all works incidental to track maintenance.

(2) Efficient execution of Special Works, such as Renewals, Spot attention, Curve realignment and deep Screening, as per approved plans and specifications.

(3) Making a date wise schedule and record in the Keyman's book indicating the Kms/TPs that the Keyman has to attend on each day of the month to complete the task required to be done as per his duties.JE/SSE/P.Way (Sectional) during their inspections should check to ensure that such locations have really been thoroughly attended to and initial against the entries.

108 Knowledge of Rules and Regulations – As per provisions contained in ***Para 105***.

109 Duties of JE/SSE/P.Way (Sectional) are detailed as below**:**

(1) Inspection and maintenance of track in a satisfactory and safe condition.

JE/SSE/P.Way (Sectional) shall conduct inspection as per the Schedules laid down by the Administration ***(Table-1B)***; enter the inspections data in TMS, and attend to the deficiencies noticed at the earliest possible.

JE/SSE/P.Way (Sectional) being directly responsible for the safety of the track; shall

(a) Devote sustained attention to Permanent way as regards safety, smooth running, economy and neatness.

(b) Be vigilant to locate faults/irregularities in the Permanent Way and ensure prompt remedy.

(c) Observe the behaviour of track under passing trains to detect inadequate packing during routine inspections.

(d) Travel on the footplate of Engine /Rear brake-van/last Vehicle of fast trains, take down notes of bad running locations, and get them rectified.

(e) Immediately bring the defects, which are beyond powers of remedy, to the notice of SSE/P.Way (In-charge) and obtain advice.

(f) Ensure timely removal / cutting of trees in proximity to and liable to foul the track during a storm.

(g) During his routine inspections, independent of detailed periodical inspections, should watch for any signs of weakness in bridges and structures affecting track and promptly report any matter demanding the attention of higher authority.

(2) JE/SSE/P.Way (Sectional) should have a thorough knowledge of important pre-requisites for proper functioning of LWR/CWR and the limitations and precautions laid down for work on LWR/CWR and ensure that the maintenance instructions are strictly followed by all the staff dealing with maintenance of LWR/CWR.JE/SSE/P.Way (Sectional) shall be responsible for the duties as mentioned in ***Para 106(2) (a).***

(3) Inspection and maintenance of track at Bridges/Tunnels/cuttings: As per provisions contained in ***Para-106 (3).*** (Relating to track only)

(4) Track Machines- while deputed on machine JE/SSE/P.Way (Sectional) shall be the in-charge of the supervision of the work of track machine and responsible for following duties:

(a) Ensuring safe movement of machine from siding to block section and back as per the provisions given in *IRTMM and G&SR*.

(b) Undertaking & ensuring all prerequisites, pre-block, during block and post-block activities according to track machine and for quality output.

(c) Arranging adequate precautionary measures for the protection of the site of work and adjoining track wherever necessary along with the safety of staff working with machine in the block section against danger of trains on the adjoining line(s).

(d) Ensuring various important Parameters of track machines like tamping depth, squeezing pressure, wear and tear of tamping tools, squeezing time, condition of cutter bars etc. as per the type of machine and provisions of *IRTMM* in order to ensure quality and output of machine during block.

(e) Checking of the track Parameters and condition of track, during working of track machines, and ensuring that the track Parameters are well within the tolerances.

(f) Ensuring that track is free of obstructions and infringements for safe passage of traffic before clearing the traffic block. As required or stipulated JE/SSE/P.Way (Sectional) shall allow traffic at suitable speed restriction based on the condition of track after machine working.

(g) To investigate and take suitable remedial measures in coordination with JE/SSE (Track Machine), in case the quality of work done by the machine is not satisfactory.

(h) To issue of all necessary caution orders for machine working.

(i) For ensuring that the machine(s) are stabled in suitable sidings and at such stations as to minimize idle run of the machines as well as wastage of block hours in entering and clearing of the block section.

(j) Co-ordinate with other departments like Traffic, OHE and S&T in the field to facilitate working

(k) Take all possible actions to clear the block section expeditiously, in the eventuality of breakdown of machine, once it is known that it cannot be repaired during the block.

(5) Execution and monitoring track works – As per provisions contained in ***Para -106(6)*** JE/SSE/P.Way (Sectional) shall carry out maintenance works as assigned to him by SSE/ P.Way (In-charge).

(6) Co-ordination with Works, Bridge and Staff of other Departments – JE/SSE/P.Way (Sectional) should keep close co-ordination with the Works, Bridge, Operating, Signalling and Electrical Staff, whenever they are required to work jointly.

(7) JE/SSE/P.Way (Sectional) should work in the SSE/P.Way (In-charge) office and assist the SSE/P.Way (In-charge) as required.

(8) Training of P.Way officials – JE/SSE/P.Way (Sectional) shall be responsible for counselling of Trackmen, Gateman, Keyman, Patrolman and Stationary Watchman for their specific duties, safety and protection rules at the appropriate stage, better maintenance practices, and also examine/check at frequent interval during routine trolley and other inspections.

(9) Action in case of Emergencies – As per the provisions contained in ***Para -106(16).***

(10) Action during extreme weather condition: As per the provisions contained in ***Para -106(17)***.

(11) Inspection of on-going works of construction and other organization (like RVNL, RITES, DFCCIL etc.) or authorized agencies in the section as much as possible during Foot plate/Trolley inspection to check quality of work and ensuring safety of the running trains.

(12) Upkeep of Station Yards – JE/SSE/P.Way (Sectional) shall be responsible for cleanliness of station yards. The materials should be stacked methodically in a tidy manner.

(13) JE/SSE/P.Way (Sectional) shall observe the track movement in yards especially at turnouts, SEJs, glued joints and other fish plated joints during passing of trains and shall take corrective measures to rectify the defects observed.

Table-1B (Para 106, 106(4(I)), 109)

Inspection Schedule of SSE/P.Way (In-charge) and JE/SSE/P.Way (Sectional)

<table>
<tr><th>Sl. No.</th><th>Type of Inspection</th><th>Schedule of Inspection</th></tr>
<tr><td>1</td><td>Foot Inspection/Push Trolley Inspection
Note: Items to be checked:
1. Condition of track including track drainage, cuttings and formation. Specific items such as completeness and condition of fittings, greasing of ERC, toe load of ERC, soundness and squareness of PSC sleepers, creep in LWR track etc. and other scheduled inspections listed in the Table.
2. Attendance of Gang, gang work, equipment, gang chart/diary, books with reference to prescribed schedule of track maintenance, counselling for safety and method of maintenance.
3. Check to ensure that every man in the gang is aware of safety rules by examining them periodically at least once in two months.
4. Routine check and review of inspection conducted by subordinates, along with cross-verification of a few selected entries made by them in TMS, particularly for points and crossings, LWRs, and level crossings.
5. Review of trespassing locations and adequacy of protection measures thereof to prevent unauthorized crossings.
(ACS – 10)</td><td>(i) **Routes having speed above 110 Kmph and Multiple Line Routes**
(a) **SSE/P.Way (In-charge):** Entire section including loops lines and yards once in 2 months by foot inspection/Push Trolley.
(b) **JE/SSE/P.Way (Sectional):** Entire section including loops lines and yards once in a fort night by foot Inspection.

(ii) **Other Routes:**
(a) **SSE/P.Way (In-charge):** Entire section including loops lines and yards once in a year by Foot Inspection.
Entire section including loop lines and yards once in 2 months by Push Trolley.
(b) **JE/SSE/P.Way (Sectional):** Entire section including loops lines and yards once in 6 months by Foot Inspection.
Entire section including loop lines and yards once in a fort night by Push Trolley

Note:
(i) In case of double/multiple lines running closely parallel, inspection of all the lines would be covered in one push trolley/foot inspection as applicable; else, separate push trolley/foot inspection as applicable will be required for each group of such lines.
(ii) For routes having speed above 110 Kmph and Multiple Line Routes, inspection by push trolley would preferably be under block protection. In case adequate numbers of blocks are not available, stipulated schedule of inspection would be completed predominantly through conduct of Foot Inspection.</td></tr>
<tr><td>2</td><td>Measurement of track parameters of loop lines and yard lines.</td><td>Track parameters (gauge, cross level, twist & versine) of all loop lines and yard lines excl. main lines (which are measured by ITMS/TRC), shall be measured by JE/SSE/P.Way (Sectional) by manual or mechanized means:
(a) Passenger running loop lines including cross overs: Once in 3 months
(b) All other running and non-running lines including cross overs: Once in 6 months

Note: Records of measurement will be kept in the form of registers, which will be countersigned by SSE/P.Way (In-charge) and ADEN during their Foot/Push Trolley inspections.
(ACS – 3)</td></tr>
<tr><td>3</td><td>Loco/ Break van / Rear window</td><td>SSE/P.Way (In-charge): Once in a fortnight
JE/SSE/P.Way (Sectional): Once in a month</td></tr>
</table>

4	Level Crossing	SSE/P.Way (In-charge) and JE/SSE/P.Way (Sectional) will inspect all level crossings once in a month by rotation. They should examine the Gateman's knowledge of rules, check the equipment, track, road approaches and all other safety aspects.
5	Curves	a) For curves > 2 degree: JE/SSE/P.Way (Sectional) shall inspect once in 6 months on rotation with SSE/P.Way (In-charge). b) For curves ≤ 2 degree: JE/SSE/P.Way (Sectional) shall inspect once in a year. SSE in-charge shall inspect the curves based on results of TRC/OMS/FP and inspection details of JE/SSE/P.Way (Sectional)
6	Points & Crossings	Passenger and running lines- Once in three months on rotation by SSE/P.Way(In-charge) and JE/SSE/P.Way (Sectional) Other lines and yard lines- Once in six months on rotation by SSE/P.Way(In-charge) and JE/SSE/P.Way (Sectional) SSE/P.Way (In-charge) and JE/SSE/P.Way (Sectional) shall do one of their inspections on proforma at Annexure-4/3 every year.
7	LWR / SEJ	Once in fortnight during two hottest and two coldest months on rotation by SSE/P.Way(In-charge) and JE/SSE/P.Way (Sectional) (The hottest and coldest months are specified by the DEN/Sr.DEN) Otherwise once in two months on rotation by SSE/P.Way(In-charge) and JE/SSE/P.Way (Sectional)
8	Track on Bridges	The track on Bridges and approaches once in a year in a prescribed month before monsoon by SSE/P.Way (In-charge). Channel sleepers - SSE/P.Way(In-charge): Once in 6 months by rotation with JE/SSE/P.Way (Sectional) JE/SSE/P.Way (Sectional) : Once in 6 months by rotation with SSE/P.Way(In-charge)
9	AT welding site	SSE/P.Way(In-charge): At least once each welding team in a month JE/SSE/P.Way (Sectional): Not defined
10	USFD Test check	Monthly- Minimum two hours during regular trolley inspection by SSE/P.Way (In-charge)
11	Night Inspection	Once in a month by SSE/P.Way (In-charge).
12	Monsoon Patrolling	SSE/P.Way (In-charge) - once in a month JE/SSE/P.Way (Sectional) - once in fortnight by train and inspection by trolley- as per the schedule laid down by administration.
13	Hot Weather Patrolling	SSE/P.Way (In-charge): When introduced; should check the work of Patrolmen during day time (preferably between 12:00 to 16:00 hrs.) once in a month either by Train/Push trolley/Motor Trolley

14	Night foot plate inspection	Once in a month by SSE/P.Way(In-charge)and JE/SSE/P.Way (Sectional)- to check alertness of Gateman / Station staff, Patrolmen, Stationary watchmen, observance of speed limits by Loco Pilots, visibility of signals/engineering fixed signals / hectometre posts, riding quality etc. Inspection should preferably be done between 00.00 hrs. to 04.00 hrs.
15	Bridge Inspection	All Bridges once in a year in a prescribed month before monsoon by SSE/P.Way (In-charge) as per the procedure and instructions given in Indian Railways Bridge Manual.
16	Tunnels	Once in a Year- All tunnels after monsoon by SSE/P.Way (In-charge) as per the procedure and instructions given in Indian Railways Bridge Manual. Tunnels condition which warrants special attention to be inspected more frequently
17	Cutting	Once in a Year immediately after monsoon by SSE/P.Way (In-charge) and before monsoon by JE/SSE/P.Way (Sectional) as per the procedure and instructions given in Indian Railways Bridge Manual.
18	Private Siding	Once in three months by JE/SSE/P.Way (Sectional) Once in Six month by SSE/P.Way (In-charge)
19	Inspection of Land Boundary and encroachment	By SSE/P.Way (In-charge) Land Boundary: - Once in a Year. Encroachment: Once in three months. (As per the procedure and instructions given in Indian Railways Works Manual.)
20	Side drains, catch water drains, bridge waterways	SSE/P.Way (In-charge)- Once in a Year before onset of monsoon JE/SSE/P.Way (Sectional) - once in a year in the month of April prior to monsoon.
21	Accompanying TRC/OMS Run	SSE/P.Way(In-charge) : Accompanying each run
22	Small track machines	SSE/P.Way (In-charge): Once in three months.
23	Work of Other Organization like RVNL, DFCCIL, Construction etc.	As much as possible during Foot plate/Trolley Inspection to check quality of on-going work and safety of the running trains on adjacent lines by SSE/P.Way (In-charge) and JE/SSE/P.Way (Sectional) both.
24	Inspection of washable apron/ Ballastless Track (when being used as washable apron)	Once in three months on rotation basis by SSE/P.Way(In-charge) and JE/SSE/P.Way (Sectional)
25	(Deleted)	(Deleted) (ACS – 3)
26	Sand humps and dead end	All sand humps and dead end to be inspected by SSE/P.Way(In-charge) and JE/SSE/P.Way (Sectional) once in a month, by rotation
27	Joint Inspection with S& T Department (1) Points & Crossings (2) Inspection of insulated Steel Sleepers on bridges	(1) Once in three months on rotation basis by SSE/P.Way(In-charge) and JE/SSE/P.Way (Sectional) (2) Once every six months on rotation basis by SSE/P.Way(In-charge) and JE/SSE/P.Way (Sectional) for insulated Steel Sleepers on bridges

28	Inspection of Track Machine (When working in section)	SSE/P.Way (In-charge) & JE/SSE/P.Way (Sectional): During supervision of pre-block, during block and post-block works but not less than once a week. *Note: Inspection shall be done as per the Items and inspection checklist given in IRTMM*

Note: Note below Table-1A regarding road access, availability of vehicle such as UTV/RBMV, decision of implementation of system of inspection and personal safety during on – foot inspection would also be applicable for Table-1B.

PART – D

Duties of JE/SSE/P.Way

(Other Than Sectional or In-Charge)

110 General Responsibilities – The JE/SSE/P.Way not in overall charge or sectional; but working as in-charge of assigned Gang(s); or of special Works, is responsible for:

(1) Regular inspection of all assets as per laid down frequency as per ***Table 1-C*** and maintenance of track in the assigned jurisdiction (section of gang/Yard) in a safe and satisfactory condition for traffic, lorrying out of material, including execution of all works incidental to track maintenance. He shall remain with the gang for at least two days in a week and supervise gang work unless otherwise directed by SSE/P.Way (In-charge).He should record all the details of his inspection in his diary and rectify the noted deficiencies as early as possible.

(2) Efficient execution of Special Works, such as Renewals, spot attention, or as instructed from higher authority.

(3) Working in the SSE/P.Way (In-charge) office and assist the SSE/P.Way (In-charge) as directed.

(4) He will be responsible for the output and quality of works entrusted to him and ensure that the all such works are carried out with safety following the stipulated rules.

(5) JE/SSE/P.Way (Special/Relaying) posted for carrying out special works etc. in LWR/CWR territory shall be responsible for all the items indicated in ***Para 106(2)*** apart from any other responsibilities assigned.

(6) Keep watch on vulnerable locations and ensure safety.

(7) Observe the track movement in yards especially at turnouts, SEJs, trespasses, glued joints and other fish plated joints during passing of trains and shall take corrective measures to rectify the defects observed.

(8) Ensure quality of work executed under his supervision.

(9) Whenever JE/SSE/P.Way is in-charge of gang(s) / units, they He will carry out all the duties/ responsibilities assigned to the Gang Mate as laid down in Part 'E' of this chapter in addition to the duties mentioned in above Para.

(10) Any other duties assigned by SSE/P.Way (In-charge) or any other higher officials

111 Knowledge of Rules and Regulations – As per provision contained in ***Para 105*.**

Table-1-C (Para 110)

Inspection Schedule of JE/SSE/P.Way (Other than In-charge or Sectional)

Sl. No.	Type of Inspection	Schedule of Inspection
1	Foot Inspection *Note:* *This inspection may be done with concerned Keyman in his jurisdiction and submit the report to SSE/P.Way(In-charge) through JE/SSE/P.Way (sectional)*	i. Complete section once in a month in a systematic manner of all individual passenger running lines including through lines of yard portion. ii. Other than passenger running lines – Once in three months. *Note:* *i. During inspection, he will note down all the irregularities like details of missing/ineffective fittings in plain track, greasing of ERC, turnouts, SEJs, Glued Joints and on bridges, cracked/damaged sleepers, unsquared sleepers, ballast deficient locations, Trespass locations, bridge approaches requiring immediate attention.* *ii. He will observe the packing condition under the running train especially at turnout/ SEJ/Tress pass locations /glued joints etc. and will note down in his diary, the bad patches requiring attention.* *iii. All such locations needing attention, shall be attended by him using the gang under* his jurisdiction.
2	Inspection of Gang	Once in a week- *Note:* *i. Include checking attendance of gang, gang work, equipment, gang chart/ diary, counselling for safety and method of maintenance.* *ii. Checking of gang working of previous day. He shall also make entry of gang work in TMS on daily basis as directed.*
3.	Level Crossing	Will inspect all Level Crossing once in a month for missing / loose fittings and make good the deficiencies as noted.
4	Curves	All curves once in six months for condition of Rails, sleeper, fittings, ballast, packing, gauge and cross level etc.
5	Points & Crossings	i. On passenger running lines once in a month. ii. Other lines - Once in three months. *Note:* *All points and crossing shall be inspected for condition of fittings, rail, sleeper stock and tongue rail, crossing, check rails etc. including packing condition and other track Parameters. All such locations needing attention, shall be attended by him using the gang under his jurisdiction.*
6	Night Inspection	As prescribed by higher authority.
7	Hot Weather Patrolling	Should check the work of Patrolmen during day time (preferably between 12:00 to 16:00 hrs.) once in fortnight with on foot inspection covering his entire jurisdiction.
8	Work of Other Organization like RVNL, DFCCIL, Construction etc.	During on Foot inspection - Inspection to check safety of the running trains on adjacent lines.
9	Inspection of SEJ	Once in fifteen days for condition of packing, fittings etc. with oiling and greasing. All such locations with deficiencies as noted shall be attended by him using the gang under his jurisdiction.

PART – E

Duties of Gang Mate, Keyman, Patrolman, Gateman and Track Maintainer

112 General: Every Gang Mate, Keyman and Track Maintainer shall be responsible for maintenance and safety of track in every situation. They shall follow the instructions of their concerned higher authorities.

113 Knowledge of Rules and Signals – Every Gang Mate, Keyman and Track Maintainer shall have the correct knowledge of hand and detonating signals and shall be conversant with the following rules:

(1) "Safety first" rules.

(2) Method of fixing and safety range of detonators.

(3) Protecting the line in an emergency and during work(s) affecting the track/safety.

(4) Action to be taken when a train is noticed to have parted, having hot axle or any other unusual(s).

(5) Action to be taken where sabotage is suspected and patrolling in emergencies.

114 Important Duties of Gang Mate:

(1) **Safety of the Line** – Every Gang Mate shall see that the line is kept safe for the passage of trains. All locations needing urgent attention shall be attended to without waiting for orders from the JE/SSE/P.Way.

(2) **Knowledge of Track Maintainer** - Gang Mate shall ensure that every track maintainer is having knowledge of safety rules before deploying them on track.

Gang Mate shall ensure that the safety equipment and signals supplied to the Gangs are kept in good order and ready for use and that every person in the Gang has correct knowledge of all these safety equipment and signals.

(3) **Equipment at Site of Work** – Gang Mate shall ensure that all the requisite tools and equipment as prescribed with gang are with the trackmen at the site of work.

(4) **Musters and Gang Charts/Diary Books –**

(a) The muster and Gang chart /diary shall be in the possession of each Gang Mate. The Gang chart should be carefully kept in a container provided for the purpose.

(b) The muster should normally be marked by the Gang Mate. However, literate Track Maintainer may be allowed to sign muster, which should be checked by Gang Mate.

(c) The Gang Mate shall see that the prescribed system of track maintenance is adhered to and the tasks allotted, according to verbal instructions or entries made in his Gang chart / diary, and explained to him, are efficiently carried out including lubrication of rail joints, attention to bad spots and isolated renewed of sleepers, if capable of entering details of work done in Gang diary, the Gang Mate should do so.

(5) **Observance of Sleeper Packing During Passage of Train –** During the passage of the first and last trains in working hours, the Gang Mate and the Trackmen should stand on the cess, each about one rail length apart, and observe the effect on the sleepers. Loose sleepers should then be marked and adequately packed. On double line, the Gangs shall invariably stand on the cess side and not in between the tracks.

(6) **Precautions when View is Obstructed –**

When working at a place from where an approaching train cannot be seen at least 600 metres away a Track Maintainer with hand signals should be sent out by the Gang Mate:

(a) On double line in the direction of approaching trains,

(b) On a single line in the direction the view is obstructed (in both directions if view is obstructed on both sides).

It will be the duty of such Flagman to warn the Gang Mate by means of signals when a train is approaching.

The Gang Mate will be responsible for warning the Gang in good time to enable them to get clear off the track. It may be deemed expedient, as an additional precaution, to issue portable whistle boards of the type indicated to the Gang Mates, who should fix them at least 600 metres from the work-site, in the direction the view obstructed to less than this distance.

(7) **Tidiness of Section –** Gang Mate shall see that the entire Gang length is kept neat and tidy and that all loose materials are collected and brought to stations, gang's quarters or gate lodges.

(8) **Safe Custody of Tools –** Gang Mate shall be responsible for the safe custody of tools used by himself, the Keymen and all Track Maintainers. Gang Mate should see that Track Maintainers on work remove their tools clear of the track on the approach of a train. After the day's work the Gang Mate should secure the tools in the toolbox. In no case should Track Maintainers be permitted to take tools home. Before Track Maintainers break for mid-day meals the Gang Mate should see that the tools are kept away from track.

(9) **Action when Line is Unsafe or in the Event of Accident –**

(a) If a Gang Mate or his Keyman considers that the line is likely to be rendered unsafe, or that any train is likely to be endangered in consequence of any defect in the permanent way or works, or due to abnormal rain or flood or any other occurrence, Gang Mate shall take immediate steps to secure the safety of trains by using the prescribed signals to "Proceed with Caution" or to "Stop" as necessity may require, vide ***Para 806/812***, and shall, as soon as possible, report the circumstances to the nearest Station Master and the JE/SSE/P.Way.

(b) In the event of an accident, the Gang Mate, Keymen and Track Maintainers should lookout for broken fittings of wagons and track components and see that these are not disturbed until these have been seen and recorded by a responsible official.

(10) **Patrolling during Abnormal Rainfall –** During abnormal rainfall, the Gang Mate should organise patrolling on the gang-length, whether or not Patrolmen are on duty. In the event of damage being detected, action should be taken to safeguard traffic by protecting the line in accordance with ***Para 812.***

(11) **Commencing Work Affecting Safety of Trains –** No work, which may involve danger to trains, should be under taken by the Gang Mate except under the personal supervision of the JE/SSE/P.Way, a competent Railway servant authorised by special instructions, unless it is an emergency where the requirements of safety warrant the commencement of the work. In such cases the Gang Mate shall ensure that Engineering Signals are exhibited at the specified distances according to rules and Flagmen are posted with necessary equipment to man them before commencing the work.

(12) **Weekly Inspection of Gang Length by Gang Mate –** Gang Mate shall inspect the entire Gang length once a week. On that day Gang Mate will carry out the Keyman's

duties; and the Keyman will remain in-charge of the Gang.

(13) **Preventing Trespass and Theft of P.Way Fittings –** Every Gang Mate and the trackmen shall endeavour to prevent trespass in Railway limits by persons or cattle on the gang length, of line, and report any attempts at encroachment or unauthorised structures when noticed. Gang Mate along with Gang, should also attempt to prevent theft of P.Way fittings and report any attempt to steal, to JE/SSE/P.Way.

(14) **Relief arrangement in Emergencies –** Gang Mate shall arrange immediate relief for Keymen, Gatemen, Patrolmen and Watchmen when, due to sickness, they are unable to perform their duties.

(15) **Assistance in protection of Trains –** Gang Mate and the trackmen should render assistance to Guards and Drivers of the trains for the protection of the trains in the event of an accident between stations, when called upon to do so.

(16) **Assistance in Placing Fog Signals –** On requisition from the Station Master, the Gang Mate of a yard gang may depute, if available, two Track Maintainers for placing of detonators, during time of poor visibility, in the rear of approach signals of the station.

(17) **Responsibilities of the Gang Mate in LWR Track –** The specific duties and responsibilities of the Gang Mate in LWR sections are as under:

(a) To carry out maintenance work under personal supervision, only if in possession of valid competency certificate issued by Zonal/Divisional Training Centre to work on LWR/CWR section.

(b) To undertake only those works of track maintenance for which Gang Mate is authorised.

(c) To maintain additional/special equipment issued in good condition and bring to the notice of JE/SSE/P.Way, if any defective equipment need repairs.

(d) To introduce hot/cold weather patrolling when instructed by the Supervisors and ensure that hot/cold weather patrolmen turn out on duty during the specified patrol period and carry out the patrolling duties correctly.

(e) To be vigilant during hot weather and order patrol if the temperature is likely to reach t_d+20°C and report to the supervisors any unusual occurrences that take place on the LWR/CWR in his beat.

(f) To take prompt action to protect the track in case of rail/weld fractures and carry out emergency repairs to permit the restoration of traffic promptly and report to nearest Station Master /SSE/JE/P.Way.

(g) To take immediate steps to secure the safety of the trains as per ***Para 806/812*****,** if they consider that track is likely to be rendered unsafe.

(h) To report any ballast deficiency or disturbance of track to the JE/SSE/P.Way.

(i) To inspect SEJ and LWR/CWR under his jurisdiction frequently, especially during the hottest part of the afternoons in summer and report any unusual occurrence on LWR/CWR to JE/SSE/P.Way to obtain further order.

(j) The Gang Mate shall note down the details of missing fittings and fastenings on plain track, turn-outs, SEJs, Glued Joints, bridges etc. and recoup them as soon as possible. He will also note down the details of cracked/ broken/ notched sleepers in the track and advise the same to JE/SSE/P.Way.

(k) On receipt of advice of a danger of buckle,

i. The Gang Mate should proceed to the site quickly with all available men/resources and ensure protection of affected portion at site.

ii. Thereafter the Gang Mate should inspect the condition of track 100 m on either side of this suspected zone and commence heaping of surplus ballast, if available, on the shoulders and up to the rail head and keep on compacting the ballast with available tool.

iii. No attempt should be made to slew or align the track or disturb the existing ballast section. The Gang Mate should continue to remain at site till the arrival of JE/SSE/P Way.

iv. The rail temperature will also be noted by one of these officials at the place of apprehended/actual buckle. The rail facing the sun will be covered up to the level of rail-head on the outside by ballast or leaves etc. to bring down the temperature of the rail.

115 Responsibilities of a Keyman:

(1) **General:** The Keyman shall inspect the entire beat once a day on foot, both the tracks and bridges, and return along the opposite rail to that taken on outward journey in case of single line. On double line, Keyman will carry out one round of inspection in morning hours by going along up line and then returning along down line or vice-versa. On the days of Gang holidays and rest, the Keyman shall perform the usual duties and get a day's rest in the week as per the roster duties in force. On rest days or during absence or leave or sickness, a competent Track Maintainer should be deputed in place of the regular Keyman.

(2) **Roster duty hours of Keyman –** The roster duty hours of Keyman for winter months should be so adjusted as to ensure one round of track inspection in early morning to enable detection of any rail or weld fractures that might have occurred during the night or early morning. DEN/Sr.DEN of the section shall decide and notify the exact timings and the period of each section.

(3) **Equipment of Keyman –** Keyman shall carry two red flags, and one green flag, ten detonators, a keying hammer, Alloy Spanner D/E, Spanner Tubular, Tapered Gauge, Tapered Pin, Keyman Diary, spare fittings and a rail closure of 30 mm size.

116 Important Duties of Keyman –

(1) While walking the Keyman should look for defects, such as loose fish bolts, loose bolts on joggled fish plates, SEJ, fittings in switches and crossings, fittings on girder bridges and open top culverts, broken or notched sleepers, broken plates or tie bars and attend to them as necessary.

If the Keyman finds that fittings are consistently working loose even after repeated attention, he should report the matter to the Gang Mate, JE/SSE/P.Way. If the defects are serious, it should be informed at once to the Gang Mate, duly protecting the line in the meantime, if necessary, according to rules.

(2) The Keyman shall keep a special watch on the rails and welds marked for observation by the USFD team.

(3) If the Keyman notices any condition of danger, such as broken rail, broken weld or wash away of ballast, theft of fittings in large numbers etc., the line shall be protected at once as per rules, and the Keyman shall take such action as is possible and report the matter to the Gang Mate, the nearest Station Master and JE/SSE/P.Way.

(4) Keyman, in addition to the normal round of the entire beat inspection and tightening of loose fittings, should attend one OHE mast /hectometre post on one line thoroughly on every day and carryout other works assigned by Gang Mate. This thorough attention should consist of checking of each bolt and fittings including fittings of fishplates, joggled fishplates, & PRC sleepers in these OHE mast /hectometre post of the beat during that particular day and tightening them, wherever required. Missing ERCs, liners, keys and other missing fittings will be recouped by Keyman, who would also ensure correct driving of fittings in this stretch.

(5) Keyman with the assistance of Track Maintainer(s) will also carry out rail end examination, lubrication of fish plated joints as per direction of JE/SSE/P.Way.

(6) For imposing of caution after stopping the train or otherwise, wherever required for safety, the Keyman will be provided pre-printed paper slips by JE/SSE/P.Way. The Keyman, after filling location and speed, will hand over the paper slip to Driver or ASM and obtain acknowledgement.

(7) The following are the additional duties and responsibilities of the Keyman in LWR/CWR territories:-

(a) Periodical (fortnightly) oiling and greasing of SEJ, checking and retightening of fastenings at SEJ and other sleepers, if necessary.

(b) Tighten loose fittings and replacement of missing fastenings not requiring lifting or slewing of track in accordance with ***Para 345(5) (a)***.

(c) To watch for sun kinks, loose or missing fastening which may result in buckling or any damage to LWR/CWR and SEJ. On noticing any buckling or damage to track, the Keyman shall take necessary action to protect the track and report the same immediately to JE/SSE/P.Way (sectional), SSE/P.Way (In-charge), and Station Master. However, the Keyman will continue to perform duties of daily inspection.

(d) To keep a sharp vigil in cold mornings, especially during winters to detect any fractures which may occur, in case of rail/weld fracture, the Keyman shall take prompt action to protect the track and carry out emergency repairs to permit the restoration of traffic promptly and report to SSE/P.Way (In-charge), JE/SSE/P.Way (Sectional) and nearest Station Master.

(8) The Keyman shall promptly report to Gang Mate/SSE/JE/P.Way any encroachment or unauthorised structures as and when they take place in the Railway land.

(9) After completing inspection of the beat, the Keyman should assist the Gang Mate in the day's work being done.

(10) When Materials, such as dynamo-belts, engine parts and personal articles of passengers, are found on line, the Keyman should collect them and arrange for handing them over to the nearest Station Master.

(11) The Keyman will remain in-charge of the gang in absence of the Gang Mate once a week. On that day, the Gang Mate is required to carry out the work and duties of Keyman.

(12) The Keyman shall watch height gauges for any damage. In case of any such damage, the Keyman shall also look for any damage/shifting of girder, infringement to track or damage to overhead electrical installations and shall report the matter to the Gang Mate, the nearest Station Master and JE/SSE/P.Way and also protect the line as the situation warrants.

(13) The Keyman shall maintain the Keyman's book supplied to them up to date wherein-

(a) All special work done, missing fittings and their recoupment with location and date are to be entered.

(b) Special locations to be watched by the Keyman should be entered.

(c) The special fittings like joggled fishplates and other Material provided in the section, which are vital for safety and for restoration of traffic should also be mentioned in the book.

(ACS – 3)

117 Duties of Patrolman / Stationary Watchman

It is of paramount importance that patrolmen and watchmen thoroughly understand what they have to do in the event of emergency. Every effort should be made to instruct and drill the persons for their duties. In the event of an emergency the patrolmen should devote their whole time and energy to the protection of the line and summoning of assistance. Having protected the line and summoned assistance, they should resume their patrolling.

(1) Monsoon Patrolman:

The duties of a Patrolman undertaking monsoon patrolling are as follows –

(a) Walk to and fro over the beat in accordance with the chart pertaining to the "patrol-section" looking out for subsidence, slips, signs of erosion, trees blown across the track during storms or any other causes likely to endanger the safety of line. The bridges and their approaches should especially be watched.

(b) Apprehend damage to line when-

(i) the flood exceeds danger level at any of the bridges, or

(ii) when there is damage to the protection work on bridges or on their approaches even before danger level is reached, or

(iii) the water on one side of the embankment is at a much higher level than on the other side, or

(iv) When any obstruction such as a fallen tree is blocking the waterway of a bridge.

(c) If the track shows signs of a settlement; take immediate steps in accordance with ***Para 1004 (8)*** to stop trains when any portion of the line is likely to be rendered unsafe due to abnormal rain or flood or any other cause.

(d) When no danger is apprehended, stand on the cess on the left hand side facing the train and exhibit his number plate, turning the light of his lamp on to it, so that the number can be seen from the passing train. The Patrolman should also blow the whistle, when the engine and the brake-van of the train passes.

(e) Obtain the signature of the Station Master/Block Hut-in-charge on duty at the Station/Block Hut concerned for arrival and departure and exchange patrol books with adjacent patrolmen.

(f) Exchange the reports as to the conditions on their beats with adjacent patrolmen and stationary watchmen on the way.

(g) Heed instructions from drivers, who may report a condition of danger at any location, and proceed to the place indicated, and take necessary measures.

(2) Hot Weather Patrolman:

The duties of a Patrolman undertaking hot weather patrolling are as follows –

(a) Patrol the track during the hottest part of the day, to look for prominent kinks, incipient buckles or tendency towards buckling.

(b) Protect the track at the site of the prominent kinks, incipient or actual buckles and report the same to nearest Station Master and JE/SSE/P.Way immediately.

(c) Walk over his beat slowly over one rail in one direction and on the other rail in the return direction. On double lines, repeat this procedure alternately on UP and DN tracks.

(d) Be vigilant and look out for kinks in the rail especially during the hottest part of the days. When a kink is observed, immediately examine at least 100 sleepers ahead and in the rear of the kink for any floating/misaligned condition of track.

(e) Should the track reveal a floating/misaligned condition, under which a buckle may be anticipated or the patrolman has detected actual buckling of track, the patrolman will take immediate steps to protect the affected portion by display of hand signals as per rules in force. After protecting the track, the patrolman will arrange to advise the Gang Mate, JE/SSE/P.Way of his apprehension of a buckle/actual buckle.

(3) Cold Weather Patrolman:

The duties of a Patrolman undertaking cold weather patrolling are as follows –

(a) Patrol the track during the coldest part of the night and lookout for weld/rail fractures and excessive gaps at SEJ.

(b) Protect the track at the site of weld/rail fractures, or excessive gaps at SEJ, or shearing/snapping of bolts; and report to nearest Station Master, JE/SSE/P.Way.

(c) On single line; walk over the beat slowly along one rail in one direction and on the other rail in the return direction. On double line; repeat this procedure alternately on UP and DN tracks.

(d) Be vigilant and look out for rail/weld failure, or excessive gaps at SEJ, or shearing/snapping of bolts etc.

(e) In case it is noticed that a rail/weld failure has occurred or gap at SEJ becomes more than the designed maximum gap, the patrolman will take immediate action to suspend the traffic and protect the line. After protecting the track, the patrolman will arrange to report to Keyman/Gang Mate, JE/SSE/P.Way, and Station Master of adjacent station.

(4) Mobile Watchman:

The duties of a Mobile Watchman are as follows –

(a) A Mobile Watchman is posted, till period of consolidation is over, on stretches where after maintenance operation, rail temperature has exceeded t_d+ 20°C during the period of consolidation as given in ***Para 337 (5)***

(b) Number of Mobile watchmen required to be posted would depend upon the length of track attended by manual methods or by tampers.

(c) The mobile watchman would patrol such section/beat to look for prominent kinks, incipient buckles or tendency towards buckling, rail/ weld fracture, excessive gaps at SEJs and shearing/snapping of bolts.

(d) Mobile watchman will be provided with all equipment as per ***Para 1005*** as the case may be, shall protect the track at site if any of the situations as given in ***Para 1004(8)*** occurs and report the same to nearest Station Master/ JE/SSE/P.Way.

(e) Mobile watchman posted on these sites would patrol the section and perform the duties of Hot/Cold Weather patrolman as the case may be.

118 Duties of Gateman

(1) *Knowledge of Gate working rules* – Gateman should have knowledge of gate working rules for opening and closing of gates. Gateman should also know the safety rules to protect the track in case of any unsafe situation for train movement.

(2) *Alertness* – Gateman should be on the alert and be prepared to take immediate action, should danger be apprehended. The keys of the gates shall be on his person.

(3) *Position during passage of trains* – Gatemen should stand facing the track on the gate-lodge side of the approaching train. Gateman should observe all passing trains and be prepared to take such action as may be necessary to ensure safety of trains.

(4) *Upkeep of safety equipment like tri-colour torch, banner flag, detonators, flags, hand signals etc. is the responsibility of gateman.*

(5) *Action in emergency* – In case of an obstruction at the level crossing, Gateman should maintain the gate signals, if any, in the "ON" position and if unable to remove it, protect the line as under –

(a) On double line, if both lines are obstructed during day, Gateman shall plant a red banner flag at a distance of 5 metres from the end of check rails on the line on which a train is expected to arrive first, then plant another red banner flag on the other line at the site of obstruction. The Gateman shall then pick up red hand signal and showing it, proceed on that line towards the direction of an approaching train to a point 600 metres from the level crossing and place one detonator on the line, after which proceed further to not less than 1200 metres from the level crossing and place 3 detonators on the line about 10 metres apart. Having thus protected the line on which a train is expected to approach first, the Gateman should return to the level crossing, picking up the intermediate detonators on his way back. He shall then proceed on the other line showing red hand signal, place detonators in the similar manner, as done in the other direction and return to the site of obstruction to warn the Driver of an approaching train.

(b) On single line, if the line is obstructed during day, Gateman shall plant a red banner flag at a distance of 5 metres from the end of check rails towards the direction from which a train is expected to arrive first, then plant another banner flag towards the opposite direction at the site of obstruction. The Gateman shall then pick up red hand signal and as in *Sub-Para (a)* above, protect the line in the direction from which a train is expected to approach first, return to the site of obstruction, and proceed with all haste in the other direction to protect the line. Having protected the line on both sides, the Gateman should station himself at the place of obstruction to warn the Driver of an approaching train. (***Annexure - 9/7***).

(c) At night, Gateman should light the two hand signal lamps and take action to exhibit red light and protect the lines as in *Sub-Para (a) and (b)* above.

(d) Gateman should take immediate action to inform the Gang Mate, JE/SSE/P.Way and the nearest Station Master about the obstruction at the level crossing through messenger or other means available.

(6) *Parting of a Train* – If a Gateman notices that a train has parted, he shall not show a stop hand signal to the Driver, but shall endeavour to attract the attention of the Driver and the Guard by shouting, gesticulating or other means.

(7) *Hot axle detection, flat tyre detection, hanging parts in train* – The Gateman shall take immediate necessary action as per the instructions given in Gate Working Rules.

119 Duties of Track maintainer:

Track maintainers are responsible for maintenance of track and performing various duties like relieving Gateman/Keyman, patrolling, Material leading / loading/ unloading etc. as instructed by Gang Mate and controlling supervisor, in order to ensure safety of track. The Track Maintainer shall follow the instructions of superior(s).

CHAPTER – 2

TRACK STRUCTURE AND COMPONENTS

201 Classification of Lines – The BG lines have been classified into four groups ‘A’ to ‘D’ on the basis of the future maximum permissible speeds as under –

(1) Group ‘A’ – Speeds up to 160 Kmph

(2) Group ‘B’ – Speeds up to 130 Kmph

(3) Group ‘C’ – Suburban Sections of Mumbai, Delhi, Chennai and Kolkata.

(4) Group ‘D’ – Speeds up to 110 Kmph.

Note – Group ‘D Special’ or ‘E’ appearing anywhere in IRPWM shall be read as Group ‘D’.

202. Track Structure: - The track structure for operation of Passenger train for speeds beyond 110 Kmph and up to 160 Kmph on Indian Railway routes is given as under: *(Back to **Para 212 (2) (a)**)*

Track Structure for speeds beyond 110 Kmph of Passenger carrying train on BG IR

Speed	**Speed above 110 Kmph and up to 130 Kmph**	**Speed above 130 Kmph and up to 160 Kmph**
Rails	60 kg 90 UTS	60 kg 90 UTS
Sleeper/ Sleeper Density	PSC at 1660	PSC at 1660*
*Note - * Wider and Heavier PSC sleeper shall be used during renewals*		
Ballast Cushion in mm	Total 300 clean 150	Total 350 clean 150
Turnouts		
Switch	Thick Web Switches on all turnouts	Thick Web Switches on all turnouts
Crossing	CMS	Weldable CMS
SEJ	Improved Type	Improved Type
Bridge Sleepers	H – Beam Sleepers/Composite sleepers	
Level Crossings	Interlocked	No Level crossing
Fencing	All along the track	All along the track
Curves	All the curves shall be suitably realigned and proper transition lengths shall be provided. Maximum permissible cant of 185 mm can be provided in the section so that speed potential on curves is fully exploited, however, this shall be subject to the consideration of maximum cant excess for the slowest moving train. This will require survey of each curve including the fixed installation and thereafter realignment should be undertaken keeping all the constraints in view. With a cant deficiency of 150 mm, the maximum permissible speed on 1.3 degree curve and 2.2 degree curve works out to be 160 Kmph and 130 Kmph respectively for 185 mm cant. (Corresponding to Goods train speed of 65 Kmph).	

Note – In case track structure does not fulfill the above requirement, relevant instructions of Railway Board would be referred.

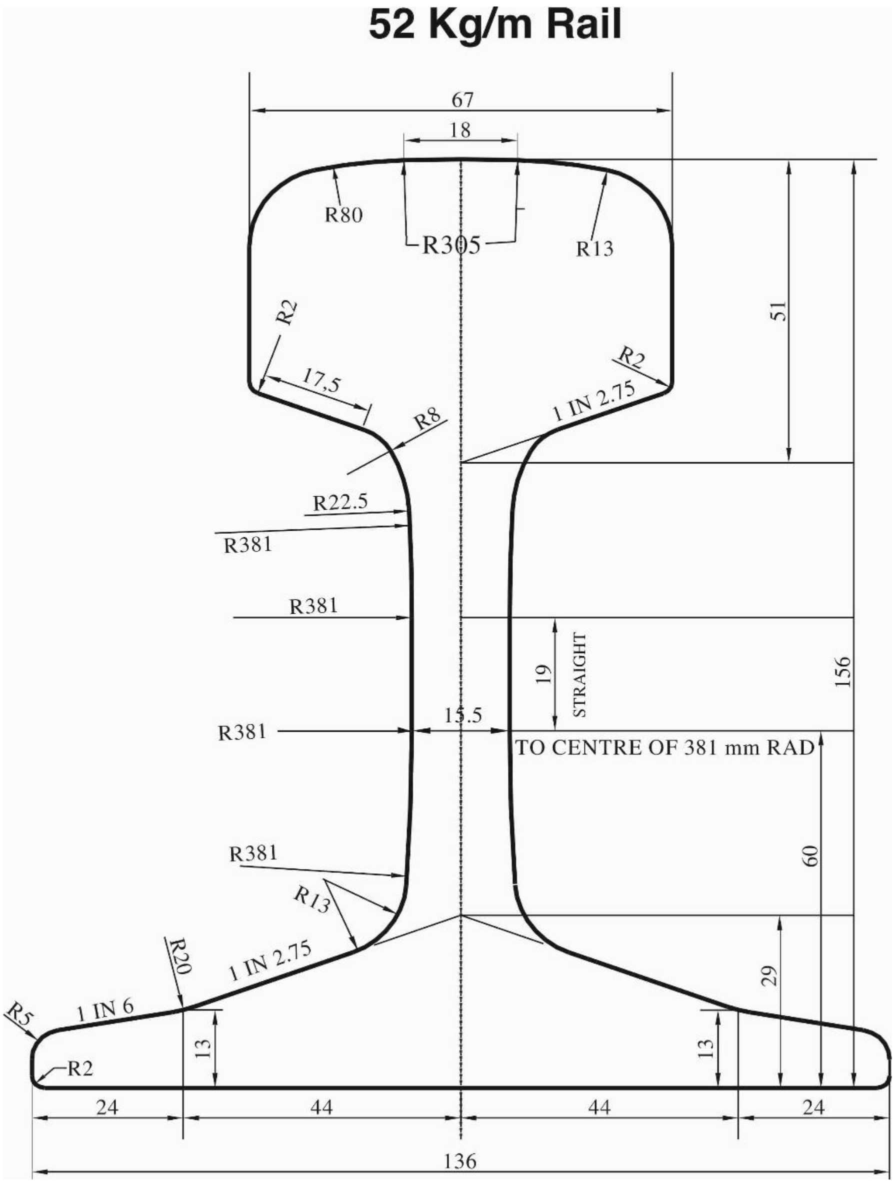
PART – A

Rail and Rail Fastenings

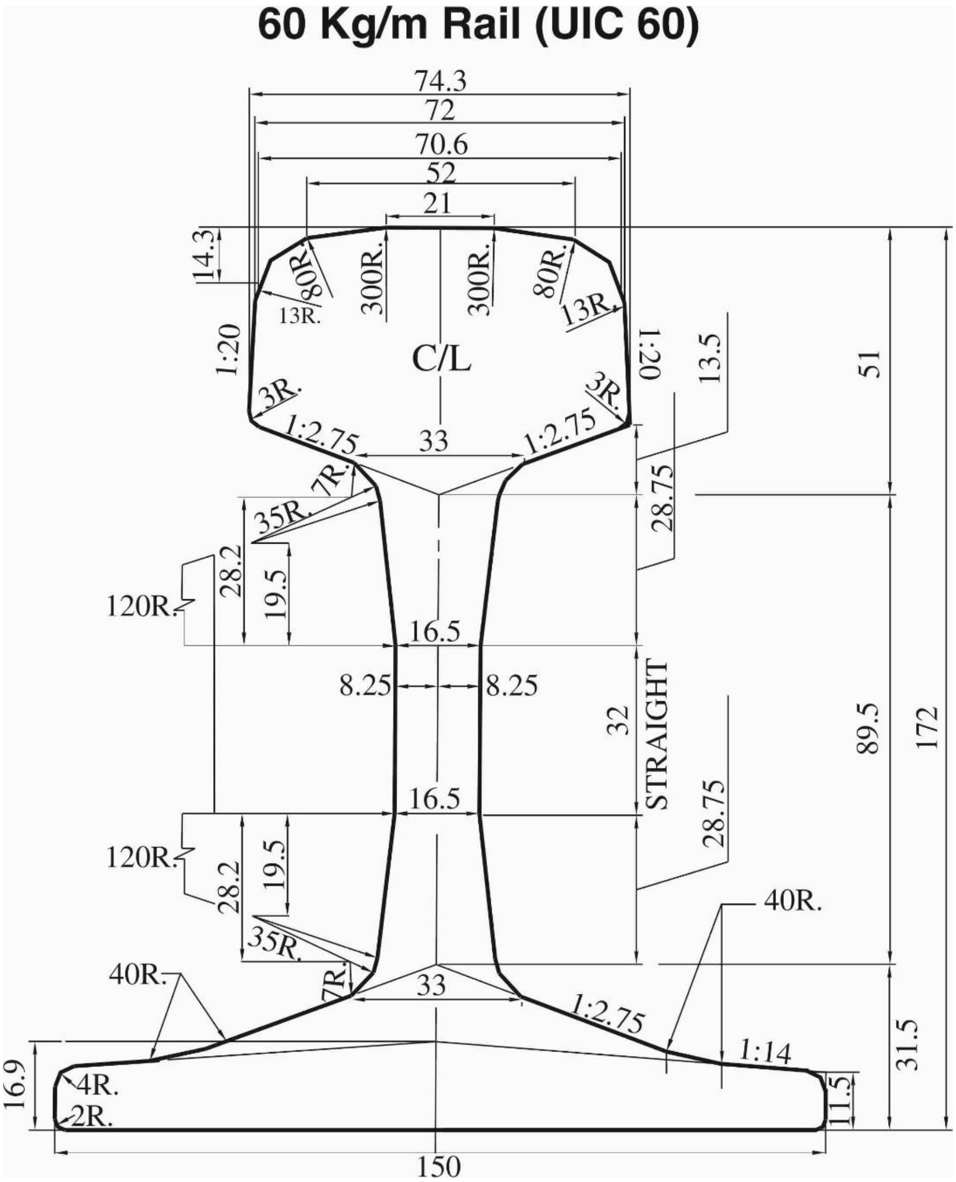
203 Standard Sections of Rails –

(1) *General* –

The rails are manufactured as per the Indian Railway Standards specification for flat bottom rail (IRS-T-12). On Indian Railways, flat-footed rails of 60 Kg/m and 52 Kg/m are being used predominantly. The typical cross-section and key dimensions of these rail sections are reproduced below.



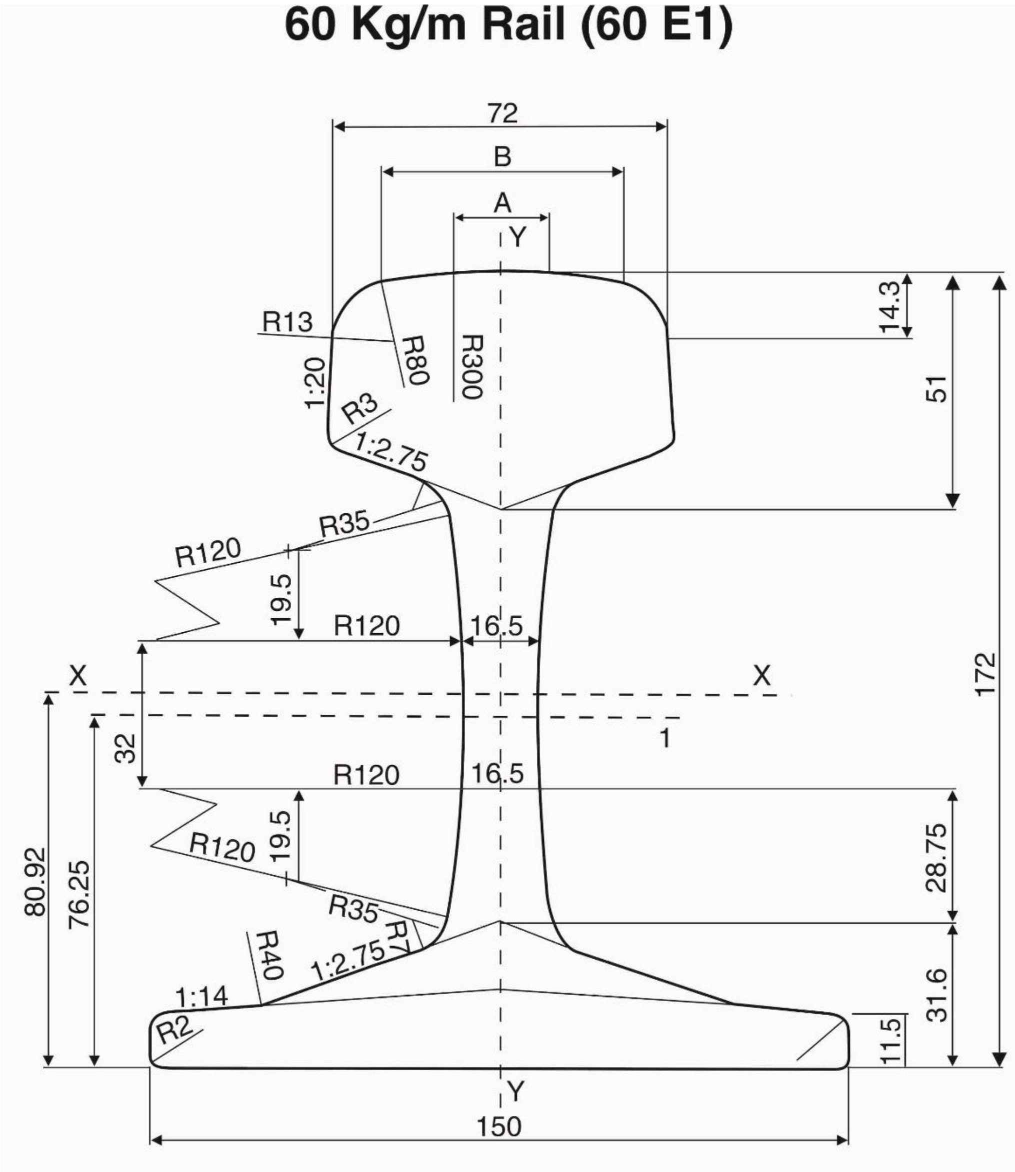
Rail Section	Cross-Section Area (cm^2)	Weight per meter in Kg
52 Kg	66.15	51.89



Rail Section	Cross-Section Area (cm^2)	Weight per meter in Kg
60 Kg (UIC 60)	76.86	60.34

For 60 Kg/m rail, the UIC 60 profile has been changed to 60 E1 profile, which is accurately dimensioned profile developed from the previous less accurately dimensioned profile of UIC 60. In this profile, there is a minor variation in the profile of rail head top as compared to the UIC 60 profile. There is no difference in the dimensions of Rail flange and web including the fishing planes.

Cross-section and key dimensions are as below:



Cross-Sectional Area - 76.70 cm^{2},

Mass per metre - 60.21 Kg/m

Indicative dimensions: A = 20.456mm,

B = 52.053mm

Note: These are for guidance only. For details, please refer IRS specification - T-12

(2) *Marking of Rails:*

Brand marks are rolled in relief on one side of the web of each rail. These brand mark usually include:

(a) Rail section

(b) Grade of steel. E.g. for grade 880 - "880"

(c) Identification mark of the manufacturer.

(d) Month (using Roman numbers) and last two digits of year of manufacture.

(e) Process of steel making: e.g. for Basic Oxygen - "O", for Electric - "E" etc.

(f) Rolling direction

204 Identification of Different Qualities of Rails in the Field –

(1) *'Prime Quality' Rails –*

These rails are to suitable for use in running track at all location and are classified as Class 'A' and Class 'B' rails based on tolerance in End straightness as given below.

End Straightness	Tolerances	
	Class 'A' rail	**Class 'B' rail**
Horizontal	Deviation of 0.5 mm Measured as maximum ordinate from the chord of 2.0 M standard straight edge.	Deviation of 0.7 mm Measured as maximum ordinate from the chord of 1.5 M standard straight edge.
Vertical (up Sweep)	Deviation of 0.4 mm measured as maximum ordinate from the chord of 2.0 M standard straight edge.	Deviation of 0.5 mm measured as maximum ordinate from the chord of 1.5 M standard straight edge.
Vertical (Down Sweep)	NIL	NIL

(2) *'Industrial Use' Rails (IU Rails)* – There is no deviation in chemical composition or mechanical properties in 'Industrial Use' rails from that of 'Prime Quality' rails. The deviations exist only in tolerances for Parameters as mentioned in IRS-T-12.

These rails can be used in industrial sidings with a speed restriction of 50 Kmph. IU rails can be identified by blue paint on end face of flange and both sides of flange for a distance of 500 mm from each end. The letter 'IU' (Industrial Use Grade) as the case may be in 15 mm size shall be stamped on both end faces of rails in addition to colour marking.

(3) *Colour Code*: The rails are painted with colour code as given in IRS-T-12 (**Annexure - 2/1**)

(4) *Permissible variations in dimensions of rail*:

S. No.	Item		Prime Quality rails (mm)	IU rails (mm)
1	Overall height of rail		+0.8 to -0.4	+2.0 to -1.0
2	Width of head Measured 14 mm below the rail top		±0.5	±2.0
3	Width of flange	For sections less than 60 kg/m	±1.0	+1.5 to -2.0
		For sections 60 kg/m and above	+1.2 to -1.0	
4	Thickness of web Measured at the point of minimum thickness		+1.0 to -0.5	+2.0 to -1.0

Note - Rails loaded in one wagon should not be mixed with other rails for dispatch.

(5) Longer rails - As per IRS-T-12, the standard length of rails is 13 m or 26 m. However, the manufacturer may also supply longer rails of 65 m, 130 m and 260 m length as required by purchaser.

205 Recommended Rail Section – *(Back to **Para 705**)*

(1) *Main line* – Track Renewals, Doubling, New Lines and Gauge Conversions – 60kg/m rails with minimum 90 UTS

Note – For Gauge Conversion works & new line works having projected traffic of less than 5 GMT, 60kg/m (SH) rails, if available with Railways, can be used depending upon future projected extension of lines etc.

(2) *Loop Lines –*

(i) Renewal of passenger running loop lines and laying of new passenger running loop lines is to be done with new 60 kg rails.

(ii) Renewal or laying of other loop lines is to be done with 60/52 kg (SH) rails. New rails can also be used for these rail renewals with the prior approval of

Principal Chief Engineer.

(3) *Private and other sidings –*

(i)	Sidings taking off from DFC or feeder routes to DFC or 25t axle load routes.	60 kg/m
(ii)	Sidings other than (i) above; With permissible speed up to 50 Kmph.	52 kg/m (SH); or 52 kg/m (IU)
(iii)	Sidings other than (i) above; With permissible speed more than 50 Kmph.	60 kg/m

206 Rail Fastenings:

(1) *Fishplates:* Fishplates are used to join the ends of rails using fishbolts and other fittings such as washers, etc. These are manufactured to comply with RDSO specification, IRS-T-1.

(2) *Joggled fishplates:* Joggled fish plates with clamps or with far end bolts are used at welded joints or at rail fracture locations. Joggled fishplates shall comply with RDSO specification IRS-T-1.

(3) *Combination fishplates –*

(a) A set of four combination fishplates is to be used at joints of two different rail sections. The 4 fishplates are different from each other and are marked I.R. (Inside Right), O.R. (Outside Right), I.L. (Inside Left) or O.L. (Outside Left) apart from their drawing numbers. Combination fishplates shall comply with RDSO specification IRS-T-1.

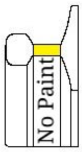
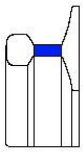
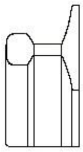
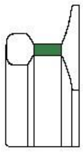
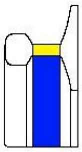
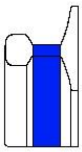
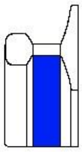
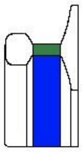
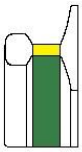
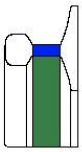
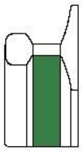
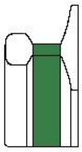
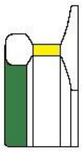
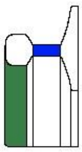
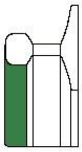
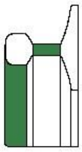
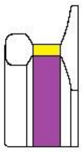
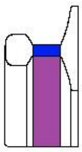
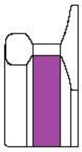
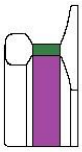
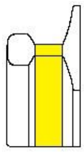
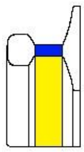
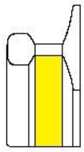
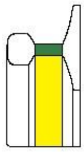
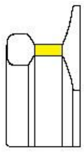
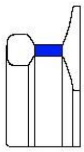
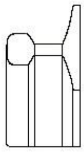
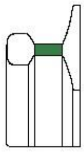
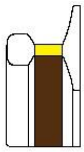
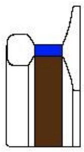
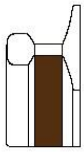
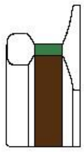
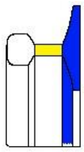
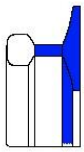
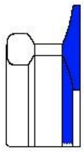
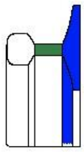
(b) The following points should be ensured:

i) On either side of combination fishplates, full length of rail should be used.

ii) Combination rails prepared by welding two rail sections as per standard drawings should, preferably be used in place of combination fishplates.

*Note: For the guidance of field officials, some of the commonly used fittings referred in this section are listed in **Annexure - 2/4 (A) and 2/4 (B)**. For detailed information, respective RDSO drawings with their latest alterations and/or Track Manual may be referred.*

COLOUR CODE FOR RAILS

S. No.	Grade	Colour Code	13m, 26m, 130m, 260m	12m, 25m, 129m, 259m	11m, 24m	10m
1	GR 880	Only common length wise colour code and no paint on web surface				
2	GR 1080 H.H.	In addition to common length wise colour code, **Blue** paint on both sides of web surface for a distance of 500mm from each ends.				
3	GR 1080 Cr	In addition to common length wise colour code, **Green** paint on both sides of web surface for a distance of 500mm from each ends.				
4	CLASS ‘ A’ RAIL	In addition to common length wise colour code, Grade code 1, 2 & 3and **Green** paint on guage/non guage face for a distance of 500mm from each				
5	NIOBIUM 880 NB	In addition to common length wise colour code, **Purple** paint on both sides of web surface for a distance of 500mm from each ends.				
6	VANADIUM 880 VN	In addition to common length wise colour code, **Yellow** paint on both sides of web surface for a distance of 500mm from each ends.				
7	Cooper-Molybdenum 880 CM	In addition to common length wise colour code, **White** paint on both sides of web surface for a distance of 500mm from each ends.				
8	Nickle Chromium Copper 880 NC	In addition to common length wise colour code, **Brown** paint on both sides of web surface for a distance of 500mm from each ends.				
9	IU	In addition to common length wise colour code, **Blue** paint on end face of flange and both sides of flange for a distance of 500mm from each ends.				

Common lengthwise colour code

1. No paint on gauge/non-gauge face indicates class ‘B’ rails.
2. Yellow paint on each end face on web region indicates **13 m, 26 m, 130 m, and 260 m** length.
3. Blue paint on each end face on web region indicates **12 m, 25 m, 129 m, and 259 m** length.
4. White paint on each end face on web region indicates **11 m, 24 m** length.
5. Green paint on each end face on web region indicates **10 m** length.

*Note: - This colour code is for new rails; for second hand rails **Para 722** may be referred to.*

PART – B

Sleepers & Fastenings

207 General:

(1) **Types of Sleepers:** depending on type of Material, there are following types of sleepers:-

(a) Wooden Sleepers
(b) Cast Iron Sleepers
(c) Steel Trough Sleepers
(d) Concrete Sleepers

(2) Wooden, Cast Iron and Steel Trough Sleepers have become obsolete and at present concrete sleepers are being used widely. For certain specific locations e.g. girder bridges, points and crossings etc. composite sleepers are being gradually introduced.

208 Concrete Sleepers:

(1) Amongst the mono-block and twin-block concrete sleeper types, Indian Railway uses the Mono-block Pre-stressed concrete sleepers predominantly. These PSC sleepers provide longitudinal & lateral stability required for LWR and due to the Flat bottom, these sleepers are suitable for mechanised tamping.

(2) The PSC sleepers are manufactured to conform to *RDSO specification No IRS: T-39 (Plain Track) and IRS: T-45 (Turnout sleepers).*

(3) *Identification of Sleepers*

(a) Concrete sleepers can be identified by the drawing no. and code of sleeper manufacturer with year of manufacture engraved on the top end surface of sleepers. Permanent Way staff should take care to see that they are not obliterated during maintenance.

(b) All the PSC sleepers are tested for electrical resistance at the time of manufacture, and sleepers are marked by paint with "FTC" to indicate Fit for Track Circuiting and "NFTC" to indicate not fit for track Circuited location. This shall be noted while using the sleepers at site.

(4) When concrete sleepers are used in yards with fish-plated track/SWR, the sleeper spacing at fish-plated joint shall be kept uniform. In addition, 1 m long fishplates may preferably, be provided at such joints.

(5) Modern sleepers manufactured in fully automated Concrete Sleeper Plants with stricter quality control and lesser human intervention should be progressively used to obtain better geometrical tolerances in the concrete sleepers.

209 Sleeper Density: *(Back to **Para 705, 719**)*

(1) *Definition:* The Sleeper density is expressed as the number of sleepers per km of track and is fixed taking into consideration the maximum permissible speed and the traffic density of the section.

(2) *Minimum Sleeper Density:*

(a) The minimum sleeper density for all track renewals (complete track renewal and through sleeper renewal), doubling, gauge conversion, new line construction works for main lines & renewal and laying of new passenger running loop lines shall be 1660 nos. per km and for other loop lines & sidings (permissible speed up to 50 Kmph) it shall be 1540 nos. per km. For sidings with permissible speed more than 50 Kmph minimum sleeper density shall be 1660 nos. per km.

Note: Higher sleeper density may be provided with the approval of the Principal Chief Engineer.

(b) Where SWR track is to be laid on concrete sleepers in unavoidable circumstances, the sleeper spacing including at fishplated joint, shall be kept uniform. In addition, 1 m long fishplates, be provided at fishplated joints.

210 Fastenings on PSC sleepers: Only approved types of fittings and Elastic fastenings shall be used with concrete sleepers. Some of the approved type of fastenings on PSC sleepers are as under:

(1) *Elastic Rail Clip (ERC):* Manufactured from Silico-manganese Spring steel by approved/ Developmental suppliers as per RDSO specification IRS-T: 31. They offer a designed Toe load at design deflection.

(2) *Grooved Rubber Sole Plate (GRSP):* Manufactured from rubber compound conforming to *RDSO specification No IRS -T-47*, the Grooved Rubber Sole Plate absorbs high frequency vibrations, shocks and reduces noise.

(3) *Composite GRSP:*

(a) For improved performance Composite GRSP with two layers of different types of rubber are developed, which has the top layer having higher modulus of elasticity (harder) while bottom is of softer Material.

(b) These are manufactured to *RDSO specifications for Composite GRSP (provisional) number RDSO/M&C/RP-198/2006 for 6.2 mm and RDSO/M&C/RP-200/2007 for 10 mm CGRSP*.

(c) As per above referred specification, the harder layer should be kept in contact of Rail, Thus, the surface of CGRSP where the manufacturer's initials are embossed should be placed on rail seat, facing up.

(4) *Nylon Cord Reinforced GRSP:* These GRSPs are specifically designed for use below Crossings of Turnouts conforming to "*RDSO specifications for 6 mm thick Nylon Cord Reinforced GRSP for placing beneath rails at turnouts, Provisional 2007(RDSO/M&C/RP-201/2007*)".

(5) *Liner:*

(a) These are the fittings used in conjunction with the GRSP/ CGRSP and rail, on both sides of the rail foot to achieve the correct track gauge to provide for the correct deflection of the ERC for the designed Toe load. The combination liners also allow flexibility to use lighter rail sections on the sleepers meant for heavier rail section.

(b) Liners are made of two Materials viz., Glass filled Nylon (GFN) liners (as per *"RDSO specifications IRS: T-44") and Metal Liners (as per "RDSO specifications for Metal liners – Provisional 2013"*). The GFN liners are generally used in track-circuited locations.

(c) Cut liners shall be used with ERC J clip at fish plated Joint/ Glued Joint

Note: For the guidance of field officials, some of the commonly used fittings referred in this section are listed in ***Annexure - 2/4 (A) and 2/4 (B)****. For detailed information, respective RDSO drawings with their latest alterations and / or Track Manual may be referred.*

210(A) Modern Fastenings:

Approved Modern Fastenings can be used in place of ERC based fastenings in phased manner. These fastenings are capable of being supplied factory fitted on sleepers from the Concrete Sleeper Plants for laying in the field.

The Modern Fastenings shall comply with the requirements of category 'C' fastening system as per EN 13481-1:2012 and EN 13481-2:2022.

PART – C

BALLAST

211 Ballast Specifications – Crushed Stone ballast to be used on all lines including points and crossings shall be conforming to *RDSO specifications for Track Ballast No. IRS -GE -1, June 2016 with latest amendments.*

211(A) Ballastless Track (BLT) may be used in Tunnels/ Viaducts/ Station Yards/ formation in deep cuttings as per site specific requirements.

212 Ballast Profile/Section/Depth of Cushion: *(Back to **Para 354**, **705**)*

(1) Ballast profile: -The following ballast profiles shall be provided for the various groups of track for LWR/CWR and other than LWR/CWR as given in ***Annexure -* 2/2A, 2/2B & 2/2C** of this section. The approximate quantity of ballast required per metre run of track for standard ballast sections has also been indicated in the sketch.

Note -

(i) Minimum Formation width to be ensured for new works/alteration to existing works in embankment and in cutting (excluding side drains), as also indicated in the sketch of ***Annexure -* 2/2A, 2/2B & 2/2C**

- *For single line – 7850 mm (straight track)*
- *For double line – 13160 mm (straight track)*

(ii) On curves, additional formation width over (i) above, shall have to be ensured as given below:

(a) Increase due to extra widening of ballast shoulder on outer side of curves in both single/double line, as indicated in sketch of ***Annexure -* 2/2A, 2/2B & 2/2C**

(b) Increase due to requirement of extra clearances on curves as stipulated in the Appendix to the IRSOD-(BG).

(iii) Increase in formation width on curves will be decided after taking into account the increase mentioned in (a) & (b) above.

(iv) Minimum Cess width of 90 cm shall also have to be ensured for both straight track & on curves, along with ensuring minimum Formation width as specified for Single/Double line including additional formation width on curves as described above.

(v) If even after provision of additional formation width, cess width on the outer side of curves reduces below 90 cm on account of increased ballast width due to super elevation, formation width shall be increased further, over and above additional width as stipulated in Note (ii) above, to meet the requirement of minimum cess width of 90 cm.

(2) *Depths of Ballast Cushion –*

(a) The minimum depth of the ballast cushion below the bottom of the sleepers at the rail seat for BG should be as under –

In case of	Minimum depth of the ballast cushion for all routes
Track Renewals (complete track renewals and through sleeper renewals)	300 mm (Where possible 350 mm shall be provided)
All Doubling, Gauge Conversion & New Line construction works	350 mm
Renewal and laying of new passenger running loop lines	300 mm
Other Loop Lines	250 mm

For higher speed, *Para* 202 would also be referred.

(b) Sidings –

Private and Other Sidings	For permissible speed up to 50 Kmph.	300 mm
	For permissible speed more than 50 Kmph	350 mm

Note – Minimum depth of clean ballast cushion at all times for mechanised maintenance under the rail seat of the PSC sleepers shall not be less than 150 mm.

(c) Increase in ballast cushion to make up the recommended depth will be carried out during complete track renewal, through sleeper renewal or programmed deep screening of track.

(3) Special attention should be given at locations such as bridge, level crossing and tunnel approaches so as to ensure full ballast section for six rail lengths on either side.

213 Assessment of Ballast Requirements –

(1) The requirement of ballast shall be assessed separately for

(a) Making good the deficiencies as existing in track,
(b) Making good deficiencies arising out of overhauling, through packing/tamping and deep screening,
(c) For providing adequate cushion in the case of mechanical tamping,
(d) For providing extra cushion/profile for converting into LWR or up-gradation of track structure for higher axle load.

(2) The ballast required for maintenance purposes shall be estimated by assessing the quantity approximately if necessary, by a survey, over a rail length in every 1 km. Care should be taken that the cores under the sleepers are not disturbed.
(3) In case of deep screening, assessment of ballast required for recoupment and providing standard section should be made by deep screening the ballast section to the full depth in a rail length for two to three sleepers at every 0.5 to 1 km. In this case screening is done under the sleepers as well.
(4) The quantities assessed vide *Sub-Para* above will be the net quantities of ballast required to recoup the deficiencies to provide required profile / sections. The above net quantities may be enhanced suitably (say 8%) to arrive at gross quantities of ballast for the purpose of procurement action in case measurements are proposed to be taken in stacks or in wagons at originating station.

214 Collection and Training out of Ballast – The collection of ballast can either be done-

(1) By resorting to alongside collection, or
(2) By collecting at depots and training them out in ballast trains.
(3) The mode of collection will have to be decided taking into account proximity of quarry, availability of good stone ballast, service roads alongside the line for carrying of ballast, availability of ballast trains, the turn round of ballast trains and availability of block for unloading.

215 Handing over Charge by Assistant Divisional Engineer – During transfer of charge of a sub division, the Assistant Divisional Engineer taking over, should satisfy himself by test checking some of the stacks at each depot and along the cess to the effect that the quantities of materials shown in the registers are correct. He should certify that this has been done by initialing each entry so checked.

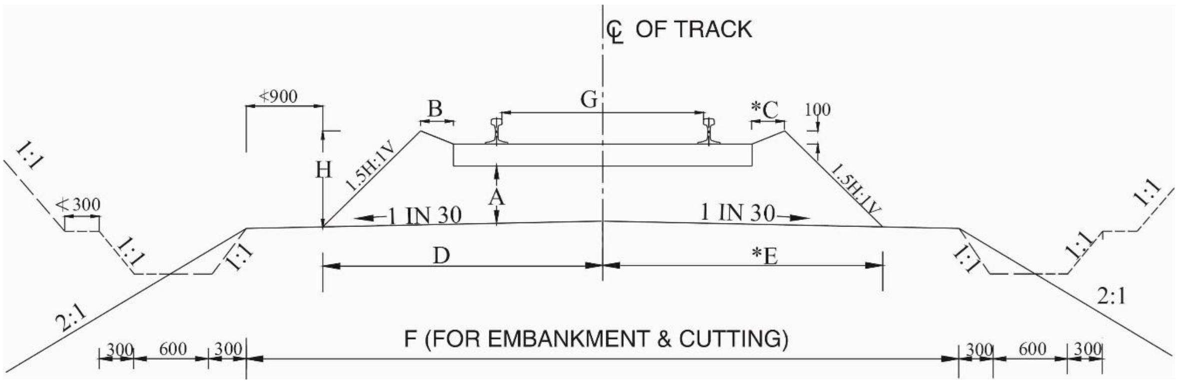
216 Unloading Ballast along the Line – When unloading ballast along the line care shall be taken that the heaps at the sides and the centre are clear of prescribed running dimensions. Care should be taken to ensure that Ballast shall be cleared from the signal wires or point rods and no stone is left inadvertently between the stock rail and tongue rail.

217 Surplus Ballast Along the Line – All surplus ballast left alongside the line should be collected and stacked in regular heaps and not left scattered on the slopes to be overgrown by grass and lost.

Annexure - 2/2(A) (*Para 212*)

Ballast Profile for LWR Track (Single Line BG)

(For PRC Sleepers)



Ballast Profile (BG single line in embankment/cutting)

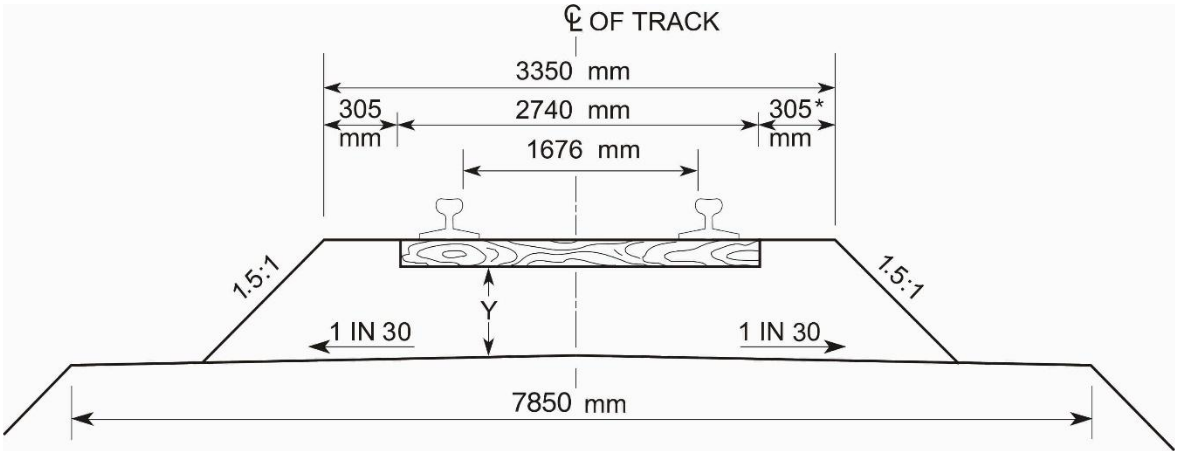
G Gauge	Type of Sleeper	A	B	C*	D	E*	F	H	Quantity of Ballast per meter in	
									Straight Track (M^3)	Curved Track (M^3)
1676 mm	PRC	250	350	500	2693	2851	7850	646	2.030	2.120
		300	350	500	2772	2930	7850	698	2.304	2.401
		350	350	500	2851	3009	7850	751	2.585	2.690

Note:

1. *Depth of ballast cushion should be provided as per Para 212(2) of IRPWM.*
2. *Cross-Slope of 1 in 30 shall be provided for New Works.*
3. *Minimum Formation width of 7850 mm shall be ensured for new works in both embankment and in cuttings (excluding side drains).*
4. *Suitable dwarf walls shall be provided in case of cuttings, if necessary for retaining ballast.*
5. **On outer side of curves only.*
6. *Super elevation has not been considered in calculation of ballast quantity for curved track.*
7. *The cess width on existing track is to be increased on programmed basis wherever required so that minimum cess width as per side slope given above is ensured.*
8. *All dimensions are in mm.*

Standard Ballast Profile for BG

(Other than LWR/CWR)



S. No.	Depth of Ballast Cushion	Quantity of Ballast per Meter	
		On Straight and Curves of Radius flatter than 600 M	Curves of Radius sharper than 600 M
1	250 mm	1.769 M^3	1.820 M^3
2	300 mm	2.022 M^3	2.078 M^3
3	350 mm	2.282 M^3	2.344 M^3

Note :

*(1) In the case of ordinary fish plated track: * To be increased on the outside of curves to 400 mm in the case of curves sharper than 600 M radius.*

(2) In short welded panel Track To be increased to 400 mm on outside of all curves, flatter than 875 M radius and to 450 mm, in the case of curves sharper than 875 M radius.*

*(3) * To be increased to 550 mm on the outside of turn in curves of turnouts in passenger yards.*

*(4) Depth of Ballast cushion should be provided as per **Para 212(2)** of IRPWM.*

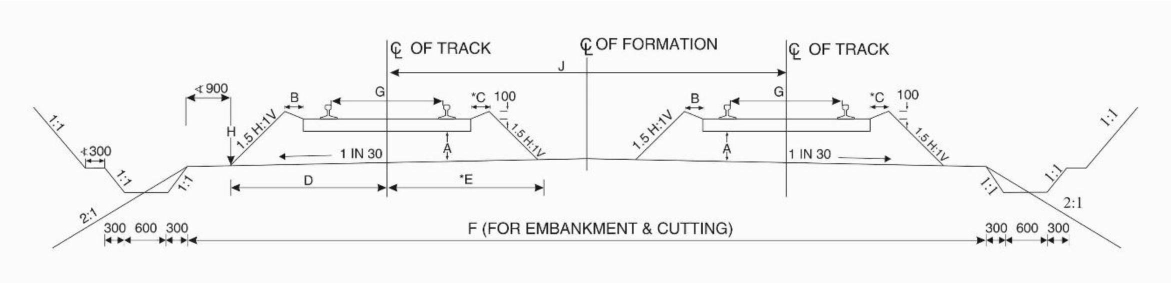
(5) Minimum Formation width of 7850 mm shall be ensured for new works in both embankment and in cuttings (excluding side drains).

(6) Super elevation has not been considered in calculation of ballast quantity for curved track.

(7) The cess width on existing track is to be increased on programmed basis wherever required so that minimum cess width as per side slope given above is ensured.

Ballast Profile for LWR Track

(Double Line BG)



G Gauge	Type of Sleeper	A	B	C*	D	E*	F	H	J
1676 mm	PRC	250	350	500	2785	2943	13160	707	5300
		300	350	500	2864	3022	13160	760	5300
		350	350	500	2943	3101	13160	812	5300

***Note**:*

1. *Depth of ballast cushion should be provided as per **Para 212(2)** of IRPWM.*
2. *Cross-Slope of 1 in 30 shall be provided for New Works.*
3. *Minimum Formation width of 13160 mm shall be ensured for New works in both embankment and in cuttings (excluding side drains).*
4. *In doubling work of existing lines, cross-slope of 1 in 40 in existing old formation need not be disturbed.*
   However, the cross slope of 1 in 30 shall be provided in widened formation width, newly constructed for doubling.
5. *Suitable dwarf walls shall be provided in case of cuttings, if necessary, for retaining ballast.*
6. *******On outer side of curves only.*
7. *Super elevation has not been considered in calculating various dimensions.*
8. *The cess width on existing track is to be increased on programmed basis wherever required so that minimum cess width as per side slope given above is ensured.*
9. *All dimensions are in mm.*

PART – D

Formation

218 Classification of Formation Requiring Treatment – Following steps shall be adopted to classify the formation requiring treatment:

(A) *Identification of Weak Formation* - Weak Formation shall be identified based on either of the following condition-

(i) Stretches having speed restrictions due to weak formation.

(ii) Stretches where more than normal track attention is required.

(iii) Stretches where ballast penetration profile is of 'W' shape and maximum depth of penetration is more than 30 cm.

In case any of the above conditions are met in field, then the 4-step action plan given below is to be followed.

(B) *Action to be taken for Weak Formation* - Following 4-step action plan should be adopted for stretches identified as weak formation:-

(i) Make the formation width, cess level and side drains strictly in accordance with prescribed profile.

(ii) Carry out shallow screening of ballast section (or deep screening where required).

(iii) Ensure no loose or missing fitting.

(iv) Increase the depth of ballast section to 30 cm or even up to 35 cm.

If track maintenance problem persists even after adoption of above measures, then it is a suspect formation and further detailed Geotechnical investigation is to be done for assessing the problem. Based on investigation results, the formation is to be classified as Bad Formation, if warranted. Remedial measures for rehabilitation/Strengthening of bad formation should be taken accordingly.

219 Nature of Formation Problems – In such stretches, the track levels get disturbed frequently causing problems in track maintenance. These problems are attributable to –

(1) Excessive or uneven settlement of banks affecting track Parameters.

(2) Slope failure leading to slips, heaving beyond the toe, creep or bulging of slopes.

(3) Ballast penetration and mud pumping of poor Subgrade Material.

(4) Swelling and shrinkage of expansive soils in fills such as black cotton soil.

(5) Cracks on the cess, affecting track Parameters.

220 Site Investigation – The following data should be collected for determining the type of treatment to the formation –

(1) *History of the affected section –*

- Period when constructed;
- Method of construction;
- Date of opening to traffic;
- Subsoil bank settlements;
- Slips if any; and
- Speed restrictions on formation account.

(2) *Site details* –

- Bank heights;
- Formation width, cess level and side slope.
- Depth of cutting;
- Nature of existing slopes (Turfed or not, with or without berms);
- Drainage conditions;
- Stagnation of water;
- Condition and proximity of borrow pits;
- Signs of movement and bulging in the slopes;
- Ground water level and its position during rains.
- Cracks on the cess.

(3) *Number of attentions to track* – The particulars of the number of attentions to track should be obtained from gang charts and/or TMS reports for the last five years, to get an idea about track maintainability. Man-days utilised for maintenance per Km should also be collected vis-à-vis men required for normal maintenance.

(4) *Ballast penetration profile* – These profiles should be obtained at regular intervals of hectometers/O.H.E. masts, to indicate the extent of ballast penetration and condition of ballast (loose, caked, mixed with sub-soil etc.)

(5) *Exact nature of present trouble* – The exact nature of the present trouble should be identified whether it is due to –

- Bulging of ballast between cribs or at the cess;
- Mud pumping;
- Slope movement;
- Slope failure; etc.
- Cracks on the cess.

221 Soil Investigation and Testing –

(1) *Soil investigation* –

(a) Undisturbed soil samples should generally be collected at every hectometer/ O.H.E. mast. Undisturbed soil samples in 100 mm sampling tubes should be collected from the following places as necessary.

(i) From the formation below the depth up to which the ballast has penetrated.

(ii) From inside the bank along the probable circle through which the slip has occurred, where the bank has been found to be structurally unstable.

(iii) From various depths below the ground level at the toe of the bank, where base failures/settlements have occurred.

(iv) From two sections in the slipped portion and one section at the toe adjoining the site where slip has not occurred in the past.

(b) Two cross sections of the bank in both the sections should also be taken by means of precise levelling.

(c) In addition to this, disturbed soil samples should also be collected at regular intervals of a hectometer/O.H.E. mast, to determine the index properties of the formation soil.

(2) *Soil testing* – Selected undisturbed/disturbed soil samples (as per ***Annexure - 2/3***) should be tested at the soil Mechanics Laboratory, to determine the following properties –

(a) Index properties viz., grain size analysis and Atterberg limits (i.e., LL, PL & SL).

(b) Natural moisture content and natural dry density.

(c) Optimum moisture content and maximum dry density.

(d) Shear property.

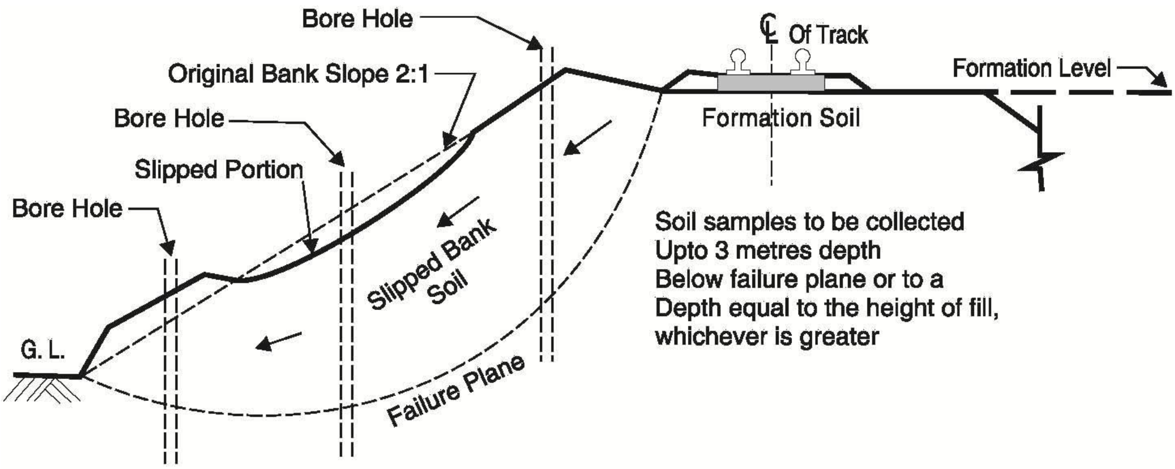
(e) Differential free swell.

For banks, which are structurally weak/unstable, the shear property of the soil sample is very important and sufficient number of samples must be tested so as to get an accurate idea of the shear strength of the bank soil and soil strata below ground level.

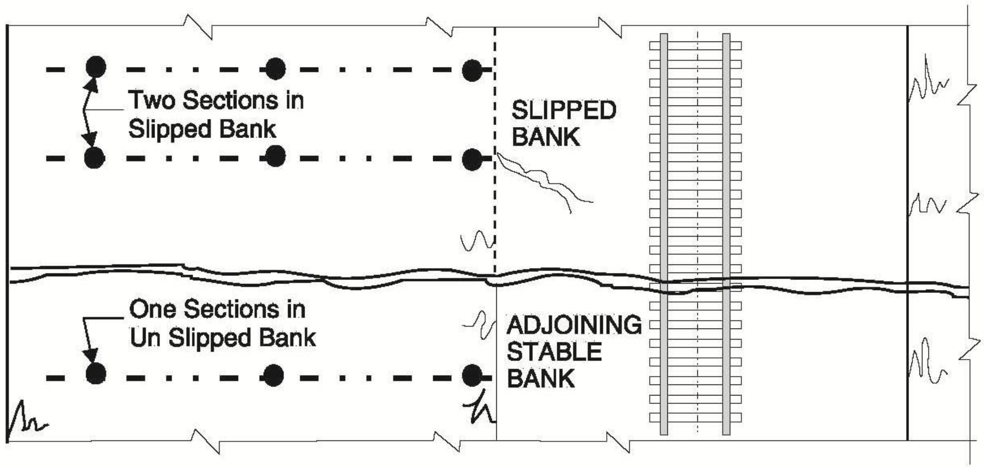
For banks where settlement has occurred, consolidation test should also be carried out.

222 Remedial Measures Suggested – Based on the site investigations and soil testing, the relevant remedial measures should be formulated. Some of the remedial measures suggested for the formation troubles generally encountered are listed below for guidance:

Sr. No.	Nature of Problems	Remedial measures*
1.	Inadequate drainage due to high cess, fouled ballast	Improve side drainage by lowering the cess and screening of ballast.
2.	i) Weak soil at formation top on contact with rain water resulting into mud pumping under trains, ii) Fouling of ballast with Subgrade fines, iii) Impaired drainage	i. Improve the drainage, ii. Provision of blanket of suitable thickness iii. Laying of Non-woven Geotextile
3.	i) Strength failure below ballast causing heaving up of cess or in between sleepers, ii) Ballast penetration exceeding 30 cm below formation	i. Provision of blanket of suitable thickness, ii. Laying of Non-woven Geotextile below blanket
4.	Seasonal variation in moisture in formation top in expansive soils causing alternate heaving, shrinkage of formation.	i. Blanket of suitable thickness, ii. Thickness of blanket may be reduced with provision of Geogrid layer, iii. Laying of Non-woven Geotextile below blanket
5.	Gradual consolidation of earth below embankment (Bank settlement & heaving of soil beyond toe).	i. Provision of Sub-bank ii. Prefabricated vertical drain along with Sand layer at top/Geo-composite drain (Horizontal) or , iii. Stone columns in sub soil
6.	Creep of formation soil.	Flatting of side slopes with sandwiched construction~~.~~
7.	(i) Inadequate sides slopes, causing embankment slips after prolonged rains, (ii) Longitudinal cracks on cess/slopes	Flattening slopes or provision of berms as per slopes analysed with slope stability analysis & with proper drainage system.
8.	Hydro-static pressure built up under live loads in ballast pockets containing water causing bank slips.	Draining out of ballast pockets by sand or boulder drains.
9.	Erosion of slope/cess of banks	i. Repair of slope/cess, ii. Provision of turfing, mats, etc.
10	Cut slope failure	i. Adequacy of slope/slope protection measure as required, ii. Provision of adequate drainage arrangement (Side drain/Pucca catch water drain etc. and ensure its proper functioning)
	** The above measures suggested are only indicative in nature and final remedial measures shall be decided based on the site investigation, soil testing, past failure history (if any) etc. For details, relevant latest instructions issued through various guidelines/specifications for Earthwork by RDSO, shall also be referred to. RDSO's help, wherever necessary, may be taken for formulating the remedial measures.*	



Cross section showing sampling Locations on Slips of Bank



Plan showing Locations of Soil Sampling

Note:

1. Depending on the type of failure, Bores are to be made at the top of Embankment, Mid Slope of Embankment and near Toe as shown above.
2. Soil Samples to be collected up to the depths as indicated above at intervals of 1.5 to 3 metres.
3. One set of bores are required from adjoining stable bank for comparison of soil behaviour.

PART – E

Insulated Joints & Switch Expansion Joints

223 Insulated Joints –

(1) *Description* – Track circuited sections are 'insulated' electrically from the track on either side by insulated joints. The standard insulated joint in normal use, is made out of ordinary fishplates duly planed on the fishing planes for accommodating channel type insulation between rails and fishplates with ferrules/ bushes over the fish bolts and end posts between the rail ends.

(2) *Laying* –

(a) Insulated joints provided shall be laid as square joints. Where staggering cannot be avoided, the distance between staggered joints should not exceed the minimum wheelbase of the vehicles.

(b) Rail ends of the insulated joints shall be square and true.

(c) All rough edges and burrs should be removed from bolt-holes.

(d) Battered ends must be put right and the gap between the rails should be equal to the thickness of the end post.

(3) Inspection and maintenance of insulated rail joint should be done as per ***Para 622***.

224 Glued Insulated Joints –

(1) Glued insulated joints have been developed using resin adhesives. These joints consist of web-fitting fishplates glued to the rails with a high polymer adhesive and bolted with high tensile steel bolts. The insulation is provided by special type of insulating side channels, bushes and end posts made of fiberglass cloth roving.

(2) In all future works of track circuiting, glued insulated joints should be provided in place of standard insulated joints, wherever feasible. There are two kinds of glued joints viz. G3L (with six bolts) and G3S (with four bolts) for usage in LWR/CWR and SWR/FR track respectively.

(3) The instructions for fabrication, installation and maintenance of glued insulated rail joints are given in the *Manual for Glued Insulated Rail joints.*

(4) *Marking of Glued Joints: -* The details of glued joint number, month, year of manufacturing and the code of the manufacturer is embossed on the gauge and non-gauge face sides of the head of the rail as per provision of the Manual for Glued Insulated Rail Joints.

225 Switch Expansion Joint: *(Back to **Para 328**)*

(1) An expansion joint installed at each end of LWR/CWR to permit expansion/contraction of the adjoining breathing lengths due to temperature variations.

(2) Normally, SEJ are provided for same rail sections. In case SEJ is required to be provided between the junction of two different rail sections such as 52 Kg rail and 60 Kg rail, Combination SEJ as per standard RDSO drawing shall be provided.

*Note: For the guidance of field officials, some of the commonly used Glued Joints and SEJ are as per **Annexure - 2/4 (A) and 2/4 (B)**. For detailed information, respective RDSO drawings with their latest alterations and/or Track Manual may be referred.*

PART – F

Track Structure on Bridges

226 Rail and Rail Joints on Bridges – *(Back to **Para 318**, **715**)*

(1) *Longitudinal profile of rails* – In standard plate girders no camber is provided. Open web girders of span 30.5 m and above are provided with camber. Track on these bridges are laid correctly following the camber of the girder.

(2) *Rail joints over the Bridge* – In the case of small bridge openings less than 6.1 m, rail joints should be avoided. For other spans, the preferred position of the rail joint is at 1/3 the span from either end.

(3) *SWR on Bridges* –

(a) SWR maybe continued over girder bridges with un-ballasted decks up to 13.3 m opening if the length of SWR is symmetrical to the centre line of bridge and up to 6.1 m opening if the length of SWR is unsymmetrical to the centre line of the bridge. No fishplated joint should be located on the girder or within six metre from either abutment. In all such cases rail free fastenings, such as rail free clips shall be used, so that relative movement between rail and sleepers may take place.

Irrespective of length of the bridge, 26 m long rolled rails may be laid on un-ballasted girder bridges with 1.0 m long fishplates and 06 bolts and with rail free fastenings only. Joint gaps are to be provided and maintained as per Para 319 & 320.

(b) SWR may be provided as a normal track over ballasted deck bridge (with bearing) of any length with following instructions:

(i) SWR shall be isolated from LWR/CWR by a minimum length of 30 m of well anchored PSC sleeper track on either side.

(ii) 26/39 m long rolled rails may be laid on bridges with 1.0 m long fishplates and 06 bolts. Joint gaps shall be provided and maintained as per Para 319 & 320.

(iii) Ballast cushion shall be as per Para 212(2)(a) on bridge and approaches.

(c) SWR can be continued over ballasted deck bridges (without bearing) of any length.

(ACS – 9)

(4) *LWR/CWR on Bridges* – In the case of laying LWR/CWR, provisions contained in ***Para 329, 330 & 331*** should be followed.

(5) *Precautions for arresting Creep* – Track on girder bridges with un-ballasted deck is always laid with rail free fastenings in all cases. Track on girder bridges laid with standard single rails and fish-plated joints should be isolated from the SWR, if existing, on approaches on either side by providing at least two well-anchored Standard rail lengths or one rail of 26 m. Similarly, the track on the girder bridges not laid with LWR/CWR shall be isolated from LWR/CWR by a minimum length of 30 metre of well-anchored SWR on either side.

227 Steel Sleepers on Bridges – *(Back to **Para 631**)*

(1) Steel sleepers on bridges refer to both steel channel sleepers and steel H–Beam sleepers. Steel sleepers to be used on girder bridges should be fabricated as per approved drawings. For girder bridges on curved track, and track on skewed alignments, steel sleepers should be designed to suit the specific locations.

(a) Steel channel sleepers, including its fittings, may be provided on girder bridges as per applicable RDSO drawings.

(b) H-Beam steel sleeper, including its fittings, for Girder Bridges may be provided as per applicable RDSO drawings. Insulated Zero Toe Load Fastenings should be provided in track circuited area for continuation of LWR/CWR.

(c) All standard drawings should be followed as per Latest alterations.

(2) *Sleeper spacing* – Maximum centre-to-centre sleeper spacing should be 600 mm at all locations on the bridge except at the cross girder in open web girders, where the spacing may be suitably increased depending upon the top flange width of the cross girder. However, in case of width of top flange of cross girder exceeds 450 mm then special channel sleeper to be provided as per applicable RDSO drawing for such situations. The clear distance between joint sleepers should not be more than 200 mm.

(3) *Fabrication of steel sleeper and other components* –

(a) Fabrication of steel sleepers on bridges and its protective coating should be in conformity with **BS–45** issued by RDSO.

(b) For girder, location of Steel Sleepers should be marked and numbered after detailed survey of the girder. The fabrication of Steel Sleeper should be location specific considering the girder centre, top flange cover plates, pitch of rivets etc.

(c) In case of bridges on curves, the location of steel sleepers should be marked after taking into account the realigned curve. In case transition curve lies on bridge fully or partially, the thickness of steel pad plate should take care of cant gradient.

(4) *Laying of steel sleepers on bridges* –

(a) Minimum level of supervision while laying of channel sleepers shall be JE/P.Way.

(b) Before laying Steel Sleepers, creep if any, should be pulled back and rail joints should be so located that after laying sleepers, joints should not become supported joints.

(c) The top flange of girder should be cleaned of old paint and then re-painted as specified.

(d) Wherever required the existing cross level and misalignment of girder/ track should be corrected in advance of Steel Sleeper laying.

(e) Single pad plate below Steel sleeper is preferable. Packing plates can be used along with pad plate to adjust Parameters, wherever required. The pad plates are not required where neoprene pad is provided to cover the rivet head.

228 Provision of Guard Rails on Bridges and Tunnels – *(Back to **Para 630**)*

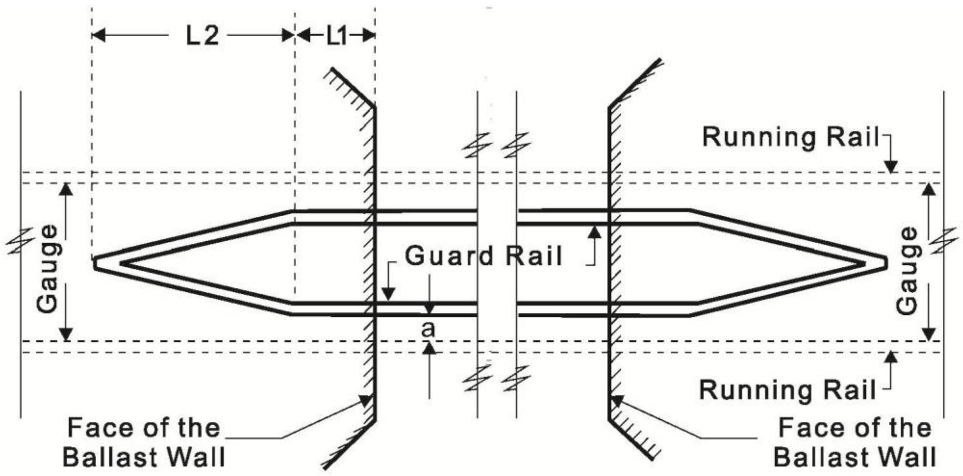
(1) *Location* – Guard rail should be provided on all girder bridges (including pre-stressed concrete girder bridges without deck slab) whether major or minor. Guardrails should also be provided on all major and important ballasted bridges and also on such other minor bridges where derailment may cause serious damages.

On all flat top, arch and pre-stressed concrete girder bridges with deck slab, where guardrails are not provided the whole width of the bridge between the Parapet walls shall be filled with ballast up to the top of sleeper level.

The provision of guardrails along the inner rail can be dispensed with, in case of ballasted deck bridges located on sharp curves where the maximum permitted speed is not more than 30 Kmph and track is laid with PSC sleepers having arrangement for provision of checkrail due to which guardrail cannot be provided.

In case of ROB/FOBs, the guard rail shall be provided on the track adjacent to a column/pier/abutment which is located within a distance of 8m from centre of track.

(2) *Design of Guard rails* – The typical arrangement of a guard rail, with the important dimensions are shown in the sketch and table as shown below –



S. No.	Particulars	Sketch Ref.	Dimensions (mm)
1	Clearance between guard rail and running rail	"a"	250±50
2	Length of guard rail outside ballast wall and maintained to Clearances mentioned in Item-1	L1	1825
3	Length of guard rails to be bent so as to be brought together at the middle of the track.	L2	4875

The top table of the guardrail should not be lower than that of the running rail, by more than 25 mm. In the case of bridges on curves with canted track, the difference should be measured with reference to a straight line connecting the running tables of inner and outer rails.

(3) *Fixing of Guard Rails –*

(a) *Splaying of Guard rails* – In the case of through girder bridges on double lines, the Guard Rails should be splayed on both ends on both lines. In the case of bridges other than through bridges on double lines, the splaying need be done only on the facing direction of the particular line. The ends of Guard Rails should be bent vertically and buried and a block of timber fixed at the end to prevent entanglement of hanging loose couplings

However, the non-splayed end should be bent downwards after it is stopped at the end of the abutment or a wooden block provided.

(b) The fixing of guard rail on concrete sleepers on ballasted deck bridges and approaches shall be done as per approved RDSO drawings by proper tightening of rail screws

(4) Provision of Guard Rails/Derailment Guard in Tunnels –

(I) For Speed above 110 kmph

(A) Tunnel with Single Track

(a) On approach of tunnel: 200 m from portal face outside the tunnel to 25 m inside the tunnel.

(b) Inside Tunnel: In addition to 25 m from face of portal as stipulated under item (a) above, guard rail/derailment guard shall be provided inside tunnels as under:
(i) **Ballastless Track:** Throughout the length of ballastless track.
(ii) **Ballasted Track:** Curves with radius upto 500m along with transition portion but excluding locations provided with check rails. Guard rail would also cover critical locations like sub-station, column/structure etc.

(B) Tunnel with Double Tracks

(a) On approach of tunnel: 200 m from portal face outside the tunnel.

(b) Inside Tunnel: Throughout the length of tunnel but excluding locations provided with check rails.

(II) For Speed above 60 kmph and upto 110 kmph

(A) Tunnel with Single Track

(a) On approach of tunnel: 100 m from portal face outside the tunnel to 25 m inside the tunnel.

(b) Inside Tunnel: In addition to 25 m from face of portal as stipulated under item (a) above, guard rail/derailment guard shall be provided inside tunnels as under:
(i) **Ballastless Track:** Throughout the length of ballastless track.
(ii) **Ballasted Track:** Curves with radius upto 500m along with transition portion but excluding locations provided with check rails. Guard rail would also cover critical locations like sub-station, column/structure etc.

(B) Tunnel with Double Tracks

(a) On approach of tunnel: 100 m from portal face outside the tunnel.

(b) Inside Tunnel: Throughout the length of tunnel but excluding locations provided with check rails.

(III) For Speed upto 60 kmph

(A) Tunnel with Single Track

(a) On approach of tunnel: No Guard rail/derailment guard is required.

(b) Inside Tunnel:
(i) **Ballastless Track:** Throughout the length of ballastless track.
(ii) **Ballasted Track:** Curves with radius upto 500m along with transition portion but excluding locations provided with check rails. Guard rail would also cover critical locations like sub-station, column/structure etc.

(B) Tunnel with Double Tracks

(a) On approach of tunnel: 25 m from portal face outside the tunnel.

(b) Inside Tunnel: Throughout the length of tunnel but excluding locations provided with check rails.

Note:

(a) The top table of guard rail should not be lower than that of the running rail, by more than 25mm. In case of curves, the difference should be measured with reference to a straight line connecting the running tables of inner and outer rails.

(b) Fixing of Guard rails to be done as per para 228(3) above.

(c) Splaying of Guard rails need to be done on both sides in Single Line and only on facing direction in Double Line section. The non-splayed end should be bent downwards beyond the end of stipulated length of Guard rails and provided with wooden block.

(d) Derailment Guard shall be designed such that in case of derailment, the wheels of derailed vehicle moving at maximum speed are retained by the Derailment Guard.

(e) Typical arrangement of guard rail with applicable dimensions ("a" and "L2") is shown in the sketch and table in Para 228(2) above

(f) Provision of Guard rails is for ballasted track and Derailment guard for ballast less track.

229 Provision of Side Pathways and Walkways- Side Pathways shall be provided on all new girder bridges as per applicable RDSO drawings to ensure safety of maintenance staff. Possibility should be explored to provide Side Pathways on existing girder bridges also. Properly secured walkways (or inspection gangways), made of chequered plates with hole, should be provided inside the track to cover the width available between the Guard Rails, and at other suitable locations to ensure safety of maintenance staff and to facilitate inspections.

Note: For the guidance of field officials, some of the commonly used RDSO drawings for commonly used steel Channel sleepers, H Beam sleepers and fixing of Guard Rails is as per ***Annexure - 2/4 (A).*** *For detailed information, respective RDSO drawings with their latest alterations and / or Track Manual may be referred.*

Annexure - 2/4(A) (*Para 206, 210, 223, 224, 225*)

List of Commonly Used Track Fittings for the Guidance of Field Engineers.

S No	Component	Drg. No.	Description
1	Fish Plate	T-090(M)	Fish Plate For 52 Kg/M Rail.
2		T-1898	Fish Plate For 60 Kg/M Rail.
3		T-5915	Fish Plate For 52 Kg/M Rail (1 Meter Long)
4		T-5916	Fish Plate For 60 Kg/M Rail (1 Meter Long)
5	Joggled Fish Plate	T-5551	Joggled Fish Plates & Clamps for Rail-Fracture B.G. For 52 Kg.
6		EDO/T-2242 & 2243	Joggled Fish Plates For 75 mm Wide Gap A.T. Weld For 52 Kg with C.I. Block
7		EDO/T-2246 &2247	Joggled Fish Plates For 75 mm Wide Gap A.T. Weld For 60 Kg (UIC) With C.I. Block
8		T-5849	Joggled Fish Plates for Use on Welded Joint for B.G. 60 Kg.
9		T-5848	Joggled Fish Plates for Use on Welded Joint for B.G.52 Kg.
10	Combination Fishplate	T-696 to 699	Fish Plate Combination For 60 Kg (UIC) And 52 Kg
11		T-6594 to 6597	Combination Joggled Fish Plates For 60 Kg. (UIC)/52 Kg Rails with C.I. Block for B.G.
11A		RT-8533-8536 (Alt.-1)	Fishplate Combination for 60E1/UIC 60 & 52 kg (1 m long) (ACS – 9)
12	Ordinary PSC sleepers	T-2495	Prestressed Concrete Sleeper for 52 kg Rail designed for 22.9 t Axle load
13		T-2496	Prestressed Concrete Sleeper for 60kg / 52 kg Rail designed for 22.9 t Axle load
14		T-8527	Prestressed Concrete Sleeper for 60kg /136 RE Rail designed for 25.0 t Axle load
15	Slack Gauge Sleeper	RT-4183-4186	PSC Sleeper for Curve with Check Rail for 60Kg Rail
16		RT-8621-8624	PSC Sleeper for Curve with Check Rail for 136RE / 60 Kg rail for 25T Axle load
17		RT-5738 – 5740	PSC Sleeper for Curve with Check Rail for 52Kg Rail
18	Sleeper for Guard rail & Bridge approaches	RT-4088-4097	PSC Sleeper for Guard Rail on Bridge and approach
19		RT-8672-8680*	PSC Sleeper for Guard Rail Bridge and approach for 25T axle load / wider sleeper
20	Sleeper for LC	RT-4148/4148A	PSC sleeper for LC for 60/52 kg running rail & 52 kg check rail
21		RT-8671 (25t)	PSC sleeper for LC for 25T axle load
22	Sleeper for SEJ	RT-4149	PSC sleeper for SEJ
23		RT-6253	PSC sleeper for SEJ (with 300 mm max: gap) 60kg (UIC) rail on bridge approaches.
24	Sleeper for P&C	RT- 4865	Sleeper Set for 1 in 8 ½ Fan shaped layout
25		RT- 4218	Sleeper Set for 1 in 12 Fan shaped layout
26		RT- 6068	Sleeper Set for Derailing switch
27	Shallow Depth Sleeper	(RT-4852)	PSC shallow sleeper (160 mm) deep
28		RT-8326	PSC shallow sleeper with Guard Rail
29	Sleeper for Re-Railing Ramp	RT-6420-6440	PSC Sleeper for Re-Railing Ramp On 52 Kg Running Rail
30		RT-8265-8291	PSC Sleeper for Re-Railing Ramp On 60 Kg Running Rail
31	Nylon Cord Reinforced GRSP	RT-7014 to 7021	6mm thick nylon cord reinforced GRSP for placing beneath crossing portion in 1 in 12 turnouts on PSC sleepers
32	Glued Joints	RDSO/T-2572	Glued Insulated Rail Joint for B.G. 60kg (UIC)-G3(L)
33		RDSO/T-2576	Glued Insulated Rail Joint for B.G. 60kg (UIC)-G3(S)
34		RDSO/T-671	Glued Insulated Rail Joint for B.G. 52kg G3(L)
35		RDSO/T-1259	Glued Insulated Rail Joint for B.G. 52kg G3(S)
36	Steel Channel sleepers	B-1636/R2, B-1636/1/R2 and B-1636/2	Steel Channel Sleepers and its fittings

S No	Component	Drg. No.	Description
37	Fittings for Steel Channel Sleepers	RT-5155 to RT-5164	Fittings for Steel Channel Sleepers on bridges with 60 Kg running rail and 52 kg guard rail
38		RT-5197 to RT-5200	Fittings for Steel Channel Sleepers on bridges with 52 Kg running rail and 52 kg guard rail
39	H-Beam steel sleeper	No. B-1636/8	H-Beam steel sleeper for 60KG Running rail
40		RT-8240 to RT-8245	fixing of running rail on H-Beam sleeper
41	Fixing of Guard rail on ballasted Deck bridges*	*T-4088 to 4097*	PSC Guard Rail Sleeper for Use on Bridge Approach Sleepers With 60/52 Kg Running Rail & 60/52 Kg/90 R Running Rail
42		*T-8672 to 8680*	PSC Guard Rail Sleeper for *wider sleeper*

Note:

******1. Provision of guardrails on PSC sleeper for bridges on sharp curves for more than 5° curves shall be as per PSC sleeper drawing No. RDSO/T-8695 or RDSO/T-8757 (wider sleeper) having arrangement for provision of check rail along inner rail and guard along outer rail.*

2. For detailed information, respective RDSO Drawings / Track Manual to be referred.

Annexure - 2/4 (B) (*Para 206, 210, 223, 224, 225*)

(a) Some of the commonly used ERCs and their salient features

S. No.	ERC type	RDSO drawing no.	Toe load (kg)	Toe def. (mm)	Dia. (mm)	Approximate Weight (kg)
1	ERC-J	RT-8258	650	8.5	20.64	1
2	Mk- III	RT-3701	850-1100	13.5	20.64	0.91
3	Mk-V	RT-5919	1200-1500	13.5	23/20.64	1.08
4	Anti-theft	RT-6254	850-1100	13.5	20.64	0.937

(b) Some of the commonly used GRSPs

S. No.	RDSO Drawing No.	Usage
1	RT-3703	6 mm GRSP for 52 kg Rail and 52 kg Sleeper
2	RT-3711	6 mm GRSP for 52/60 kg Rail and 60 kg Sleeper
3	RT-3709	10 mm GRSP for 52/60 kg Rail and slack gauge PSC sleeper RT-4183-4186
4	RT-4218, RT-4219, RT-4220	GRSP Set for Turnout 1 in 12 - 60 kg (as contained in the three drawings of Layout Assembly, Switch and Crossing)
5	RT-4865, RT-4966, RT-4967	GRSP Set for Turnout 1 in 8.5 - 60 kg (as contained in the three drawings of Layout Assembly, Switch and Crossing)
6	RT-6068	GRSP Set for 60 Kg for Derailing Switch (as contained in the drawing of Derailing switch)
7	RT-5836	GRSP Set for 52 Kg for Derailing Switch (as contained in the drawing of Derailing switch)
8	RT-4732, RT-4733 RT-4734	GRSP Set for Turnout 1 in 12 - 52 kg (as contained in the three drawings of Layout Assembly, Switch and Crossing)
9	RT-4865, RT-4866 RT-4867	GRSP Set for Turnout 1 in 8.5 - 52 kg (as contained in the three drawings of Layout Assembly, Switch and Crossing)
10	RT-6154, RT-6155 RT-4220	GRSP Set for Turnout 1 in 12 with Thick Web Switch (TWS) - 60 kg (as contained in the three drawings of Layout Assembly, Switch and Crossing)
11	RT-6279, RT-6280 RT-4967	GRSP Set for Turnout 1 in 8.5 with Thick Web Switch (TWS) - 60 kg (as contained in the three drawings of Layout Assembly,

		Switch and Crossing)
12	RT-4159	6 mm thick GRSP for SEJ

S. No.	**RDSO Drawing No.**	**Usage**
13	RT-5163	6 mm thick GRSP for 52 Kg guard rail on channel sleeper
14	RT-5156	10 mm thick GRSP for 60 kg running rail on channel sleeper
15	RT-5199	10 mm thick GRSP for 52 Kg running rail on channel sleeper
16	GRSP 8292 to 8295	6 mm thick GRSP with horns for Turnouts (1 in 12 & 1 in 8.5)

(c) Some of the commonly used Composite GRSPs

S. No.	**Description/Usage**	**RDSO Drawing No.**	**Thickness of CGRSP**
1	For 52kg / 60 kg Rail on PSC sleeper RT-2496	RT-6618	6.2 mm
2	For 52 kg Rail on PSC sleeper RT-2495	RT-8327	6.2 mm
3	For 136RE/60 kg Rail on Wider PSC sleeper RT-8527	RT-8528	10 mm

(d) Some of the commonly used Liners

S. No.	**Rail Section**	**Sleepers meant for rail section**	**RDSO Drg. No.**	**Type of Liner**	**Colour Band**
1	52 kg	52 kg	RT-3738	Metal	
2	60 kg	60 kg	RT-3740	Metal	
3	52kg	60kg	RT-3741(GS)	Metal	Yellow
			RT-3742 (NGS)	Metal	Green
4	52 kg	52 kg	RT-3702	GFN	Pink
5	60 kg	60 kg	RT-3706	GFN	White
6	52kg	60kg	RT-3707 (GS)	GFN	Yellow
			RT-3708 (NGS)	GFN	Light Green
7	60kg	136RE	RT-8616(GS)	Metal	Blue
			RT-8617(NGS)	Metal	Brown
8	60kg	136RE	RT-6938(GS)	GFN	Light Brown
			RT-6939(NGS)	GFN	Grey
9	136RE	136RE	RT-8618	Metal	-
10	136RE	136RE	RT-6937	GFN	Sky Blue

For details of Cut liners, RDSO drawing no. RT-4322(for 52 kg rail) & RT- 4511(for 60 kg rail) may be referred

(e) Commonly used SEJs

S. No.	**RDSO Drawing No**	**Rail section**	**Maximum Design Gap**
1	RT-4160	52 Kg/m	80 mm
2	RT-4165	60 Kg/m	80 mm
3	RT- 6902	60 Kg/m	80 mm (Single Gap)
4	RT- 6914	52kg/m	80 mm (Single Gap)
5	RT- 6922	60 Kg/m	65 mm (Double Gap)
6	RT- 6930	52kg/m	65 mm (Double Gap)

Note – Combination SEJ to RDSO Drawing No. RT-6782 with 80 mm gap shall be provided between the junction of 52 Kg rail and 60 Kg rail.

CHAPTER – 3

INSTALLATION AND MAINTENANCE OF WELDED RAILS

PART – A

Alumino-Thermit Welding of Rails

301 General – Thermit welding process is used for carrying out welding of rails at site.

302 Alumino Thermit Welding of Rails – On Indian Railways Alumino-Thermic welding with short pre-heating process by using high silica sand mould (carbon dioxide dried) is being followed at present for welding rails of different chemistry and sections. Short pre-heating is done by air-petrol fuel mixture, Oxy-LPG and compressed air petrol fuel mixture.

303 Selection of rails to be welded – For both new as well as second hand rails, before welding it should be ensured that the end bends of the rails are within +0.5 mm, -0 mm in vertical and + 0.5 mm in lateral direction when checked with one metre straight edge as shown in **Fig. 3.1(a), (b) and (c)** in ***Annexure - 3/1***. Further, in case of welding of new rails as well as repair/maintenance welding, fish boltholes are to be eliminated as far as possible to make the weld amenable for USFD testing for lack of fusion.

(1) **New rails:** New rails to be welded shall conform to the tolerances stipulated in the specification IRS-T-12 (Indian Railway Specification for Flat Bottom Rails).

(2) **Second hand rails**: For conversion of existing single rails/short welded panels into SWP/LWR/CWR or during secondary rail renewal, old serviceable rails may be welded subject to the following conditions:

(a) Obsolete rail sections and rails older than 50 years shall normally not be welded. Specific approval of the CTE may, however, be obtained in special cases.

(b) The Chief Track Engineer shall satisfy himself that second hand rails have a substantial rail life to make it a safe and economical proposal.

(c) Rails shall be free from corrosion or excessive wear. The height of rail and width of railhead shall not be less than the values as indicated below.

Rail section	Normal height of new rail (mm)	Minimum height of old rail (mm)	Width of head of new rail (mm)	Minimum width of head of old rail (as measured at the gauge corner) (mm)
60 kg/m	172	163	72	66
52 kg/m	156	150	67	61

The limit of lateral wear in the rail head as mentioned in table above may be followed subject to uniform gauge without any abrupt change.

(d) Rails shall be tested before welding with Ultrasonic Flaw Detector apart from visual inspection, so that rails having cracks and internal flaws are not welded. In order to achieve satisfactory running on welded rail panels, rails with excessive scabbing, wheel burns, corrugations and wear of rail seats are not to be welded. The rail flange bottom is to be visually inspected to ensure freedom from defects like dent, notch, corrosion, etc.

(e) Even where cracks/flaws are not detected during visual/USFD examination before welding, the ends of second hand rails should be suitably cropped so as to eliminate fish bolt holes.

(f) The rail ends shall be cut by sawing or using abrasive disc cutter and not by flame cutting.

(g) Second hand rails shall be match-marked before releasing from track to enable matching of the rail ends at the time of welding. Kinks, if any, in the rails shall be removed before welding.

(h) The rolling marks on the web of rails shall be checked before welding to ensure that generally rails of different Grades of rails are not welded together. However, in unavoidable circumstances, where rails of Grade 710 (72 UTS) rail chemistry and that of Grade 880 (90 UTS) chemistry are to be welded, the portion of Grade 880 (90 UTS) chemistry shall be utilised for welding.

(i) The rail ends to be welded shall be checked and aligned both in horizontal and vertical planes to the dimensional limits given in **Fig 3.2** ***Annexure - 3/1***

304 Portion for welding – The portion used for welding shall conform to the technical requirements as mentioned in *"Indian Railway Standard Specification for Fusion Welding of Rails by Alumino – Thermic Process"*. The suitability of the 'portion' for the welding process in respect of the type and section of rails to be welded shall be ensured before commencing welding. Thermit welding portions and consumables to be used for welding shall be from RDSO approved sources only. Welding Parameters viz. preheating time, preheating pressure, mould waiting time etc., as approved by the RDSO for the particular source and particular welding technique shall be ensured, while executing the AT weld at site.

(ACS – 9)

(1) **Shelf life of portion:** No specific shelf life has been indicated for AT welding portions. The life of portions would depend on the quality of packing and storage condition. AT welding portion is sensitive to moisture. Once the portion absorbs moisture, the same cannot be removed even by drying as chemical reaction takes place in the ingredients. Such portion should not be used for welding. Portions should be used in rotation i.e. first in-first out.

(2) Notwithstanding aforesaid, in (1) above, the following procedure may be adopted for permitting use of portions beyond two years after the date of manufacturing:

(a) One sample per supplied batch shall be taken.

(b) The sample shall be tested for reaction test. If the reaction is normal, the batch represented by the sample can be used without further tests.

(c) In case the reaction is found to be quiet or boiling, a test joint should be made from one more sample selected from the batch. Following tests should be conducted on the test joints.

(i) *Weld Metal Chemistry Test*

(ii) *Load deflection test*: These tests should be conducted at Zonal CMTs organisation and/or the Flash Butt Welding Plant. If the values obtained in above tests are within the specified values as given in "*Indian Railway Standard Specification for Fusion Welding of Rails by Alumino – Thermic Process*" , the batch represented by the sample can be used, otherwise batch should be rejected.

(d) The rejected portions are to be disposed-off by igniting five portions at a time in pit away from the store.

305 Storage and transportation of Portions – The manufacturer of portion shall provide guidelines containing best safety practices with every package for guidance of the user covering various aspects in safe handling, storage, transportation and disposal of Thermit Materials. Tubes of igniters should be stored in a locked steel cupboard, or other secure steel container. On no account must these be stored in the same building as the portions. AT Portion should not be transported in passenger coaches. The package containing igniters should be kept in tin cases/steel containers. For detailed guidelines on storage and transportation, AT Welding Manual may be referred.

306 Equipment, staff and Traffic block for welding –

(1) The list of one set of AT welding equipment by short pre-heating process is given in **Annexure - 3/2**.

(2) The composition of Thermit welding team is given in **Annexure - 3/3**.

(3) A minimum traffic block of 70-75 minute duration, depending upon the type of preheating technique adopted, should be obtained for complete operation of welding and to ensure good quality of AT weld.

(4) The traffic can be allowed only after 30 minutes have elapsed after welding of the joint. Suitable speed restriction shall be imposed until the grinding operation is completed.

307 Execution of Welding and other precautions –

(1) Alumino Thermic Welding of rails may be carried out in accordance with the detailed procedure laid down in the *'**Manual for Fusion Welding of Rails by Alumino Thermic Process'***. A Thermit welding done in-situ shall be joggled fish plated with two clamps and supported on wooden blocks of length 300-450 mm until tested as good by USFD.

(2) Joggled fishplates with far end bolts shall be provided on AT welds, which have undertaken traffic equal to or more than 50% of stipulated fatigue life (GMT) of the rail.

(3) Joggled fishplate with clamps or two far end bolts on good AT welds shall be provided on banks having height 5 m or more.

(4) Joggled fish plate with clamps or two far end bolts on good AT welds shall be provided on bridges (having length of waterway as 100 m or more) and on its approaches upto 100 m length.

(5) Joggled fishplate with clamps or two far end bolts on good AT welds shall be provided on curves of 3˚ or sharper.

308 Tolerances on finished welds – All the finished joints shall be checked to ensure that the joint geometry is within the following tolerances: *(Back to **Para 311(2)**)*

(1) Vertical alignment: Variation not more than +1.0 mm, − 0.0 mm measured at the end of one metre straight edge.

(2) Lateral alignment: Variation not more than ± 0.5 mm measured at centre of one-metre straight edge.

(3) Finishing of top surface: + 0.4 mm, − 0.0 mm measured at the end of 10 cm straight edge.

(4) Head finishing on sides: ± 0.3 mm over gauge side of the rail head measured at the centre of 10 cm straight edge.

*Note: In specific cases for joint geometry in case of old rails, dispensations may be permitted by Chief Track Engineer. The method of checking the geometry of welded joints is illustrated in **Fig. 3.3** of **Annexure - 3/1.***

309 Record of joint geometry –

(1) In case of welding by outsourced agency, the details of geometry of each joint shall be jointly signed by the firm's and Railway's representative and kept as record.

(2) In case of welding by outsourced agency, any joint found not conforming to the above stipulations should be cut and re-welded, free of cost, by the firm.

(3) JE/SSE/P.Way shall maintain 'Thermit Weld Register' as per proforma given in ***Annexure - 3/4*** & shall make entries in TMS.

(4) The welded joints shall be serially numbered in a kilometre.

(5) The Repair welds/additional welds done at a later date may be given continuing weld

number in that kilometre. For example, the last Thermit weld number in a particular kilometre was 88 and subsequently a Thermit weld has been executed, it shall be numbered 89, irrespective of its location in that kilometre.

(6) Each joint shall have a distinctive mark indicating month, year of welding, agency and welder/supervisor identification code number (as appearing on his competency certificate) at non-gauge face side of AT weld on head as detailed in AT welding Manual.

310 Painting of Thermit welds –

(1) Painting of weld collar should be done on all welds to protect them against corrosion immediately after the welding.

(2) In service painting (maintenance painting) of Thermit welds should be carried as per following frequency:

(a) Once in four years in areas not prone to corrosion.

(b) Every year at locations prone to corrosion as defined in **Para 612 (1).**

(c) The frequency may be increased depending on the site conditions.

(d) On condition basis at locations which are prone to severe corrosion (areas of severe corrosion to be decided by Chief Track Engineer).

(3) The procedure for painting of weld collar for Thermit welded rail joints to protect against normal corrosion and severe corrosion is outlined in *AT Welding Manual*.

311 Acceptance tests –

(1) *Visual inspection:*

All the welded joints shall be cleaned and examined carefully to detect any visible defect like cracks, blow holes, shrinkage, mismatch, surface finish (smooth surface finish required) etc. Any joint, which shows visible defect, shall be declared defective. The bottom of the joint shall be checked by feeling with fingers as well as inspected with the help of a mirror for presence of 'fins' at the parting line of the mould. If fin is observed in any joint, the joint shall be declared defective.

(2) *Dimensional check:*

All finished joints shall be checked for dimensional tolerances, which should be within the tolerances as specified in **Para 308** above.

(3) *Ultrasonic flaw detection test:*

All the welded joints shall be ultrasonically tested as per the provisions of *'Manual for Ultrasonic testing of rails and welds*' as early as possible in any case not later than 30 days and record maintained as per **Annexure - 3/5**.

The cumulative number of AT welds found defective in ultrasonic testing and in other criteria shall be limited as per **Clause 7.3.1** of *AT Welding Manual***.**

For upgraded AT welding techniques approved in terms of Part E of IRS: T-19, cumulative number of failed AT welds in ultrasonic testing and in other criteria shall be limited as per C**lause 7.3.1.1** of *AT Welding Manual***.**

Subsequent USFD testing of AT welds shall be done as per the provisions given in "*Manual for Ultrasonic Testing of Rails and welds***".**

PART – B

Flash-Butt Welding of Rails

312 General – Flash butt welding uses the principle of softening of interface by electric current and then butting the rail ends under pressure for welding. In Indian Railways, flash butt welding is done by Stationary flash butt welding plant or by mobile flash butt welding plant.

Weld Parameters for different rail sections/chemistry have been prescribed by manufacturers and are unique to the particular welding plant. These shall be approved by RDSO in accordance with **Para 5.6** of **"***Manual for flash butt welding of rails***".** Should any change in these Parameters be considered necessary, it shall be approved by RDSO. The welding operators are also to be certified by prescribed authority.

313 Rail Welding by Stationary Flash Butt Welding plant – These are used in rail manufacturing plants and in Flash Butt welding Depots of Indian Railways. It is necessary to get requisite approval from RDSO for the QAP and welding Parameters for the rail section and plant being used. Competency certificate to welding operators shall be granted by Chief Track Engineer.

314 Rail Welding by Mobile flash butt welding plant –

(1) Flash butt welding of new or second hand rails shall be carried out as per detailed procedure given in **"***Manual for Flash Butt Welding of Rails***"**, which gives the details of type and suitability of rails to be welded, pre-welding inspection, preparation of rail ends, procedure of execution of welding, finishing of welded joints, acceptance tests etc.

(2) Quality Assurance Program for mobile flash butt welding shall be got approved from RDSO as detailed in **Annexure - X** *of Manual for Flash Butt Welding of Rails*. After having obtained approval of QAP from RDSO, approval for field welding shall be granted after execution of 30 welds on track (carried out in two shifts), if they satisfy the weld acceptance criteria defined in **Para 5.6.4.1, 5.6.4.4, 5.6.4.5, 5.6.4.6, 5.6.4.7, 5.6.4.8 and 5.6.4.10** of *Manual for Flash Butt Welding of Rails*, (visual, dimension, ultrasonic, hardness, transverse testing, macro and micro examination). In case of Flash butt welding work of Zonal Railway, this shall be carried out in presence of Engineer in-charge and the approval shall be granted by Chief Track Engineer/ Chief Engineer Construction. The welding operators are also to be certified by prescribed authority.

315 Suitability of rails for welding – For suitability of old/new rails for flash butt welding, **"***Manual for Flash Butt welding of Rails***"** should be referred.

316 Acceptance Tests –

(1) *Visual Inspection:*

All welds and rails shall be inspected visually for welding, trimming, clamping or profile finish imperfections, such as tears, cavities, cracks, damage and thermal damage, in particular, in the electrical contact areas.

(a) There shall be no sign of tearing, chisel mark or cavity in weld metal due to trimming and upset shall not be raised more than 3 mm and there shall be no depression in accordance with **Annexure - IV-A & B** of *Manual for Flash Butt Welding of Rails*, as applicable.

(b) Step across the weld: All the welds shall be measured in as welded condition to determine step across the weld. No step shall be permitted except as provided in **Para 3.3.3 and 3.3.4** of *Manual for Flash Butt Welding of Rails***.**

(2) *Dimensional Check:*

Finished weld samples shall be checked for weld geometry and shall conform to tolerance laid down as per following.

Finishing Tolerances for Welds with New Rails

S. No.	Parameter	Value
1	Vertical misalignment	At the centre of a 1 m straight edge +0.3mm -0.0 mm
2	Lateral misalignment	± 0.3 mm at the centre of a 1 m straight edge
3	Head finishing (in width)	Side of rail head should be finished to ± 0.25 mm on gauge side at the centre of 10 cm straight edge
4	Finishing of top table surface	At the centre of 10 cm straight edge + 0.2 mm - 0.0 mm
5	Web zone (under side of head web, top of base, both fillet each side)	+ 3.0 mm of the parent contour - 0.0 mm
6	Upper sides, under surfaces and edges of rail foot shall be ground smooth. The edges of foot should be rounded and bottom of rail foot ground smooth without any minus tolerances to ensure proper seating on sleepers, unhindered movement of welded panels on end unloading rakes, avoid damage to elastic rail pads and eliminate stress riser.	

Finishing Tolerances for Welds with Old Rails

S. No.	Parameter	Value
1	Vertical misalignment	± 0.5 mm at the centre of a 1 m straight edge
2	Lateral misalignment	±0.5 mm at the centre of a 1 m straight edge
3	Head finishing (in width)	± 0.3 mm on the gauge side at the centre of a 10 cm straight edge
4	Finishing of top table surface	± 0.2 mm at the centre of a 10 cm straight edge
5	Web zone (under side of head web, top of base, both fillet each side)	+ 3.0 mm, -0.0 mm of parent contour
6	Upper sides, under surfaces and edges of rail foot shall be ground smooth. The edges of foot should be rounded and bottom of rail foot ground smooth without any minus tolerances to ensure proper seating on sleepers, unhindered movement of welded panels on end unloading rakes, avoid damage to elastic rail pads and eliminate stress riser.	

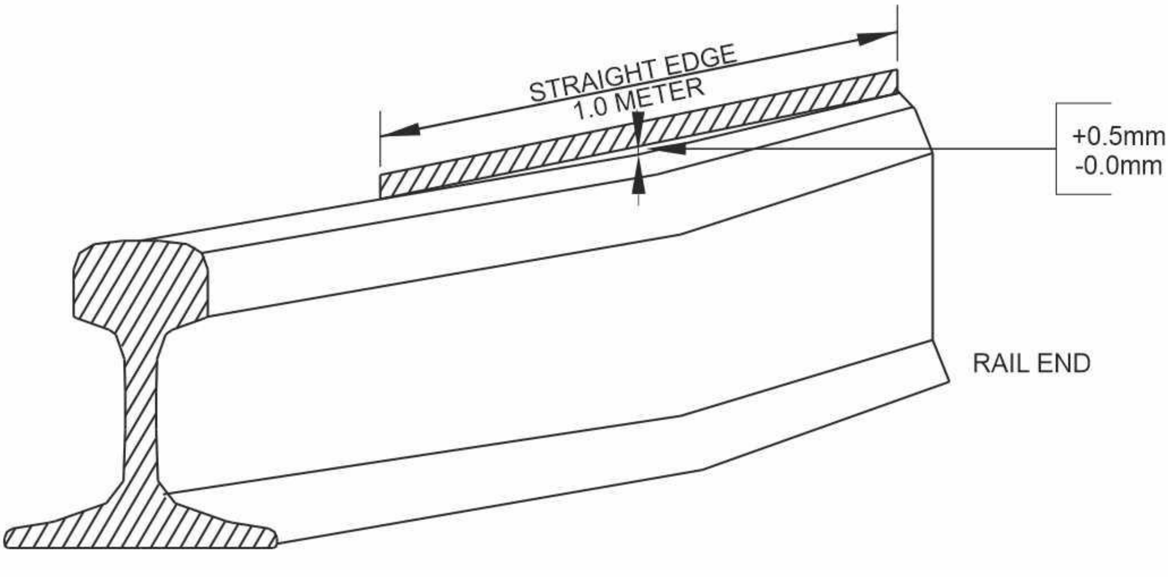
Note: The above tolerances are finished tolerances of welds inclusive of tolerances of rail.

(3) *Ultrasonic test:*
All Flash Butt welds made in Flash Butt Welding Plants shall be subjected to USFD Testing using Phased Array Ultrasonic Testing (PAUT) method for detecting internal flaws. All Flash Butt Welds made in field shall be subjected to ultrasonic testing by USFD machine preferably using Phased Array Ultrasonic Testing method for detecting presence of internal defects in the weld. Testing shall be done by trained personnel as per the procedure laid down in **"***Manual for Ultrasonic testing of rails and Welds*" and Procedure Order issued by RDSO. Results shall be maintained as per proforma given in ***Annexure - 3/5*** and entries made in TMS. Defective joint shall be distinctly marked and shall be cut & removed before panel is laid in track.

(4) **Lab tests:**
Hardness test, Transverse load test, Macro examination and Micro examination shall be conducted as per procedure and frequency prescribed in the "*Manual for Flash Butt Welding of Rails*".

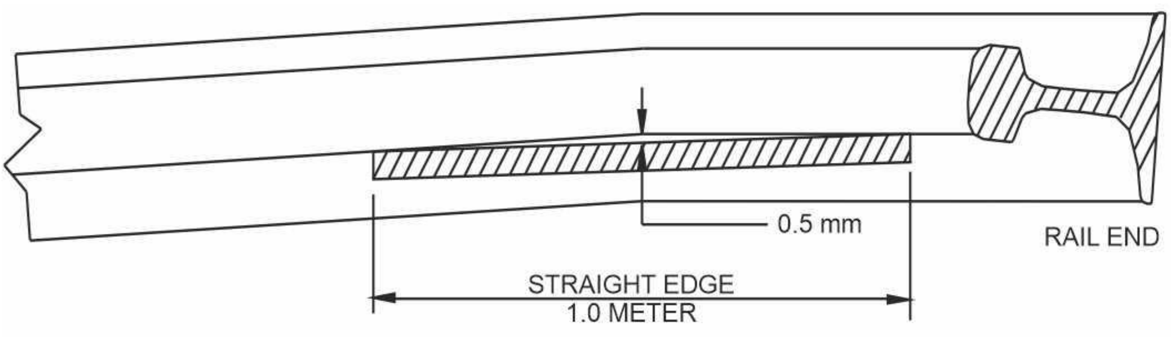
Note: *In case a sample joint does not comply with the requirements of the test, two more sample joints will be made and tested. If both the sample joints meet the requirements of the tests, welding may continue. In case of failure of any of the retest joints, RDSO should be consulted for investigation and fixing revised welding Parameters for the F.B welding plant.*

Annexure - 3/1 (*Para 303, 308*)



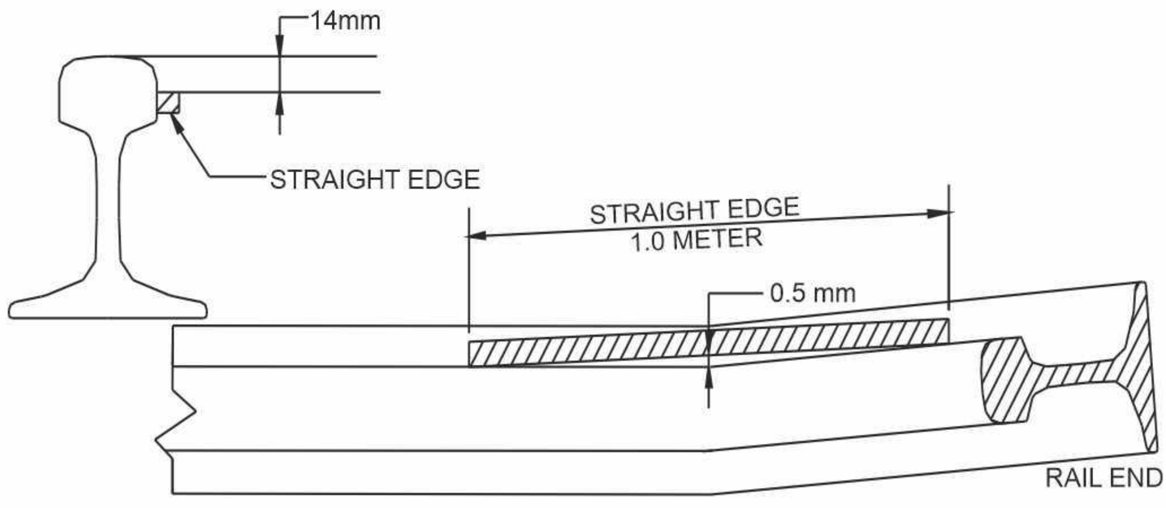
ELEVATION

FIG: 3.1(a) Tolerance on the End Bends in the Vertical Plane



PLAN

FIG: 3.1(b) Tolerance on the End Bends in the Horizontal Plane



PLAN

FIG: 3.1(c) Tolerance on the End Bends in the Horizontal Plane

Annexure - 3/1 (*Para 303, 308*)

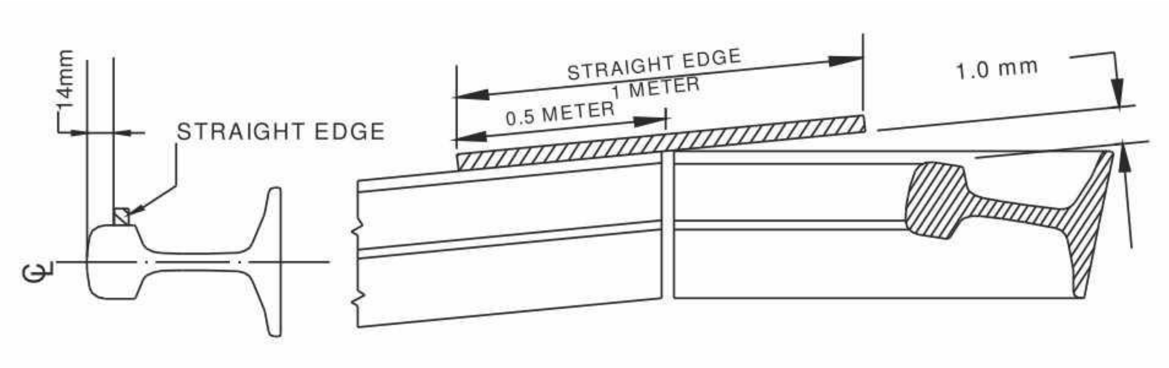


FIG: 3.2(a) Tolerance for Lateral Misalignment at the Time of Welding

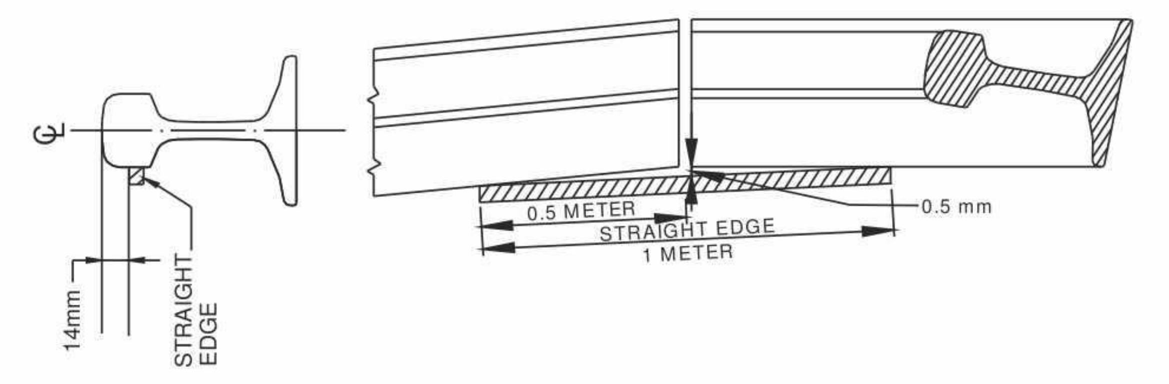


FIG: 3.2(b) Tolerance for Lateral Misalignment at the Time of Welding

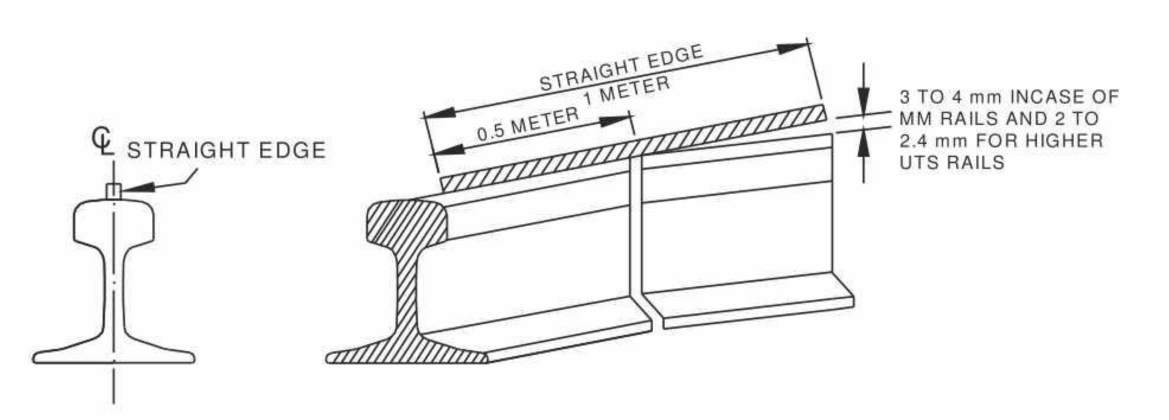


FIG: 3.2(c) Tolerance for Vertical Alignment at the Time of Welding

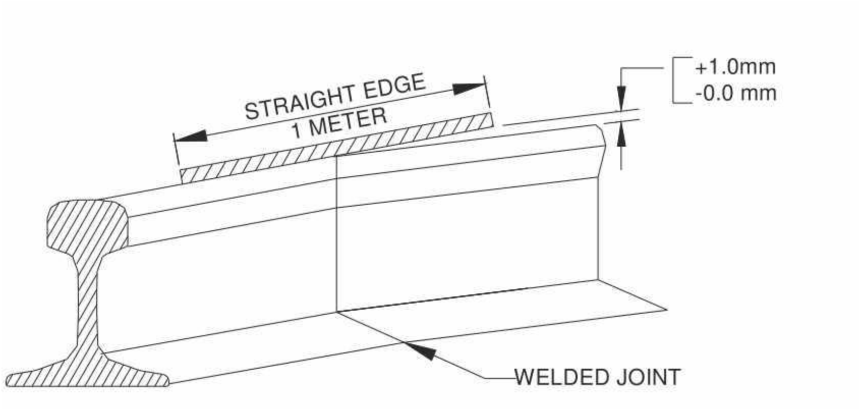


FIG: 3.3(a) Tolerance for Vertical Misalignment of Welded Joint

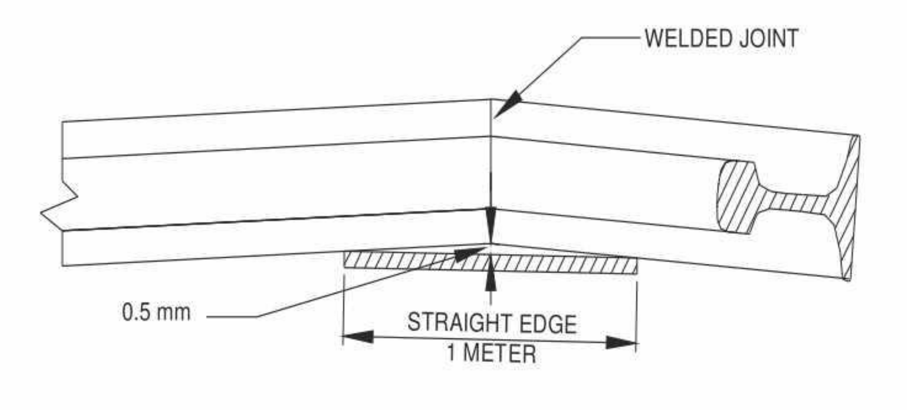


FIG: 3.3(b) Tolerance of Lateral Misalignment of Welded Joint

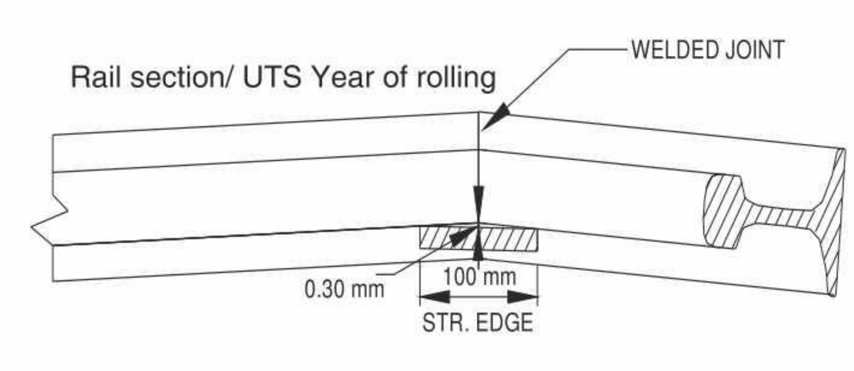


FIG: 3.3(c) Tolerance for Finishing on Sides of Head of Welded Joint

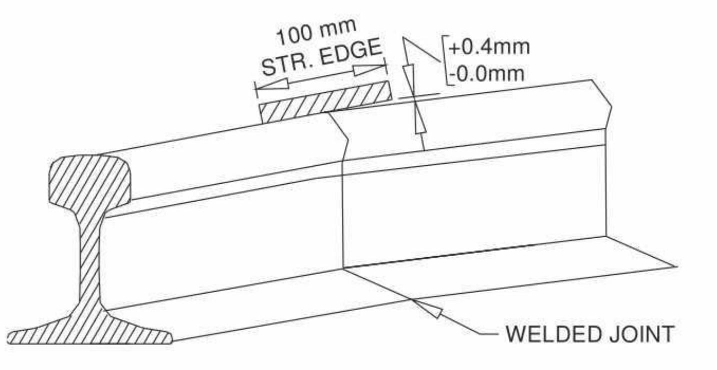


FIG: 3.3(d) Tolerance for Finishing Top Table Surface of a Welded Joint

Annexure - 3/2 (*Para 306*)

List of Equipment for Alumino – Thermic Welding of Rail Joints by Short Preheating Process per Welding Team

S. No.	Description	Quantity		Life in terms of No. of joints
		Mass welding	Repair welding	
A.	PRE-HEATING EQUIPMENT			
A1.	Air- Petrol Pre-heating			
1.	Pressure tanks with pressure gauges complete	2 Nos.	1 No.	500
2.	Vaporisers (burner) complete	2 Nos.	1No.	500
3.	Nozzle prickers	4 Nos.	2 Nos.	50
4.	Nozzle keys	1 No.	1 No.	500
5.	Vaporiser stand	2 Nos.	1 No.	1000
6.	Goose neck attachment to vaporiser	4 Nos.	2 Nos.	50
A2.	Compressed Air-Petrol Pre-heating			
1.	Suitable compressor system with pressure gauges	2 Nos.	1 No.	Periodical maintenance half yearly 500
2.	Torch (Burner) complete	2 Nos.	1 No.	300
3.	Torch (burner) keys	1 No.	1 No.	500
4.	Torch (burner) stand	2 Nos.	1 No.	1000
5	Goose neck attachment to vaporiser	4 Nos.	2 Nos.	50
A3.	Oxy- LPG Pre-heating			
1.	Oxy- LPG torch (burner)	2 Nos.	1 No.	150 – 200
2.	Oxygen cylinder with pressure gauge	2 Nos.	1 No.	100
3.	LPG cylinder with pressure gauge	2 Nos.	1 No.	100
4.	Torch (burner) stand	2 Nos.	1 No.	500
5.	Connecting Hose pipe	4 Nos.	2 Nos.	75 – 100
B.	OTHER EQUIPMENT			
1.	Crucible complete – Crucible shell & Crucible lining	2 Nos.	1 No.	500 & 50
2.	Crucible caps	2 Nos.	1 No.	50
3.	Crucible forks	2 Nos.	1 No.	500
4.	Crucible stands	2 Nos.	1 No.	1000
5.	Crucible rings	2 Nos.	1 No.	500
6.	Mould pressure (clamp)	2 sets	1set	1000
7.	Cleaning rod round	2 Nos.	1 No.	500
8.	Tapping rod	1 No.	1 No.	1000
9	Straight edge 1 m long	2 Nos.	1 No.	–
10.	Straight edge 10 cm. long	2 Nos.	1 No.	–
11.	Aluminium/steel rod for thermal plugging	2 Nos.	2 Nos.	–
12.	Leather washers for pump	4 Nos.	2 Nos.	100
13.	Gap gauges and height gauge	2 Nos.	1 No.	–
14.	Filler gauge	2 Nos.	1 No.	–
15.	Tools for punching the marking	2 Sets.	1 Set	–
16.	Mould shoes	6 Pairs	2 Pairs	100
17.	Stop watch	1 No.	1 No.	–
18.	Pyrometer/Thermal chalk for measurement of rail temperature	1 No.	1 No.	–
19.	Wooden wedges for rail alignment	24 Nos.	12 Nos.	–
20.	First aid box filled with medicines bandages, cotton etc.	1 No.	1 No.	–
21.	Mirror 150 x 100 mm with handle	2 Nos.	1 No.	–

S. No.	Description	Quantity		Life in terms of No. of joints
		Mass welding	Repair welding	
22.	Tool box containing –			
i)	Hot sets (chisels) (for Emergency use only)	2 Nos.	2 Nos.	–
ii)	Funnel tin (for pouring petrol)	1 No.	1 No.	–
iii)	Adjustable spanner	1 No.	1 No.	–
iv)	Hammer 1 kg	1 No.	1 No.	–
v)	Sledge hammer double panel 5 kg.	2 Nos.	2 Nos.	–
vi)	Steel wire brush	1 No.	1 No.	–
vii)	Blue goggles	2 Pairs.	1 Pair.	–
viii)	Paint brush 50mm	1 No.	1 No.	–
ix)	Slag container (bowl)	2 Nos.	1 No.	500
x)	Asbestos gloves	4 Pairs.	2 Pairs.	500
xi)	Hose clips	4 Nos.	4 Nos.	–
xii)	Pliers	1 No.	1 No.	–
xiii)	Rail file 350 × 40 × 6 mm (For Emergency use only)	4 Nos.	2 Nos.	–
23.	Weld trimmer(Cutter)	1 No.	1 No.	100
24.	Insulation hood for control cooling(for 110 UTS rail welding)	1 No.	1 No.	–
25.	Rail profile guided grinding trolley (Grinding wheel).	1 No.	1 No.	50
26.	To ensure quality, protective clothing, shoes gear & Leather gloves.			

Note:

1. *For crucible lining, Magnesite powder and sodium silicate should always be available.*
2. *Expected life of the equipment has been given as guide lines for initiating action for procurement by zonal railways depending upon their requirement. The expected life of various equipment may vary depending upon site conditions and its use.*
3. *The items for which, expected life has not been given, they should be replaced on condition basis.*
4. *Tools and equipment viz. Pre-heating arrangement, Crucible and Mould used for A.T welding shall be as per the Approved A.T welding technique of a particular firm by RDSO. Also, critical process timing viz. Preheating time, tapping time, mould waiting time, time for passage of First train on AT weld etc. shall be followed as per the approved AT welding technique.*

Annexure - 3/3 (*Para 306*)

Composition of Thermit Welding Team (Compressor Tank- Wise)

S. No.	Designation	Numbers
1	Welder Grade I/Grade II	1
2	Welder Grade III/Skilled Artisan	2
3	Helper Khalasi/Khalasi	5
4	Trackman	As per work load

Note: The composition of welding team has been framed taking into account that trimming and grinding operation would be done by weld trimmer and rail profile grinder.

<u>Annexure - 3/4</u> (*Para 309*)

Proforma for Thermit Weld Register

S. No.	Date of Welding	Location details					Rail		Bolt hole distance (mm)
		Block Stn.	Cess/ In-situ	Km TP	U/D	L/R	Section	UTS	
1	2	3					4		5

Portion details				Welding details			
Agency code	Batch No.	Portion No.	Date of Manufacturing	Agency code	Process	Supervisor code	Welder code
6				7			

Weld No.	Block time		Average temperature during welding	If rail tensor is used for welding, whether equalization of forces done (Yes/No)	Date of finished grinding	Dimensional tolerances on finished joint				USFD testing after welding	
	From	To				On 1m		On 10cm		Date	Result (Pass/ Failed)
						Lateral	Vertical	Top	Side		
8	9		10	11	12	13				14	

In service failure details		Test joint date removed	Replacement Weld Reference				Sign. of JE/SSE P.Way Welding	Date of sending test joint with reference
			Weld 1		Weld 2			
Date	Type		S. No.	Date	S. No.	Date		
15		16	17				18	19

Test joint results									Chainage of weld	Reference point for Chainage
Date of receipt of results with reference	Hardness (BHN)			Transverse load		Porosity %	Date of marking 'X' for extended guarantee	Remarks		
	Rail	Weld	HAZ	Load	Deflection (mm)					
20									21	22

Annexure - 3/5 (*Para 311, 316*)

Ultrasonic Testing of Welded Joints

1. Date/Month/year
2. Details of Weld
   (Joint No, Km / Chainage / LR / RR /
   UP / DN / Line No etc.)
3. Name of Operator
4. USFD testing Machine used (make, model, serial number)
5. Rail section & chemistry
6. Day / Night shift
7. Result of testing
8. If defective, details of flaw Defective zone Head/Web/Foot
9. Probe wise USFD peak pattern.
10. Remarks
11. Signature

Summary (at the end of the month)

No. of joints welded during the month (Rail section-wise)

No. of joints tested (Rail section-wise)

No. of joints found defective (Rail section-wise)

PART – C

SHORT WELDED RAILS

317 General – SWR shall be laid generally on stable and efficiently drained formation. 100 mm extra width of shoulder ballast over and above the standard ballast section on tangent track shall be provided on outside of curves upto 875 metre radius. In case of sharper curves, the extra width shall be 150 mm. In case of 60 kg/m Rails, LWR profile shall be adopted.

318 Condition of Laying –

(1) *Alignment* – SWR on PSC sleepers shall not be laid on curves sharper than 440 metre radius.

Existing SWR laid on sharper curves may, however, be allowed to continue if there is no difficulty experienced in maintaining these lengths. Chief Track Engineer's approval should be taken in such cases.

(2) *Junction with insulated joints and points and crossings* – SWR butting against insulated joints, heel of crossing and stock rail joints, shall be anchored for a length of 39 metre on the approach effectively to arrest creep in either direction.

(3) Regarding laying of SWR in Level Crossings and Bridges refer ***Para 918** and **Para 226.***

319 Laying of Short Welded Rails – The gaps to be provided for SWR at the time of laying shall be in accordance with *Table 1* depending on the installation temperature **(t_i)** and the Zone in which the rails are laid. *(Back to **Para 226 (3) (c), 320(5), 715**)*

TABLE 1

Initial Laying Gaps for SWR for Various Installation Temperatures

For Zone I and II		
Rail temperature at the time of installation (ti)	**Initial laying gaps (in mm)**	
	For 39 m panels	**For 26 m rolled rails**
t_m- 17.5°C to t_m - 12.6°C	12	10
t_m - 12.5°C to t_m - 7.6°C	10	9
t_m - 7.5°C to t_m - 2.6°C	8	7
t_m - 2.5°C to t_m + 2.5°C	6	6
t_m + 2.6°C to t_m + 7.5°C	4	5
t_m + 7.6°C to t_m + 12.5°C	2	3
For Zone III and IV		
t_m - 22.5°C to t_m - 17.6°C	12	10
t_m - 17.5°C to t_m - 12.6°C	10	9
t_m - 12.5°C to t_m - 7.6°C	8	7
t_m - 7.5°C to t_m - 2.5°C	6	6
t_m - 2.4°C to t_m + 2.5°C	4	5
t_m + 2.6°C to t_m + 7.5°C	2	3

Note:

If the laying has to be done outside the temperature range given in table above, or whichever joint gaps could not be provided as per the table, readjustment of gap shall be carried out within two days of laying before the track consolidates. Along with the gap adjustment, any re-spacing of sleepers, if required, must be carried out.

320 Gap Survey and Adjustment of Gap – (*Back to **Para 226 (3), 620***)

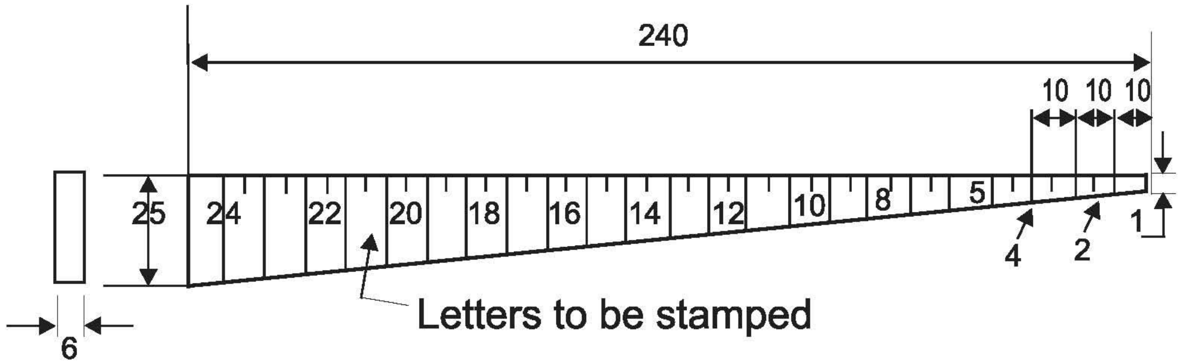
(1) *General* – Gap survey and rectification of gaps is to be carried out, in stretches where track develops excessive creep, jammed joints, sun kinks, misalignment, wide gaps, battered and hogged joints, fractures at joints and bending of bolts etc. In SWR, the gap survey and adjustment should normally be done before the end of February once a year (i.e. before onset of summer).

(2) *Gap survey* – (Back to **Para** ***322(3)(c)***)

(a) The gap survey shall be conducted on a clear and sunny day in the cool hours of the day in rising rail temperature trend.

(b) The length over which gap survey is to be done should, wherever possible, be divided into suitable sub-sections, each bounded by fixed points such as level crossings, points and crossings etc. The survey should be completed during as short a time as possible, by employing adequate number of parties so that the rail temperature is not likely to vary appreciably.

(c) The joint gaps shall be measured by taper gauge in mm (shown below) and the readings entered in the proforma as shown in ***Annexure - 3/6***.



TAPER GAUGE
Fig. 3.4

(3) *Recommended range of value of gaps* **–** The recommended range of value of gaps (in mm) during service for various ranges of rail temperature is indicated in the Table-2 given below:

Table – 2

Rail Temperature During Gap Survey	Permissible Values of gaps (in mm)	
For Zone I and II		
	For 39 m panels	**For 26 m rolled rails**
t_m - 17.5°C to t_m - 12.6°C	11-14	8-13
t_m - 12.5°C to t_m - 7.6°C	9-13	6-11
t_m - 7.5°C to t_m - 2.5°C	7-11	5-10
t_m - 2.4°C to t_m + 2.5°C	5-9	3-8
t_m + 2.6°C to t_m + 7.5°C	3-7	2-7
t_m + 7.6°C to t_m + 12.5°C	1-5	1-5
For Zone III and IV		
t_m - 12.5°C to t_m - 7.6°C	11-14	8-13
t_m - 7.5°C to t_m - 2.6°C	9-13	6-11
t_m - 2.5°C to t_m + 2.5°C	7-11	5-10
t_m + 2.6°C to t_m + 7.5°C	5-9	3-8
t_m + 7.6°C to t_m + 12.5°C	3-7	2-7
t_m + 12.6°C to t_m + 17.5°C	1-5	1-5

(4) *Calculations for adjustment –*

The average of the measured gaps is worked out as shown in the proforma for gap survey **(*Annexure - 3/6*)**. A comparison of the results of the gap measurements recorded and the permissible values of gap (concerned range for gap) given above will lead to one of the following cases**:**

Case 1 – Average gap is within the recommended range, but some of the individual gaps fall outside the range.
Case 2 – Average gap falls outside the recommended range.
Case 3 – Average gap as well individual gaps fall within the range.

(5) *Action to be taken* – The action to be taken is as follows –

Case 1 –

Rectification work should be restricted to correcting the individual gaps, which falls outside the recommended range.

Under no circumstances, adjustment shall be done by cutting a rail or introducing a longer rail.

Case 2 –

The joint gaps shall be systematically adjusted from one end to the other end of the sub-section.

The rails shall be unfastened over convenient length, the gaps adjusted to the initial laying gaps as per ***Para 319*** and rails fastened.

In this case, introduction of a longer or shorter rail might be required.

Case 3 –

No action is to be taken

(6) As far as possible, the day chosen for rectification should be a day on which the rail temperature is not likely to vary much during rectification period.

PROFORMA FOR GAP SURVEY AND RECTIFICATION OF GAPS

Between stations Nawabpalem and Nidadavole Down line
Between Km 551/13-551/0
Rails 52 Kg on PRC Sleeper M + 7 Density
Mean annual rail temperature t_m
T_m = 38°C Zone II

Survey Details
Date 28th February 1981
Time: 12.00 hrs

Average rail temperature 45°C (t_m +7) during gap survey

Rail temperature –
At start - 44°C
At Close - 46°C

Recommended range of gap for 45°C noted at the time of survey
As per Table-2: 5-9 mm

Adjustment details –
Date 2nd March 1981 Time: 4.30 Hrs

Rail Temperature
At Start: 40°C, close: 45°C
Average temperature: 42.5°C (tm +4.5°C)

To be adjusted to the gap as shown in Table-1 = 4mm

Location and description of immovable point	Sr. No. of Joints	Gap in mm.		Action taken with JE/SSE/P.Way initials and date	Adjusted Gap in mm.	
		Left	Right		Left	Right
Girder Bridge at Km 551/13	1	15	11	Gaps systematically adjusted from one	4	4
(First Fix Point)	2	14	9	end to the other end and by providing	4	4
	3	17	14	a longer rail on 2nd March1981 and gap	4	4
	4	14	15	adjusted to 4 mm.	4	4
	5	10	15		4	4
	6	15	15		4	4
	7	17	14		4	4
	8	17	12		4	4
	9	16	10		4	4
	10	14	9	(Sd/-)	4	4
	11	11	6	JE/SSE/P.Way	4	4
	12	8	10		4	4
	13	11	12		4	4
	14	5	9		4	4
	15	13	12		4	4
	16	8	13		4	4
	17	15	15		4	4
	18	12	14		4	4
	19	14	14		4	4
	20	15	14		4	4
	21	13	16		4	4
	22	14	14		4	4
	23	15	17		4	4
Km 551/0	24	18	20		4	4
(Second Fix Point)	25	19	10		4	4
	26	20	20		4	4
	Total	359	340		104	104
	Average	13.8	13.1			
		This fall in case 2				

321 Counteraction and Adjustment of Creep –

(1) *General* –

Rails have a tendency to move gradually in the direction of the dominant traffic. It is believed to be caused by the 'ironing out' of yielding track by the moving load, augmented by braking loads, and by the impact of the wheels on the running-on ends of the rails, particularly at times when they are in a state of expansion or contraction. Among the troubles caused by 'creep' are –

- (a) Sleepers getting out of square.
- (b) Distortion of gauge.
- (c) Loosening of joints.
- (d) Shearing and breaking of bolts and fishplates.
- (e) Buckling in extreme cases.

(2) *Causes for creep in track* –

The following are some of the avoidable causes to which creep is attributed:

- (a) Inadequate toe loads of the fastening and rails not secured properly to sleeper.
- (b) Inadequate ballast resistance to the movement of sleepers due to poor or insufficient ballast or other causes.
- (c) Inefficient or badly maintained rail joints.
- (d) Improper expansion gaps.
- (e) Damaged sleepers, uneven spacing of sleepers.
- (f) Lack of proper drainage.
- (g) Yielding formation.
- (h) Loose/uneven packing.

(3) *Precautions to reduce creep* – (*Back to* ***Para 322 (3) (d)***)

The PSC sleepers with effective elastic fastenings are considered as creep resistant and therefore no other creep anchors are required. In case, excessive creep is observed on PSC sleeper road, the condition of elastic fastenings, sleepers and adequacy of ballast resistance should be examined. Action for replacement/ renewal of fittings, sleepers and providing adequate ballast resistance etc. should be taken as necessary.

(4) *Creep Record* –

Creep records should be maintained in the proforma given in ***Annexure - 3/7***. Entries should be complete as regards kilometerage, section and length of rail, sleeper density. Periodical readings of creep should be recorded in TMS in the prescribed pro forma. Frequency of recording of creep should be specified by the Divisional Engineer taking into consideration the rate of creep. The Assistant Engineer should test check the record frequently, particularly sections which are prone to creep.

(5) *Creep indicator posts* – (*Back to* ***Para 715***)

Creep indicator posts, square to the track should be erected on either side of the track on the cess at suitable intervals of not more than one km apart. These may be unserviceable rail posts with chisel mark square to the joints. The top of the post should be about 25 mm above the rail level and the amount of creep one way or the other measured with a fishing cord stretched over the chisel marks.

(6) *Permissible amount of creep* –

Creep in excess of 150 mm shall not be permitted.

(7) *Adjustment of creep* –

Adjustments of creep should be carried out in the following manner:

(a) It is a good practice to adjust creep before the commencement of summer. It is desirable to pull back the rails during the cool hours of the day.

(b) Careful measurement of expansion gaps, as existing, should be done and appropriate length, which can be dealt with in one operation should be chosen. The total amount of gap in the length should be equal to the standard expansion gap required for the temperature at the time, multiplied by the number of joints in the length.

(c) Work should start at the running-on end of the length, commonly just beyond the points and crossings or level crossings. The work of creep adjustments should be carried out under the protection of engineering signals by the JE/SSE/P.Way as envisaged in ***Para 806 (1)*** or under traffic block***,*** on busy routes***.***

(d) When the value of total gap existing is more than the standard expansion gap required for the temperature at the time of adjustment multiplied by the number of joints, it is necessary to provide closure rails. When closure rails are put in, a speed restriction of 30 Kmph should be imposed, which should be removed, when closure rail is changed.

Annexure - 3/7 (*Para* 321)

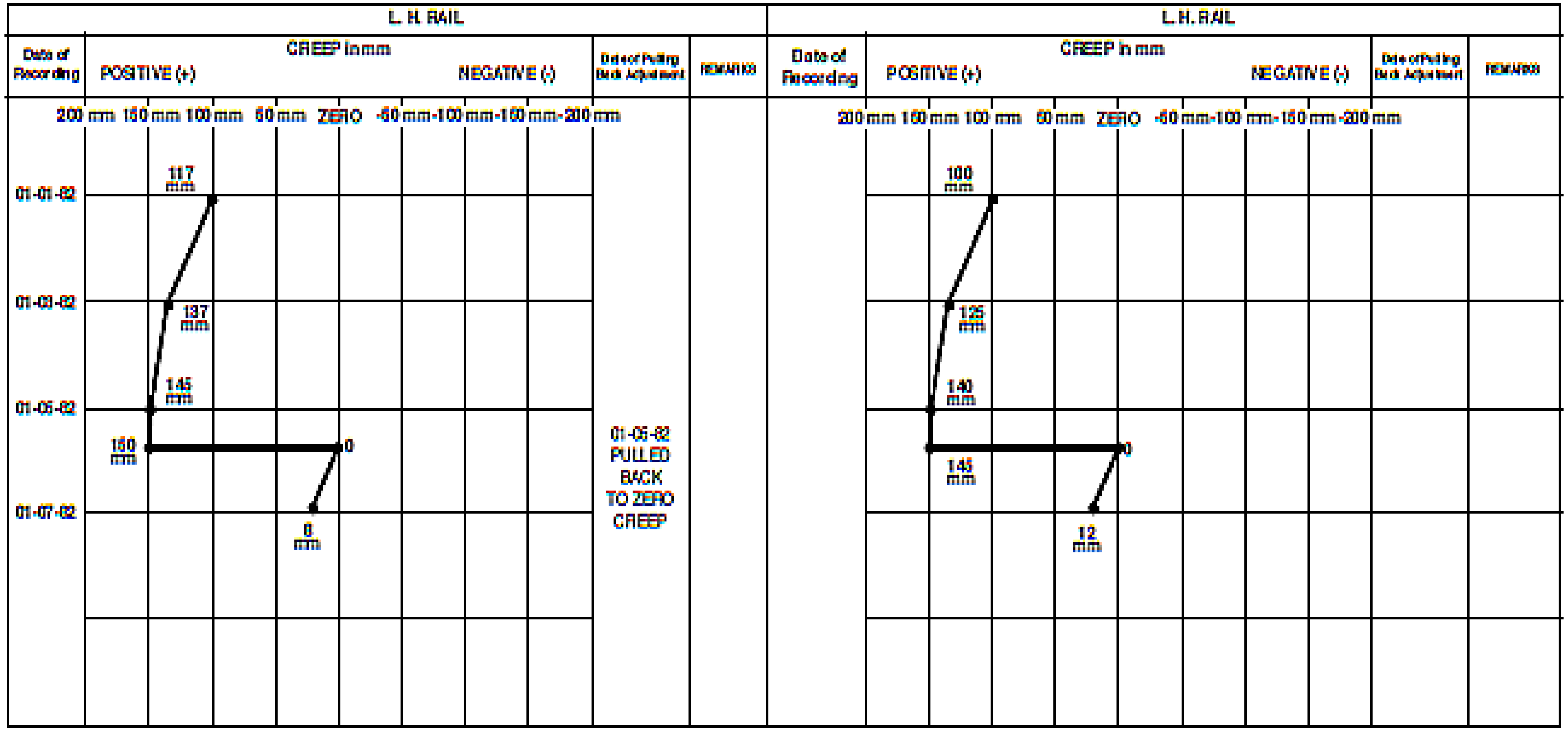
Proforma of Creep Register

Section ______________________________ Kilometre ______________________________

Up-Down Line ______________________________ Details of Sleeper & Fittings ______________________________

Particulars of Rail & Fittings ______________________________ Any Special Feature ______________________________

Details of Anchors Provided ______________________________



322 Buckling of Track (other than LWR) –

(1) *General* – Buckling of track occurs when high compressive forces are created in the rails associated with inadequacy of lateral resistance in the track at the place. A special watch should be kept on the junction of two stretches of track, one liable to creep and the other held against creep. As one side of such a junction point is held firmly against creep, the movement of rails due to creep from the other side is resisted resulting in heavy compressive force being exerted, which will tend to buckle the track. Jammed rail joints at such junctions are therefore an indication of the track being subjected to undue strain.

(2) *Conditions, which induce Buckling* –

(a) The following conditions create high compressive forces in the rail:

(i) Inadequate expansion gaps,

(ii) Failure to counteract creep in time.

(iii) Non-lubrication of rail joints,

(b) The lateral resistance gets impaired due to inadequacy of ballast and due to carrying out of operations such as deep screening, lifting of track and slewing of track, without adequate precautions.

(3) *Precautions against Buckling* – It should be seen that –

(a) Operations, which impair the lateral resistance of track, are not carried out when rail temperatures are high.

(b) The greasing of fishplates is done before the hot weather sets in.

(c) The joint gap survey is done in the case of SWR and adjusted before the onset of hot weather as per ***Para 320(2)*****.** Similarly, in case of free rail track, joint gaps should be adjusted wherever necessary.

(d) Adequate precautions are taken to reduce creep as detailed in ***Para 321(3).***

(e) Over tightening of fish bolts is avoided, but they should be reasonably tight.

(f) Particular attention is also paid to stretches of track, one liable to creep and the other held against creep *(refer Para above).* Jammed joints at such junctions call for remedial measures.

(g) Adequate shoulder ballast should be provided at all places.

(4) *Action on buckling of track* –

If a buckling does occur or appears imminent, the track should be protected immediately with hand signal flags and detonators as per the protection rules laid down. The buckled rails shall preferably be cut adequately apart not less than 6.5 metres. The track shall then be slewed to the correct alignment and cut rails of the required length shall be inserted to close the gaps making due provision for welding of joints on both rails.

The cut rails shall then be connected by use of special fishplates and screw clamps and the line opened to traffic with speed restriction. It may not be possible to do any more until the temperature drops when the joints must be adjusted. Particular care must be taken to see that the factors, which contributed to the buckling i.e. jammed joints, seized fishplates or shortage of ballast, receive appropriate attention without delay.

323 Conversion of SWR into LWR – Wherever conditions permit, conversion of SWR into LWR should be considered. The following additional precautions should be observed when converting SWR into LWR –

(1) The rails shall be tested ultrasonically and all defective rails replaced before conversion into LWR.

(2) Rail ends which are hogged or battered or have a history of cracks in bolthole region, shall be cropped before conversion into LWR.

324 Maintenance of Short Welded Rails – (*Back to **Para 609***)

Regular maintenance operation –

(1) Regular track maintenance operations like packing, lifting, aligning, local adjustment of curves, screening of ballast other than deep screening and scattered renewal of sleepers may be carried out without restriction when the rail temperature is below t_m + 25°C in the case of zone I & II and t_m + 20°C in the zone III and IV. However, on curves of less than 875 metre radius in Broad Gauge or yielding formation, the above temperature limit shall be restricted to t_m + 15°C in the case of Zone I and II and t_m +10°C in the case of Zone III and IV.

(2) If the maintenance operations have to be undertaken at temperature higher than that mentioned above in ***Sub-Para (1) above,*** not more than 30 sleeper spaces in one continuous stretch shall be opened, leaving at least 30 fully boxed sleeper spaces between adjacent lengths which are opened out. Before the end of the day's work, it shall be ensured that the ballast is boxed up.

(3) As an additional precaution, during summer months, to be specified by the Chief Engineer, for attention to run down track, even if temperature is less than the temperature specified in ***Sub-Para (1) above,*** not more than 30 sleeper spaces in one continuous stretch shall be opened, leaving at least 30 fully boxed sleeper spaces between adjacent lengths which are opened out. Further, if joint gaps are not available at the time of opening of the track even when rail temperature are less than those specified in clause ***Sub-Para (1) above*** not more than 30 sleepers in one continuous stretch should be opened leaving at least 30 boxed sleeper spaces between adjacent length which are opened up.

(4) Major lifting, major alignment of track, deep screening and renewal of sleepers in continuous length- Each of these operations shall be done under suitable precautions and normally when the rail temperature is below t_m + 15°C in the case of Zone I and II, and t_m + 10°C in the case of Zone III and IV. If it becomes necessary to undertake such works at rail temperature exceeding the above values, adequate speed restrictions shall be imposed.

(5) Adequate number of joggled fishplates with special clamps shall be provided to the gangs for use in emergencies.

(6) In the case of any fracture in the weld or in the rail, the portion of rail with fracture is cut, and removed for a length of not less than 5.5m to carry out the re-welding duly introducing a rail piece of equivalent length, also ensuring that no weld lies closer than 4 m from the fish- plated joint.

PART – D

Long Welded Rails

325 Long Welded Rail (LWR) is a welded rail, the central part of which does not undergo any longitudinal movement due to temperature variations. A length of welded rail greater than 250m on Broad Gauge will normally function as LWR.

326 Permitted Locations for LWR/CWR:

(1) *General Considerations for laying LWR/CWR:*

(a) All new constructions/doublings/gauge conversions, permanent diversion shall be opened with LWR/CWR.

(b) All CTR/TSR/TRR (Primary) shall provide for LWR/CWR, wherever permissible.

(c) The existing rails on permitted locations may also be converted into LWR/CWR, provided they meet the requirements for Welding of Rail Joints by Alumino Thermic (SKV Process)/Flash Butt Process, as the case may be.

(d) In yard lines, rail joints may be welded to form LWR if the condition of all the components of track is generally sound and without any deficiency, subject to such relaxation as may be approved by Chief Track Engineer, in each specific case.

(2) *Alignment:*

(a) LWR with 60 Kg/m rail on PSC sleeper with 1660 sleeper density may be permitted on curves upto 6.5 degree in temperature Zone–I & Zone–II and upto 6.0 degree in temperature Zone–III & Zone–IV by Principal Chief Engineer either through PCE circular or on case to case basis subject to fulfilment of all stipulations mentioned in the Instructions as per Annexure–3/19 and site specific conditions. Limits of sharpest curve and sharpest curve associated with steepest gradient for all four temperature zones are tabulated as under:

Temp. Zone	Sharpest permitted degree of curve	Sharpest permitted curve with steepest gradient
Zone – I	6.5	5 degree with 1 in 65
Zone – II	6.5	5 degree with 1 in 65
Zone – III	6.0	5 degree with 1 in 65
Zone – IV	6.0	4 degree with 1 in 80

Note: (i) Cross-bracing arrangement to drawing no. RDSO/T–8329 (Annexure–3/19A) should be provided on curves sharper than 6 degree to enhance lateral stability of LWR track.

(ii) Reduction in de-stressing temperature as stipulated under Para 335 shall not be applicable in the above case.

(b) LWR/CWR with 52 kg/m rail on PSC sleeper with 1540 sleeper density and above may be laid on curves upto 440 m radius. However, in temperature Zone–I, LWR/CWR may be laid on curves up to 350 m radius (5° Curve) with following additional precautions:

(i) Minimum track structure should be 52 kg/m rails on PSC sleeper 1540 sleeper density with 300 mm clean ballast cushion.

(ii) Shoulder ballast for curves sharper than 440 m radius should be increased to 600 mm on outside of curve and should be provided for 100m beyond the tangent point.

(iii) Reference marks should be provided at every 50 m interval to record creep.

(iv) Each curve of length greater than 250 m should preferably be provided with SEJ on either side. SEJ should be located in straight track at 100 m away from the tangent point.

(c) LWR/CWR may be continued through reverse curves. Shoulder ballast of 600mm over a length of 100 m on both side of the common point of a reverse curve would be provided. In case there is a straight track between the reverse curves, this 100m would be considered from the center of the straight track. No such measure would be required, if the length of straight track between the reverse curves is more than 50 m.

(3) *Gradient:*

The steepest permitted grade for LWR/CWR shall be 1 in 100. However, LWR with 60 Kg/m rail on PSC sleeper with 1660 sleeper density may be permitted upto 1 in 65 gradient for temperature Zone–I, Zone–II & Zone–III and upto 1 in 80 gradient for Zone–IV by Principal Chief Engineer either through PCE circular or on case to case basis subject to fulfilment of all stipulations mentioned in the Instructions as per Annexure–3/19 and site specific conditions. If gradient is associated with curve, Para 326(2)(a) shall be referred. Reduction in de-stressing temperature as stipulated under Para 335 shall not be applicable for gradient steeper than 1 in 100.

(4) *Approvals & deviations*:

Installation of LWR/CWR, or change in its constitution at a later stage shall have the approval of the Chief Track Engineer in each case, on a detailed plan prepared in accordance with ***Para 336 (1) (c)*.** However, for any deviation from this provision, approval of Principal Chief Engineer shall be obtained.

(5) *Track structure for LWR/CWR:*

(a) LWR/CWR shall be laid on stable formation having stipulated formation width and ballast cushion (below the bottom of the sleeper); and with approved PSC sleepers and its matching fastening system.

(b) The minimum rail section to be used shall be of 52 kg/m.

(c) In a LWR/CWR, two different rail sections are not permitted.

(d) In case of LWRs laid on concrete sleepers having different rail section on either side of SEJs, combination SEJ to RDSO Drg. No T-6782 (52kg / 60 Kg) shall be provided. Alternatively, two 3 rail panels (39 m), one of each rail section shall be provided with combination fish plated joint, between the two panels.

(e) New rails used in LWR/CWR shall, as far as possible, be without fish-bolt holes. Joining of rail ends temporarily during installation of LWR/CWR shall be done by 1 m long fishplates with special screw clamps/joggled fish-plates having slotted grooves & bolted clamps as in **Fig. 3.9, 3.10, 3.11, 3.12, 3.13** with speed restrictions indicated in ***Annexure - 3/8***.

(f) Bolt holes, if any, shall be chamfered.

(g) **LWR/CWR on Ballastless Track (BLT)**

(i) LWR / CWR shall also be laid on ballastless track (BLT) with approved matching fastening system with minimum in-service longitudinal rail restraint of 15 KN/m/rail. Test plan and Technical criteria of fastening system are enclosed at **Annexure-3/18**.

(ii) Minimum rail section to be used shall be 60 Kg/m.

(iii) LWR / CWR on BLT may be laid on curves upto 350 m radius and permitted steepest gradient shall be 1 in 80.

(iv) At the junction of BLT and Ballasted track, transition track of suitable design shall be constructed to smoothen the change in stiffness of track from BLT to ballasted track. To improve the lateral stability of ballasted track on the approach of BLT at junction, a suitable ballast retaining wall shall be provided for a length of 100 meters from the junction of BLT and ballasted track.

(v) In case LWR / CWR on ballastless track is required to be isolated from ballasted track due to field constraints, SEJ shall be provided in the ballasted track at a minimum distance of 30 m from the junction of BLT and ballasted track.

(vi) The movement of SEJ towards BLT is governed by the effectiveness of fastening on BLT. Longitudinal track resistance of BLT is more than ballasted track, therefore movement at SEJ will be less for LWR / CWR on BLT as compared with movement at SEJ for LWR / CWR on ballasted track. Gap at SEJ towards BLT shall be compared with the values given in **Annexure-3/9**. If the movement at SEJ reaches the limits prescribed in **Annexure-3/9**, the effectiveness of fastenings on BLT shall be checked by measuring the clamping force.

(vii) The creep of LWR / CWR track in ballasted track approach at the junction with BLT shall be monitored upto a length of 500 meters by providing creep posts at interval of 100 m. If the creep exceeds 10 mm in 500 m length, ballasted track shall be destressed for a length of 1000 m.

(6) *Continuity of track structure:*
Wherever LWR/CWR is followed by fish-plated track/SWR, the same track structure as that of LWR/CWR shall be continued for at least three rail lengths (39 m) beyond SEJ.

(7) *Level Crossings:*
Level crossings situated in LWR/CWR territory shall not fall within the breathing lengths.

(8) *Points and Crossings:*

(a) In case, LWR is terminated near Points & Crossings, one three rail panel (39 m) shall be provided between stock rail joint (SRJ) and SEJ as well as between the crossing and SEJ. This length shall be provided with elastic fastenings with adequate toe load to arrest creep.

(b) In case, LWR/CWR is taken through Points & Crossings, the provisions contained in RDSO report no. ***CT-48*** shall be followed.

(9) *Weldable CMS crossings:*
CMS crossing using weldable rail legs i.e. Weldable CMS Crossings have been developed for two variants i.e., 1 in 8.5 (BG) 60kg and 1 in 12 (BG) 60kg. Weldable CMS crossings should be used in yards to continue LWRs through turnouts as per RDSO Report No. CT-48, May 2024. WCMS may also be used to avoid fish plated joints where LWR is not continued through turnout due to other reasons.

(10) *Zero Fish Plated Track:*
Fish plated joints shall be gradually eliminated on main line track to achieve Zero Fish Plated track by providing Weldable CMS crossing and welding its leg joints. Fish plated joints should also be eliminated on bridges by following the provisions contained in Para 329, 330 and 331.

327 Provision of Digital Axle Counters and Glued Joints:

Digital Axle Counters shall be provided in all new works. In other works, insulation for track circuiting in LWR/CWR can be done by providing glued joints of G3(L) type. All existing glued joints shall progressively be replaced by Digital Axle Counters.

328 Location of SEJ:

The exact location of SEJ shall be fixed taking into account the location of various obligatory points such as level crossings, bridges, points and crossings, gradients, curves and insulated joints.

The various designs of SEJs in use on Indian Railways are as per ***Para 225***

(1) The conventional SEJ (RT-4160 and RT-4165) with straight tongue and stock shall not be located on curves sharper than 0.5° (3500 m radius).

(2) The improved SEJs (RT-6902, RT-6914, RT-6922, RT-6930) may be located on curves up to 2°. For curves beyond 2° and up to 4°, ISEJs shall be laid to Drg. No. RT-8924 (80 mm max Gap) or RT-8926 (65 mm max Gap) for 60 Kg BG track with the approval of CTE.

(3) Thick Web Switch Expansion Joints (TWSEJ): On straight track, TWSEJ (RT-8822) shall be provided progressively in place of SEJ/Improved SEJ during the renewals/ replacements/new works in approved temperature zones.

(4) SEJ of any type shall not be located on transition of curves.

329 Bridges with Ballasted Deck (without bearing): (*Back to **Para 226 (4)***)

LWR/CWR can be continued over bridges with ballasted deck without bearings like slabs, box culverts and arches.

330 Bridges with Ballasted Deck and Ballast Less Track (BLT) (with bearing): (*Back to **Para 226 (4)***)

Detailed calculations shall be done by the Design office of Chief Bridge Engineer/CAO(C) to ascertain the effect of LWR on such bridges and its effect on the substructure of the bridge as per **Para 2.8.1.2** of **"***Bridge Rules***".**

The LWR/CWR may be permitted as per RDSO's report BS-126 Rev 1, December 2023 *"Guidelines for continuation of LWR/CWR over ballasted deck bridges on Indian Railways"* subject to satisfactory results of Rail Structure Interactions (RSI) analysis. In case, LWR cannot be permitted to continue due to any site-specific conditions, SWR may be provided. The LWR/CWR on BLT Bridges may only be permitted, if found satisfactory on the basis above calculations. Chief Bridge Engineer/CAO(C) may further permit use of special arrangements to control RSI effects as stipulated in the RDSO report no. BS-114.

(ACS – 9)

331 Bridges with Un-Ballasted Deck: (*Back to **Para 226 (4), 630***)

LWR/CWR shall be continued over such bridges with overall length as specified in *sub-Para (1) to (3) below:*

(1) Bridges provided with rail-free fastenings (single span not exceeding 30.5 metre and having sliding bearings on both ends)

Overall length of the bridge should not exceed the maximum as provided in Table-1 with following stipulations:

(a) Rail-free fastenings shall be provided throughout the length of the bridge between abutments.

(b) SEJ of the LWR should be located such that bridge does not fall in the breathing length of the LWR. The approach track upto 50 m on both sides shall be well anchored by providing PRC sleepers with elastic rail clips with adequate toe load so as to arrest creep.

(c) The ballast section of approach track upto 50 metre shall be heaped upto the foot of the rail on the shoulders and kept in well-compacted and consolidated condition during the months of extreme summer and winter.

(2) Bridges provided with rail-free fastenings and partly box-anchored (with single span not exceeding 30.5 metre and having sliding bearings at both ends)

Overall length of the bridge should not exceed the maximum as provided in Table-1 with following stipulations:

(a) On each span, 4 central sleepers shall be box-anchored with fair 'V' or similar type creep anchors and the remaining sleepers shall be provided with rail-free fastenings. For fair 'V' type anchors, typical drawing Nos. RDSO/T-1045 for 60 Kg rail section and RDSO/T-10327 for 52 Kg rail section may be referred.

(b) The track structure in the approaches shall be laid and maintained to the standards as stated in *(1) (b) & (c) above*.

(c) The girders shall be centralized with reference to the location strips on the bearing, before laying LWR/CWR.

(d) The sliding bearings shall be inspected during the months of March and October each year and cleared of all foreign Materials. Lubrication of the bearings shall be done once in two years.

TABLE - 1

Maximum Overall Length of Bridges Permitted on LWR/CWR (in m) ***Para – 331(1) & 331(2)***

Temperature Zone	Rail Section	Rail-free fastenings on bridges as per Para 331(1)	Rail-free fastenings on bridges and partly box-anchored as per Para 331(2)
I	60 kg/m	30	77
	52 kg/m	45	90
II	60 kg/m	11	42
	52 kg/m	27	58
III	60 kg/m	11	23
	52 kg/m	27	43
IV	60 kg/m	11	23
	52 kg/m	27	43

(3) LWR/CWR may also be continued over a bridge with the provision of SEJ at the far end approach of the bridge using rail-free fastenings over the girder bridge **(Fig. 3.6(b)**. The length of the bridge in this case, however, will be restricted by the capacity of the SEJ to absorb expansion, contraction and creep, if any, of the rails. The length of the bridges with the above arrangement that can be permitted in various rail temperature zones for LWR/CWR with SEJs having maximum movement of 120 mm and 190 mm are as under:

Rail temperature zone	Max. movement of SEJ used (mm)	Overall length of bridge Para 331(3)	Initial gap to be provided at t_d
IV	190	55 m	7.0 cm
III		70 m	7.0 cm
II		110 m	6.5 cm
I		160 m	6.5 cm
II	120	20 m	4.0 cm
I		50 m	4.0 cm

Note:

(i) SEJ is to be installed 15 metre away from the abutments.

(ii) Improved SEJ with 2 gaps of 65 mm (max.) each (Drawing no. RDSO/T-6922 and RDSO/T-6930) may also be used for laying at far end approach of bridges in lieu of IRS design SEJ with 120 mm max gap.

(4) Welded rails may be provided from pier to pier with rail-free fastenings and with SEJ on each pier. The rail shall be box-anchored on four sleepers at the fixed end of the girder if the girder is supported on rollers on one side and rockers on other side. In case of girder supported on sliding bearings on both sides, the central portion of the welded rails over each span shall be box-anchored on four sleepers. See **Fig. 3.6 (a).**

(5) Welded rails may be provided over a single span bridge with rail free fastenings and SEJs with 190 mm gap at 30 m away from both abutments. The rail shall be box anchored on four sleepers at the fixed end of the bridge if bridge is supported on rollers on one side and rockers on other side. In case of bridge supported on sliding bearings on both sides, the central portion of the welded rails shall be box anchored on four sleepers. The approach track upto 50 m on both sides shall be well anchored by PRC sleepers with elastic rail clips with minimum toe load as specified. The installation temperature of such welded panels shall be equal to t_m. The length of single span bridge permitted temperature zone-wise shall be as under:

Temperature zone	Maximum length of single span girder bridge
IV	75 m
III	87 m

II	110 m
I	146 m

(6) Bridges on which LWR/CWR is not permitted/provided as per above shall be isolated by a minimum length of 30 metre of well anchored PSC sleeper track on either side.

(7) In case of LWR is continued over bridges as per *Sub Para (3)* above, the measurement of gaps of stock rail / tongue rail tip of SEJ provided at bridge approach from the reference post shall be compared with the theoretical gaps as prescribed in ***Annexure - 3/9A*** for conventional PSC sleepers and Annexure - 3/9C for wider base PSC sleepers.

(8) In case welded rails are provided as per *Sub Para (4) or (5)* above, these shall not be entered in TMS as LWR and accordingly, measurement of gaps of at such SEJs of welded panels is not warranted.

332 Measurement of Rail Temperature:

(1) *Thermometer:*

The following are the types of approved thermometers for measuring rail temperature:

(a) Embedded type – This is an ordinary thermometer inserted in a cavity formed in a piece of railhead, the cavity filled with mercury and sealed. The rail piece is exposed to the same conditions as the rail inside the track. This type of thermometer takes 25 to 30 minutes for attaining temperature of the rail.

(b) Dial type – This is a bi-metallic type thermometer, which is provided with magnet for attaching it to the rail. The thermometer is attached on the shady side of the web. A steady recording of the rail temperature is reached within 8 minutes.

(c) Continuous recording type – It consists of a graduated chart mounted on a disc, which gets rotated by a winding mechanism at a constant speed to complete one revolution in 24 hours or 7 days as applicable giving a continuous record of rail temperature. The sensing element is attached to the web of the rail and connected to the recording pen, through a capillary tube, which is filled with mercury.

(d) Any other type of thermometer approved by RDSO/Chief Engineer.

(2) Where a number of thermometers are used to measure the rail temperature at one place, as in case of laying of LWR, de-stressing etc. or during routine tools inspection at office of SSE/ P.Way, any of the thermometer showing erratic readings, appreciably different from the other adjoining thermometers, shall be considered as defective.

333 Temperature Measurements –

(1) The existing SSE/P.Way (In-charge) shall record rail temperature using preferably a well-calibrated continuous recording type thermometer and data to be updated in TMS.

(2) The maximum and minimum rail temperature for a continuous period of at least 5 years shall be ascertained and the mean rail temperature (t_m) for the region arrived at.

(3) These temperature records shall be analysed to assess the probable availability of time periods during different seasons of the year for track maintenance, de-stressing operations and requirements of hot/cold weather patrolling etc.

(4) The rail thermometer shall also be available with each Gang and sectional JE/SSE/P.Way to enable the Gangs to work within the prescribed temperature ranges.

334 Temperature Records –

(1) The maximum daily variation of rail temperature and the mean rail temperature (t_m) for the section shall be ascertained from the temperature records available with the SSE/P.Way(In-charge) or as built up as per ***Para 333.***

(2) If rail temperature records of preceding five years are not available, the mean and range of rail temperatures shown in the '*Map of India showing Rail Temperature Zones*' (**Fig. 3.7**), shall be adopted.

335 Thermal Forces in LWR/CWR – (*Back to* ***Para 338***)

Temperature changes cause movement of the ends of LWR/CWR in the breathing lengths but the central portion of LWR/CWR does not expand/contract. This results in building up of thermal forces in the central portion. The thermal force (P) calculated by

$$P = E A \alpha t$$

Where,

P = Thermal force in the rail (kg)

E = Modulus of elasticity of rail steel, **(2.11 x 10^6 kg/cm^2)**

A = Area of cross section of the rail (cm^2)

Rail Section	Cross-sectional Area (cm^2)
60 kg/m	76.86
52 kg/m	66.15

α = Coefficient of linear expansion of steel, (1.152 x $10^{-5}/^0C$)

t = Variation of rail temperature from t_d /t_o (°C)

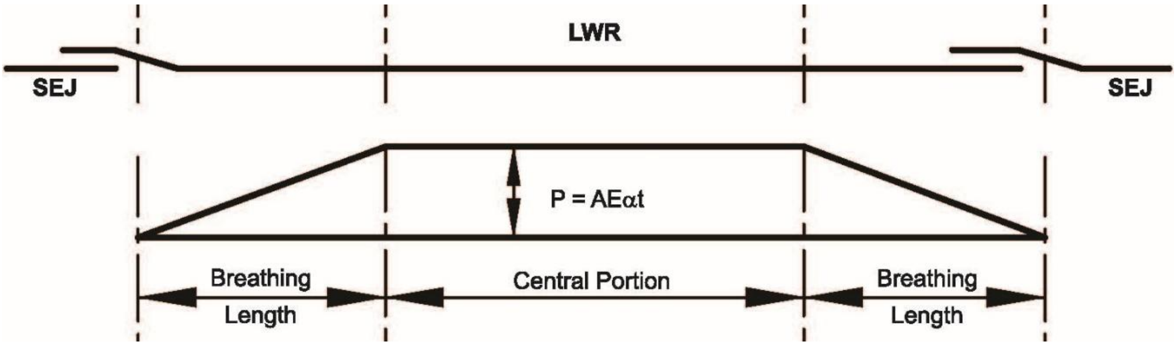


Fig. 3.5: Force Diagram in LWR / CWR

The Range of t_d or t_0 shall be within the limits of rail temperature shown below:

Temperature Zone	Rail Section	Range
I, II, III	All Sections	t_m to t_m+ 5^0 C
IV	52 kg/m & heavier	t_m+5^0 C to t_m+10^0 C

However, laying of LWR on wider base sleeper with 60 Kg rail and sleeper density of 1660 nos. per Km may be permitted with reduced de-stressing temperature range as under:

Temperature Zone	Range of destressing temperature	Permitted Degree of Curve (Max.)	Permitted steepest Gradient
Zone – I	t_m-5 to t_m	5°	1 in 100
Zone – II	t_m-5 to t_m	4°	1 in 100
Zone – III	t_m-5 to t_m	4°	1 in 100
Zone – IV	t_m to t_m+5	4°	1 in 100

Note*: Above provisions of reduced de-stressing temperature for LWR with wider sleepers* *shall not be applicable for LWR continued on sharp curves (sharper than 5 degree in Zone-I and sharper than 4 degree in Zone-II, III and IV) and steep gradients (steeper than 1 in 100) as per provisions mentioned under Paras 326(2)(a) & 326(3).*

Usual breathing lengths on PSC sleepers for different temperature zones and density is shown in **Annexure - 3/16**.

The level of maximum thermal stresses in LWR depends upon variation of Rail temperature from the stress free temperature. The thermal force diagram in LWR is shown as above (**Fig 3.5)**.

336 Laying of LWR / CWR

(1) *Survey:*

(a) A foot by foot survey of the sections where LWR/CWR is proposed to be laid shall be carried out in regard to the Locations over which LWR/CWR cannot be carried through on account of constraints *such* as bridges having substructure/superstructure in a distressed condition, curves, gradients, points and crossings, unstable formation etc. Such stretches of track shall be isolated from the remaining portion of LWR/CWR by provision of SEJs at either end.

(b) Locations where following preliminary works are required to be carried out shall be identified for completion before laying of LWR/CWR:

(i) Replacement of insulated joints by glued joints

(ii) Realignment of curves

(iii) Lifting or lowering of track to eliminate sags and humps

(iv) Introduction and improvement of vertical curves

(v) Stabilisation of troublesome formation

(vi) Rehabilitation of weak bridges involving removal or lifting of rails or introduction of temporary arrangements.

(vii) Deep screening of ballast along with lifting or lowering of track, if required.

(c) A detailed plan shall be made showing the exact locations of SEJs and of various other features mentioned in *Sub-Para* (a) and (b) above. A sample of the detailed plan may be seen at **Fig. 3.8**. The plans may be prepared to a horizontal scale of 1:5000. (*Back to* ***Para 326(4)***)

(2) *Materials Required* – Following Materials are required for laying one LWR:

(a) Four numbers of 4 metre or longer rail pieces of the same rail section as LWR

(b) Two sets of SEJs with sleepers and fastenings

(c) Adequate numbers of 1 metre long fishplates with special screw clamps/ joggled fishplates with slotted grooves & bolted clamps as in **Fig. 3.9, 3.10, 3.11 & 3.12**.

Note: Slotted fishplates as in ***Fig. 3.13*** *with fish-bolts may be used in exceptional cases.*

(d) Rail closures of suitable sizes

(e) 1 metre and 10 cm straight edges

(f) Callipers and feeler gauges (2 mm to 0.1 mm)

(g) Rail cutting equipment

(h) De-stressing equipment i.e. rollers, mechanical/hydraulic rail tensor, mallets and side rollers for curves, **Fig. 3.14, & 3.15.**

(i) Alumino-thermic welding equipment and consumable Materials

(j) Equipment for protection of track.

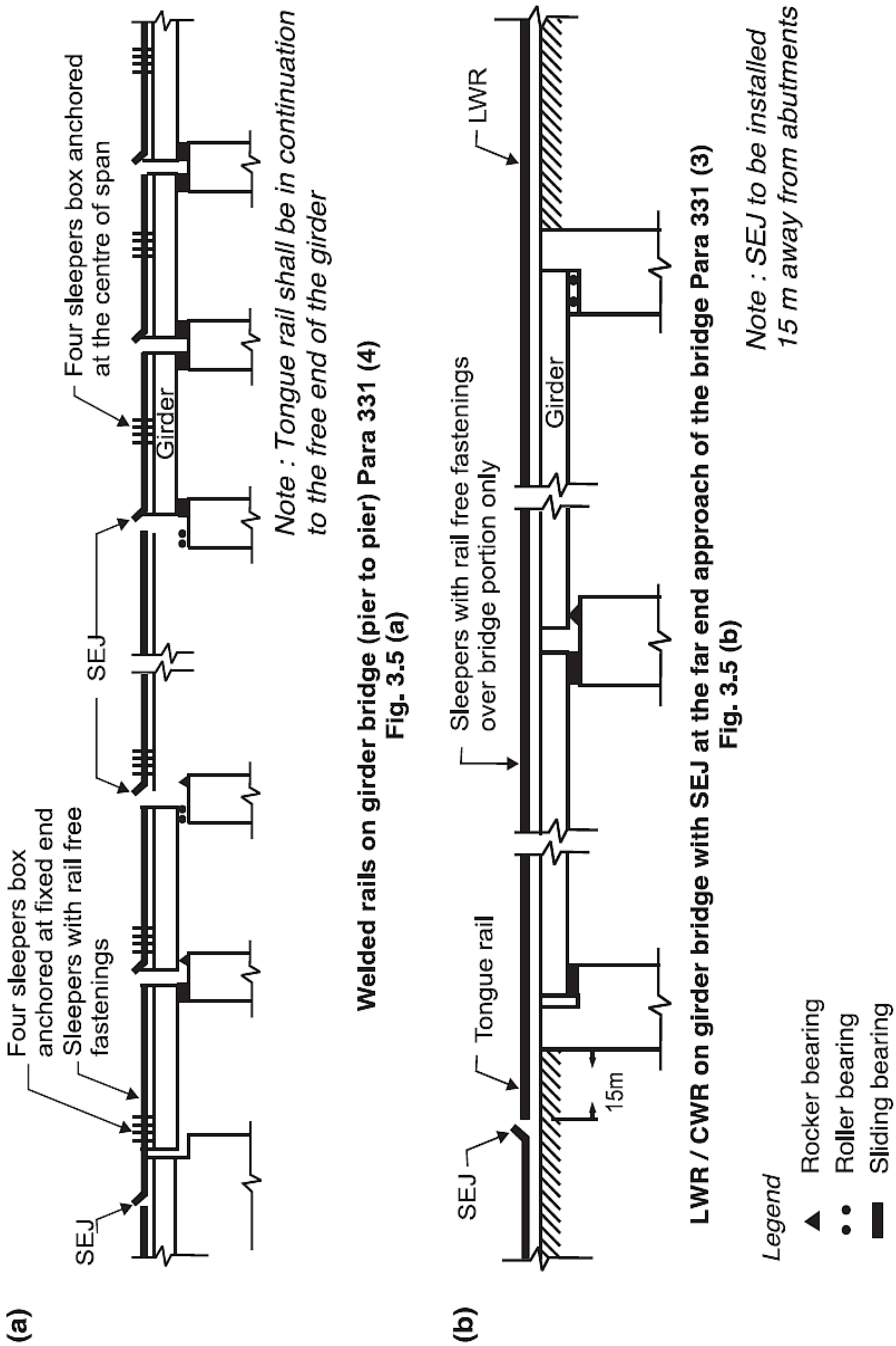


Fig 3.6 Welded Rail on Bridge (*Back to* ***Para 331(3)***)**

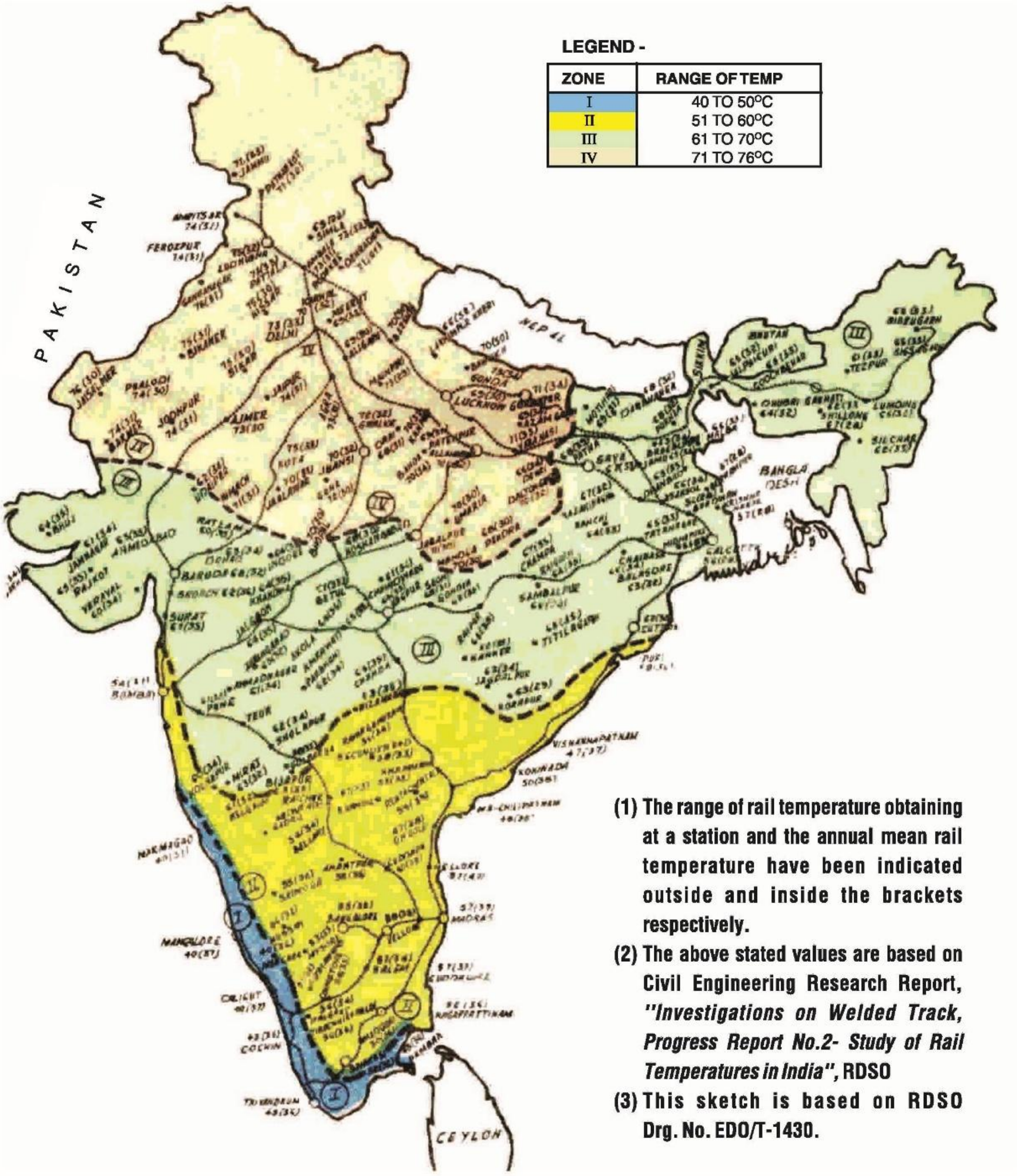


Fig. 3.7 (*Back to* ***Para 334*** above)

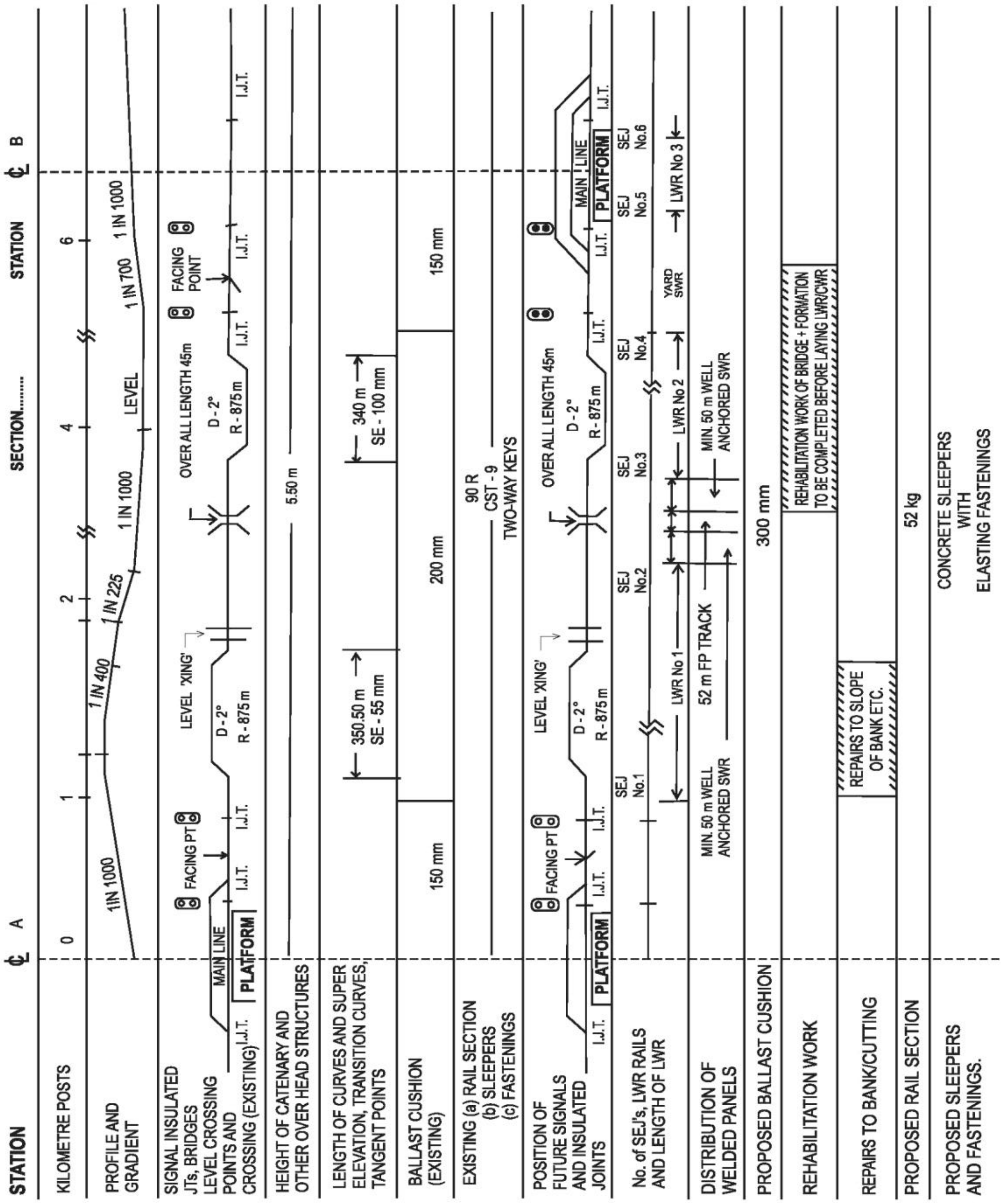
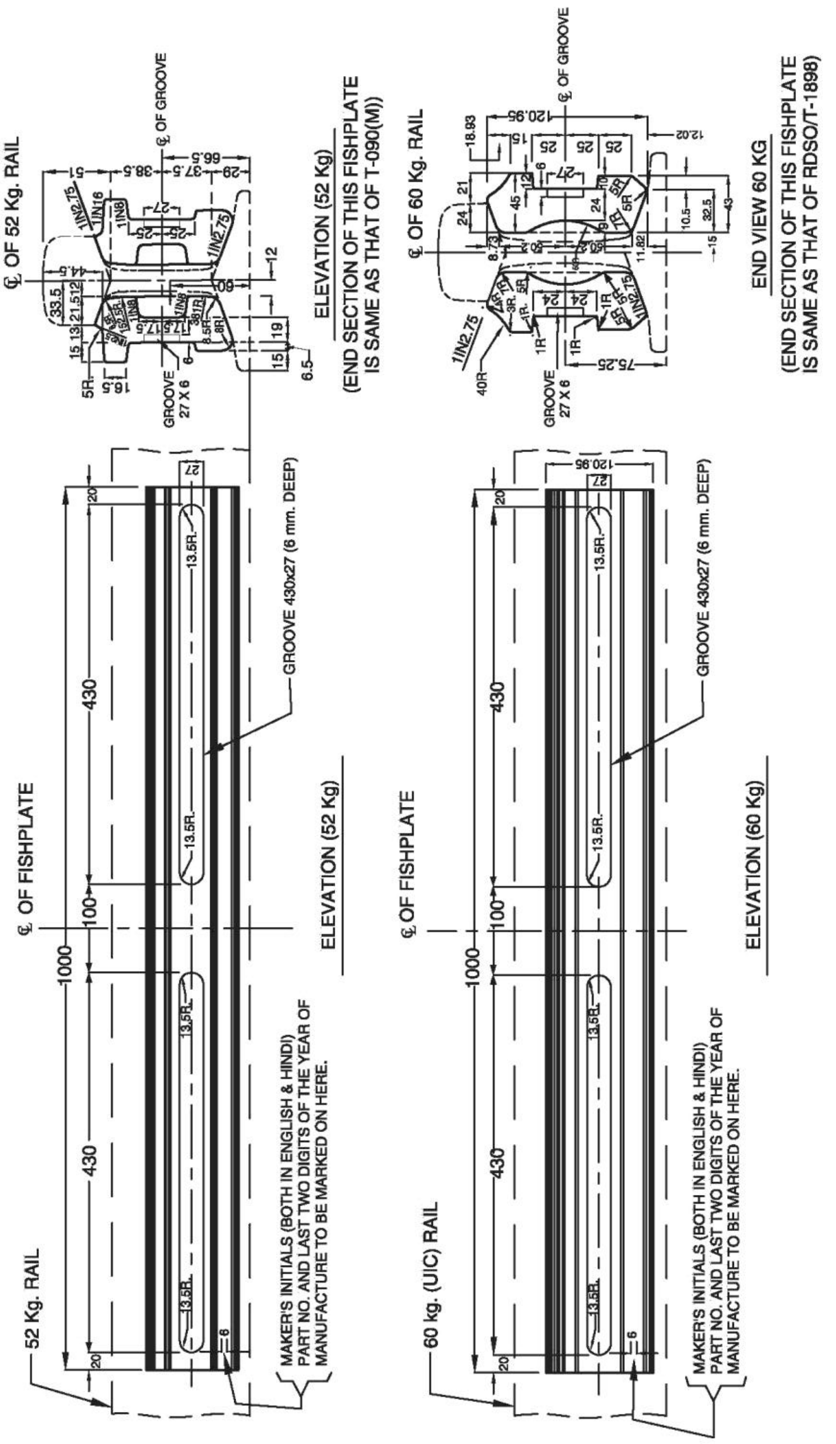


Fig 3.8 Proposal for laying LWR / CWR

*Back to **Para** **336 (1) (c)***

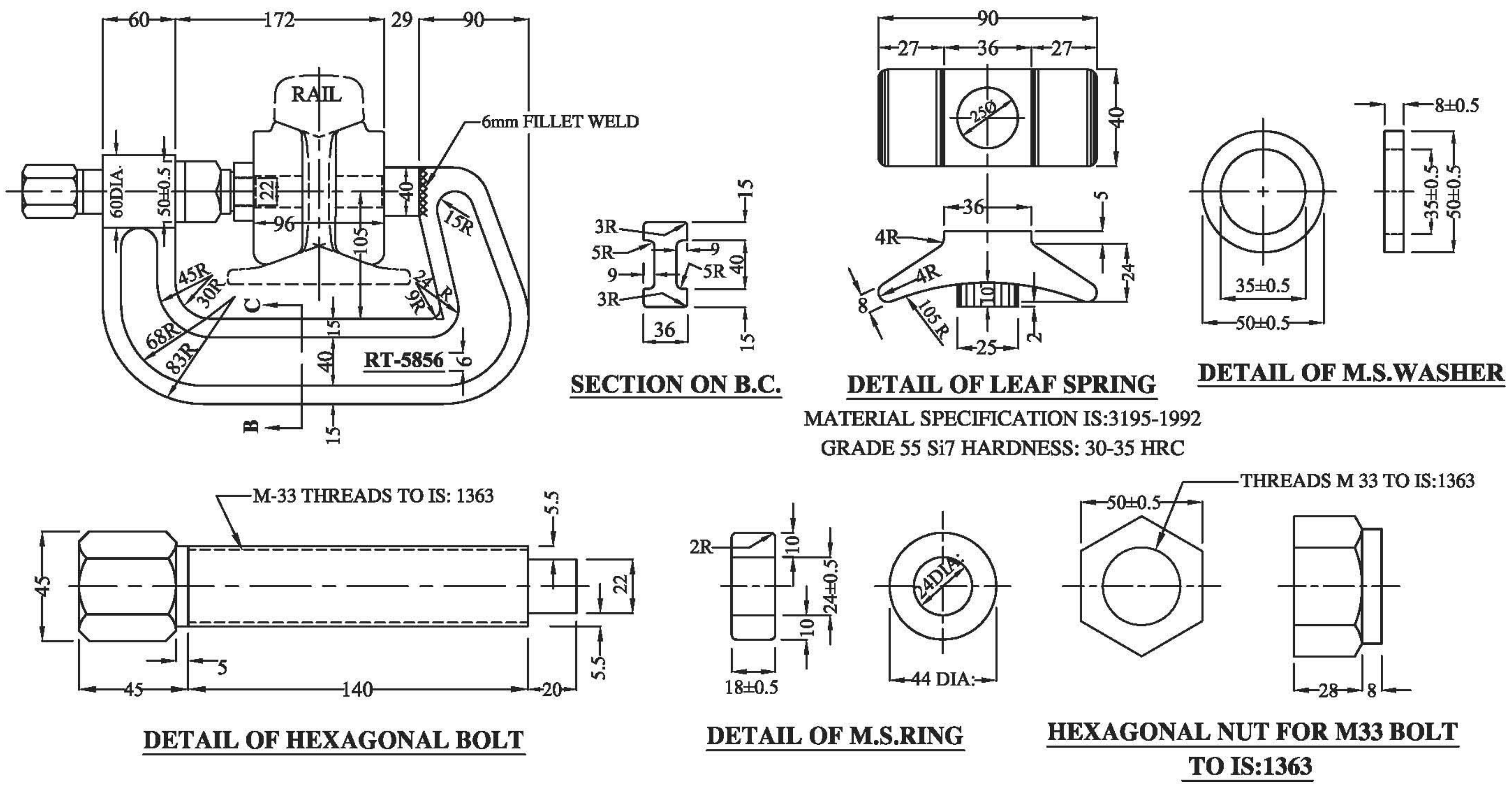


Note –

1. *All dimensions are in millimetres.*
2. *All radii are 2mm except where otherwise shown.*
3. *Salient features/dimensions have been shown in the sketch. For details, drawing no. RDSO/T-5850 to RDSO/T-5851 would be referred to.*
4. *These fishplates shall be fixed by means of screw clamps or M.S. Clamps. For fixing with screw clamps, drawing no. RDSO/T-5856 and for fixing with M.S. Clamps, drawing no. RDSO/T-5852 to RDSO/T-5855/1 may be refereed to.*
5. *When these fishplates are used, a speed restriction of 20km/h shall be imposed. However, speed restriction may be relaxed to 30km/h if there is a 24hrs watch.*

Fig. 3.9 - 1 m LONG SLOTTED FISH PLATE FOR CLAMPED JOINTS /SUPPORT ARM

*Back to **Para** **326(5) (e)**, **336**, **337**, **349***

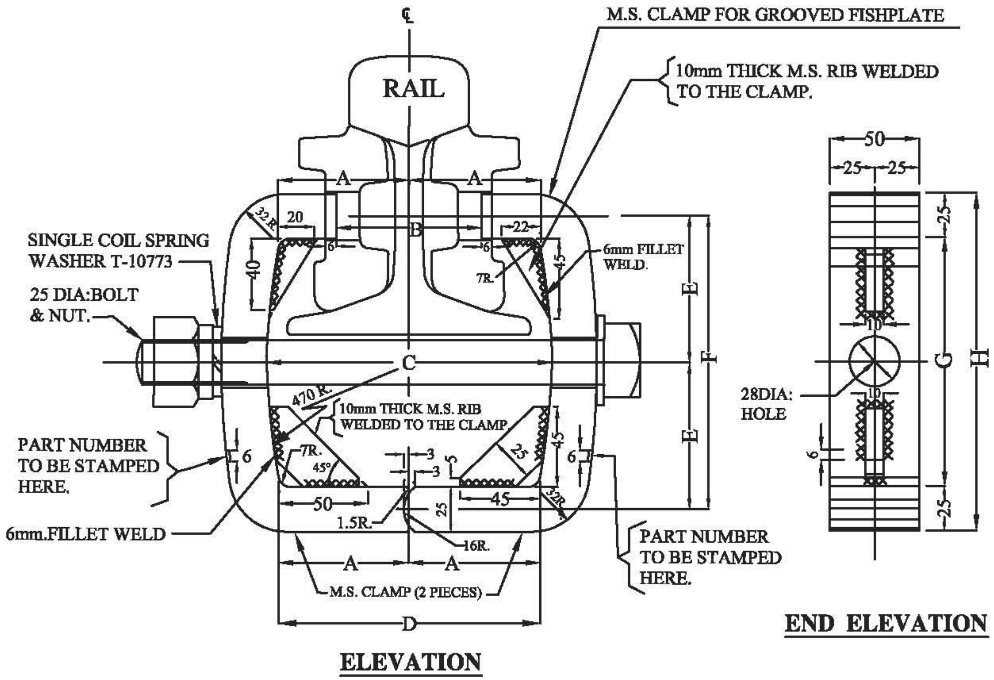


Note –

1. *All dimensions are in millimetres.*
2. *Salient features/dimensions have been shown in the sketch. For details, drawing no. RDSO/T-5856 would be referred to.*
3. *Screw clamp and leaf spring shall be manufactured from materials as per specification no. IRS M-37 and IS:3195-1992 grade 55 Si 7 (HRC:30-35) respectively.*
4. *This screw clamp can be used with standard fishplates, joggled fishplates and 1m long fishplates for 60kg (UIC), 52kg & 90R rails.*
5. *When these clamps are used, a speed restriction of 20km/h should be imposed. However, speed restriction may be relaxed to 30km/h if there is a 24hrs watch.*

Fig. 3.10 SCREW CLAMP FOR FIXING 1 m LONG FISH PLATE

*Back to **Para** **326(5) (e)**, **336**, **337**, **349***



PART Nos.AND DIMENSIONS

(M.S. CLAMP FOR GROOVED FISHPLATE)

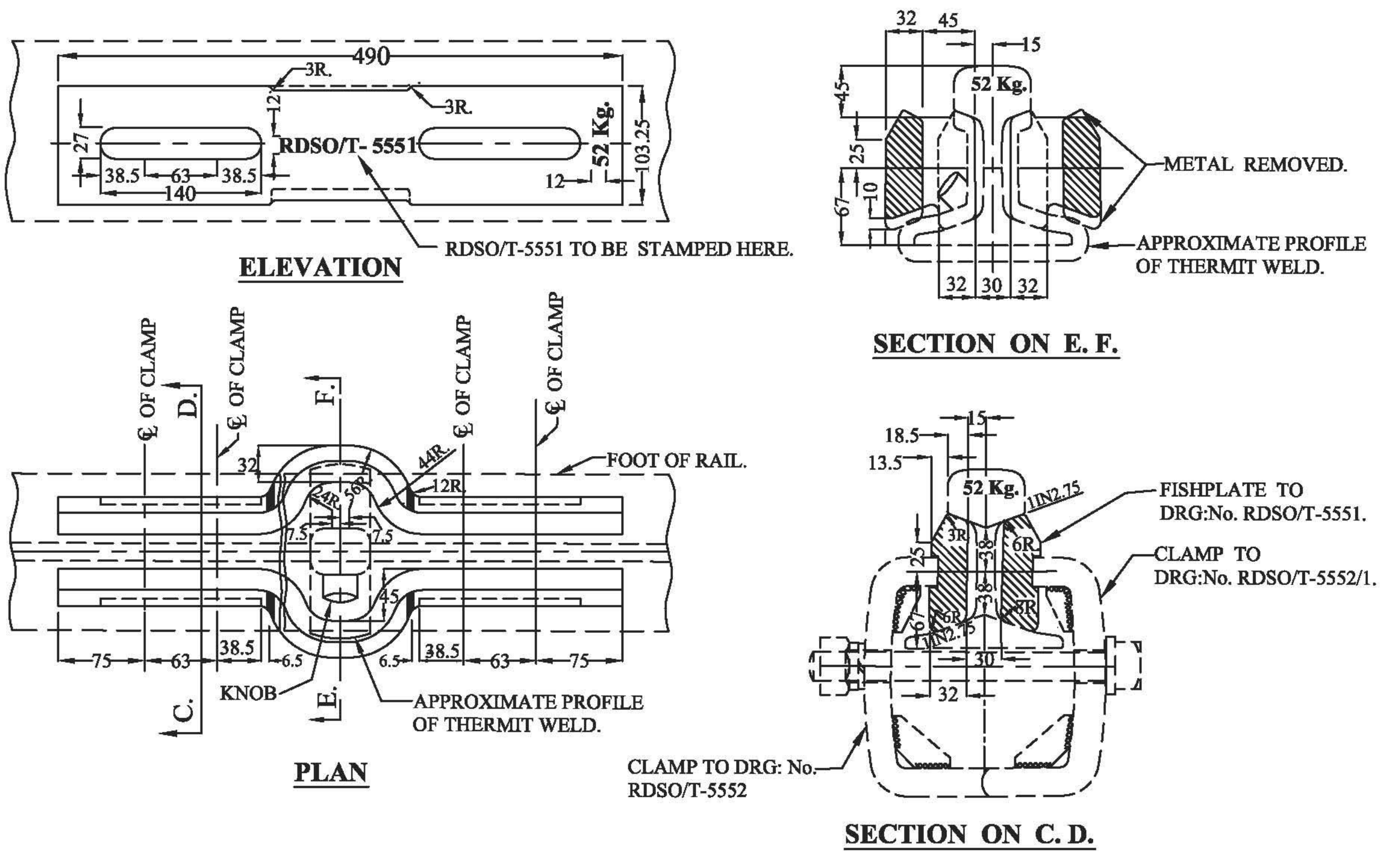
M.S.CLAMP	RAIL & FISHPLATE	BOLT & NUT	DIMENSIONS							
			A	B	C	D	E	F	G	H
RDSO/T-5854& RDSO/T-5854/1	60 Kg. RDSO/T-5851	T-11523	80	84	172	160	91.5	183	158	208
RDSO/T-5855& RDSO/T-5855/1	52 Kg. RDSO/T-5850	T-11522	73	81	160	146	82	164	139	189

Note -

1. *All dimensions are in millimetres.*
2. *Salient features/dimensions have been shown in the sketch. For details drawing no. RDSO/T-5852 to RDSO/T- 5855/1 would be referred to.*
3. *For better effectiveness of these clamps single coil spring washer to Drg.No. T-10773 may be used and this single coil spring washer should be replaced by double coil spring washer when available.*
4. *These clamps consist of two parts, one on the right side and the other on the left side. Both parts are kept in position by means of bolt and nut arrangement as shown above.*
5. *When these clamps are used, a speed restriction of 20km/h should be imposed. However, speed restriction may be relaxed to 30km/h if there is a 24hrs watch.*

Fig. 3.11 M.S. CLAMP FOR FIXING 1 m LONG FISH PLATE

*Back to **Para** 326(5) (e), 336, 337, 349*



Note –

1. *All dimensions are in millimetres.*
2. *Salient features/ dimensions have been shown in the sketch. For details, drawing no. RDSOIT-5551 and RDSOIT- 5552 to RDSOIT-555211 would be referred to.*
3. *For the purpose of temporary joining of rails without any weld, ordinary fish plates with M. S. Clamps may be used.*
4. *The joint sleeper spacing may be suitably altered to accommodate the clamps.*
5. *The speed restriction of 20 kmph should be imposed when these joggled fish plates and clamps are used. However, speed restriction may be relaxed to 30 kmph if there is a 24hrs watch.*

Fig. 3.12 DETAILS OF JOGGLED FISH PLATE WITH CLAMP / SUPPORT ARM

*Back to **Para** **326(5) (e)**, **336**, **337**, **349***

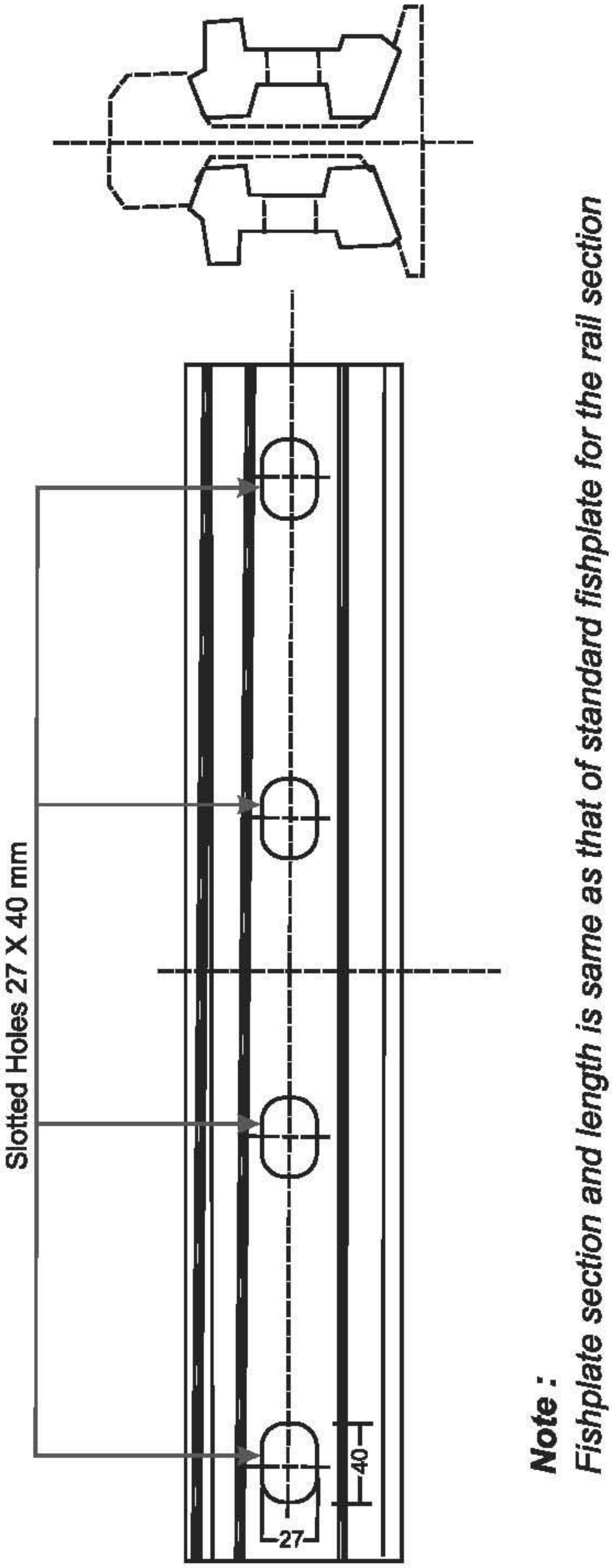
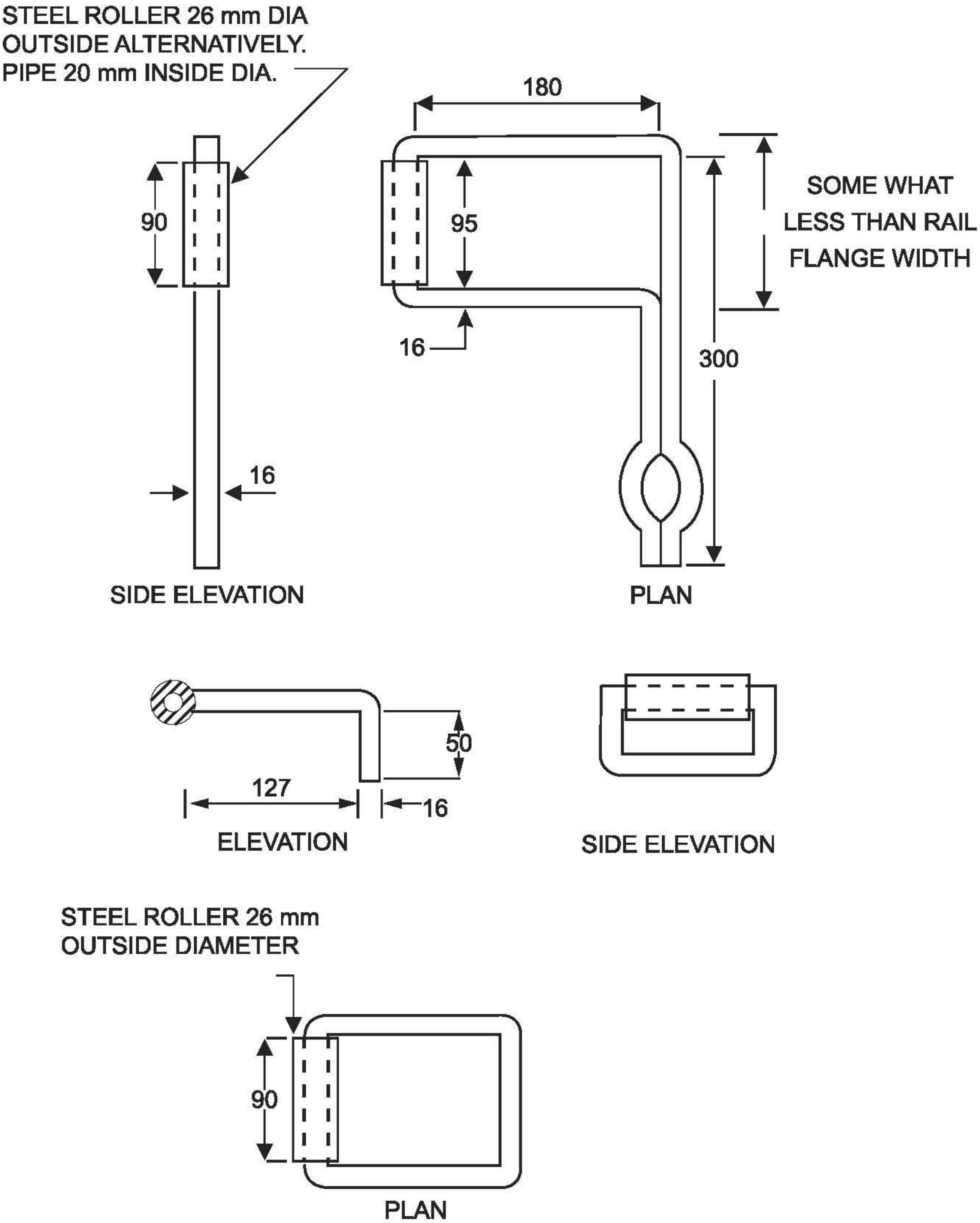


Fig. 3.13 SLOTTED FISH PLATE

Back to ***Para*** ***326(5) (e)***, ***336***



Note –

1. *Alternate designs of rollers for supporting rails during Destressing.*
2. *All dimensions are in millimetres.*

Fig. 3.14 ROLLER

*Back to **Para** **336**, **340***

Used for curved track to minimise friction and to give even extension to the rails and prevent rails from bow stringing out of the fastening position. For use on concrete sleepers

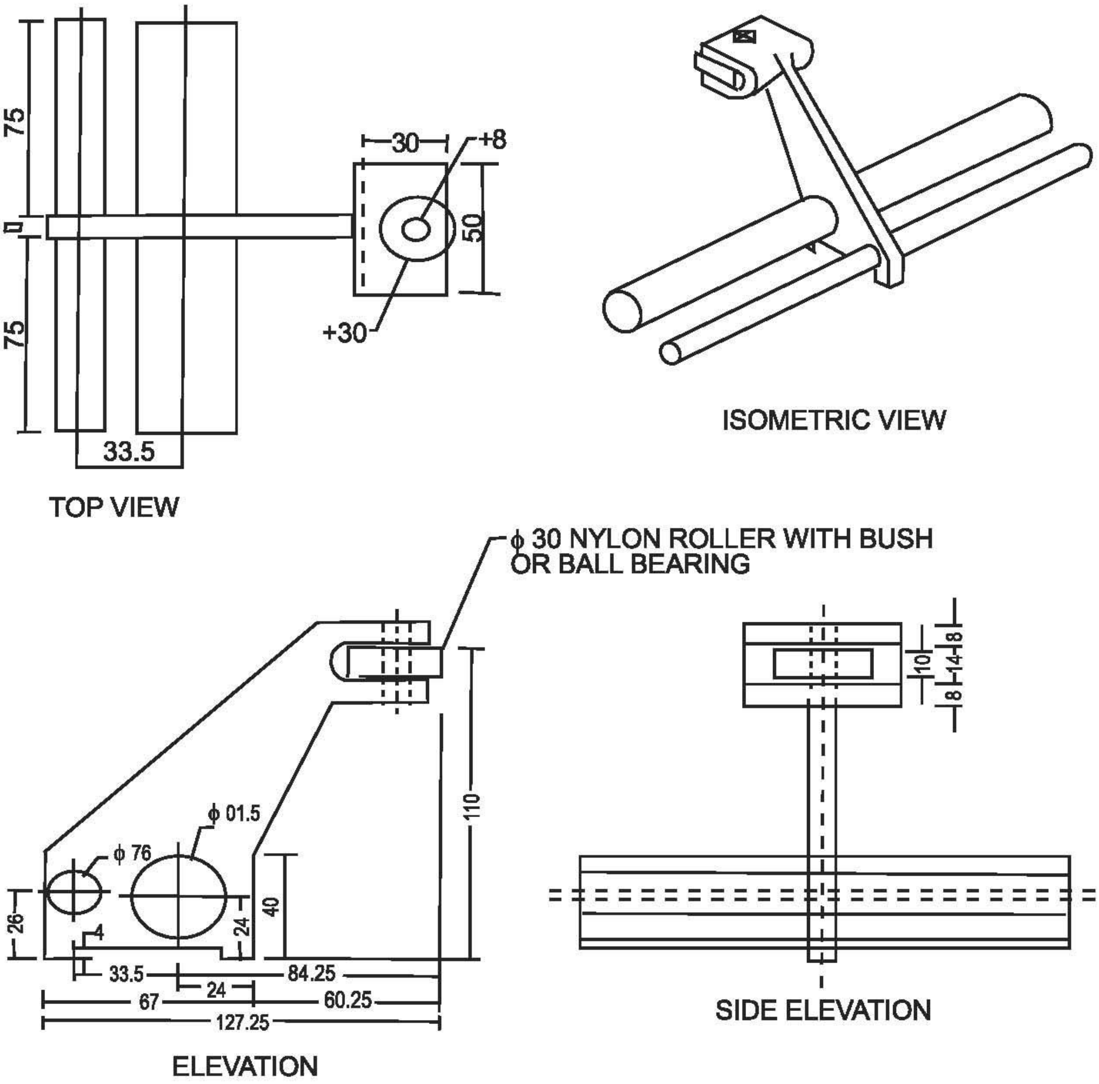


Fig. 3.15 SIDE ROLLER / SUPPORT ARM

Back to ***Para*** ***336***

337 Welding of Rails to form LWR:

(1) Rails shall normally be welded into sufficiently long panels of 10 to 20 rail lengths or more by flash butt welding, either in the welding depot or on cess or in-situ. The joints in between only shall be welded by Alumino-Thermic welding (SKV process)/flash butt welding (using mobile FBW plant).

(2) Before laying long welded panels and/or before welding of rails, two complete sets of SEJs, one at either end of the proposed LWR/CWR shall be inserted at pre-determined locations with gaps in mean position as per ***Para 338*** below. Closure rails of suitable length (refer ***Para 340 / 341***) shall be provided at LWR side/sides of SEJs to facilitate adjustment of gaps during de-stressing operation.

(3) Laying of welded panels and/or welding of joints at site can be done at any time of the year. However, after welding into sufficiently long panels of about 1 km or longer, de-stressing as per ***Para 340 / 341*** shall be undertaken as soon as possible.

(4) Under unavoidable circumstances where de-stressing could not be done soon after and not likely to be done within a reasonable period, a strict vigil shall be maintained on the prevailing rail temperatures, and if the rail temperature rises more than 20˚C above the rail temperature at which welding of rails/laying of welded panels was done temporary de-stressing shall be undertaken at a rail temperature of 10˚C below the maximum rail temperature likely to be attained until final de-stressing. If the rail temperature comes down appreciably, cold weather patrolling as per ***Para 1005(3)*** should be introduced. Final de-stressing shall be done after consolidation of track has been achieved.

(5) *Consolidation of track can be achieved by the following* – (*Back to **Para 117(4)(a)***)

(a) For Existing track where maintenance activity involving disturbance to ballast compaction (tamping operation) has been undertaken**.**

(i) For the track structure consisting of concrete sleepers, passage of at least 50,000 gross tonnes of traffic or a period of two days whichever is later.

(or)

(ii) At least one round of stabilisation by Dynamic Track Stabiliser (DTS).

(b) For newly laid track (CTR/TSR) or freshly deep screened Track

Three rounds of packing, last two of which should be by on-track tamping machines

(6) Temporary speed restriction as indicated in **Annexure - 3/8** shall be imposed on the length of track where welded panels are joined by 1 m long fishplates with special screw clamps or joggled fishplates with slotted grooves & bolted clamps as in **Fig. 3.9, 3.10, 3.11 & 3.12**.

338 Gaps at SEJ – (*Back to **Para 341(10)***)

(1) (a) The thermal force in a LWR as shown in ***Para 335*** is to be resisted by suitable track structure. Accordingly, the Gap at SEJ depends on following factors –

(i) Longitudinal Ballast Resistance of sleepers (taken as 13.28 or 13.74 kg / cm / rail per sleeper for PSC sleeper of density 1540 or 1660 per km respectively, which is indicative and can vary as per site conditions)

(ii) Area of rail section

(iii) Modulus of Elasticity (E) for rail steel

(iv) Coefficient of linear expansion (α) for rail steel

(v) Difference between the De-stressing temperature and prevailing rail temperature of LWR

(vi) Initial gap at SEJ at de-stressing temperature.

(b) Gaps at SEJ shall be adjusted at the time of de-stressing of LWR/ CWR as under: (*Back to* ***Para 340***)

Rail section laid	Gap to be provided at 't_d'
52 kg/m	40 mm
60 kg/m	

(c) For Gaps at different types of SEJ and its laying and measurement, **Fig No 3.17, 3.18, 3.19, 3.20** may be referred to:

(2) **Hysteresis Curve:**

(a) In service, the change in gap at SEJ due to rail temperature variations is in the form of a Hysteresis Curve. Therefore, for any given rail temperature, the measured gap at the SEJ may fall within the range defined by the Hysteresis curve.

A typical hysteresis curve for Zone – IV with 52 Kg/m rail on PSC sleeper with 1540 density is as under in **Fig 3.16** below:

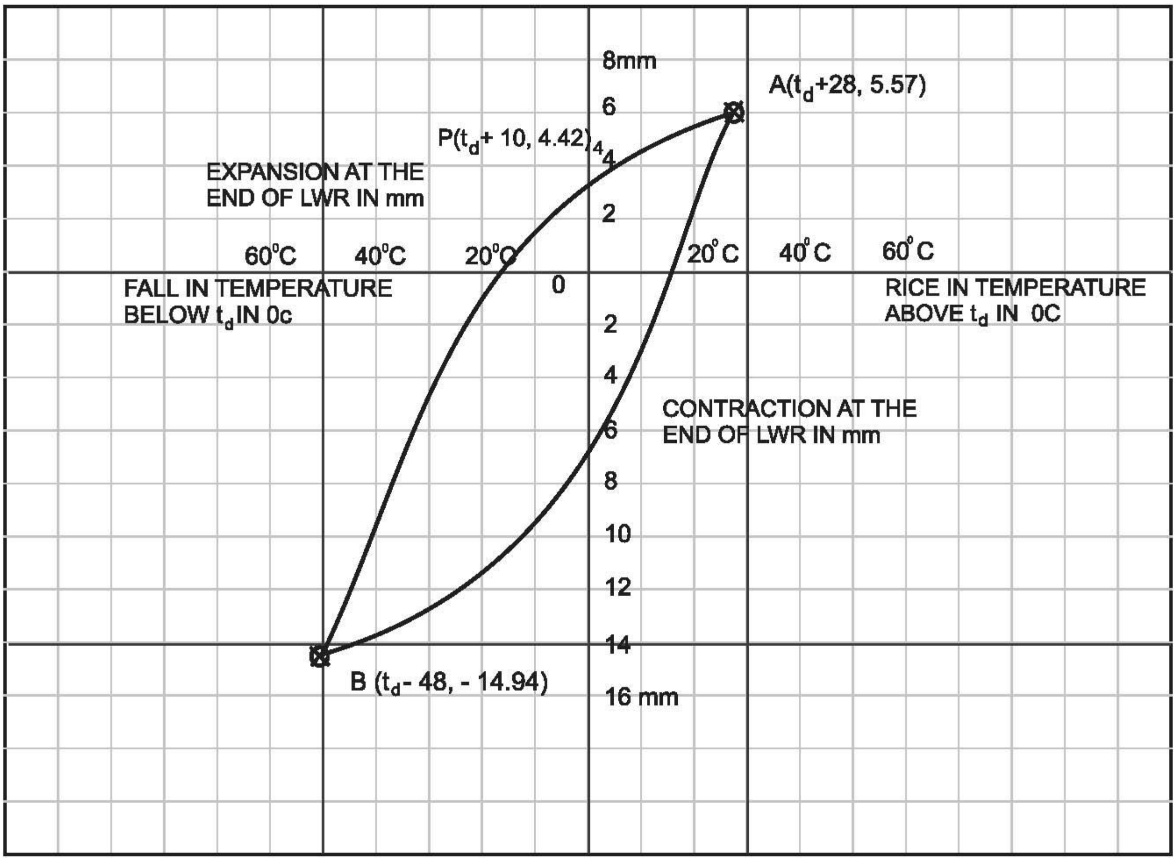
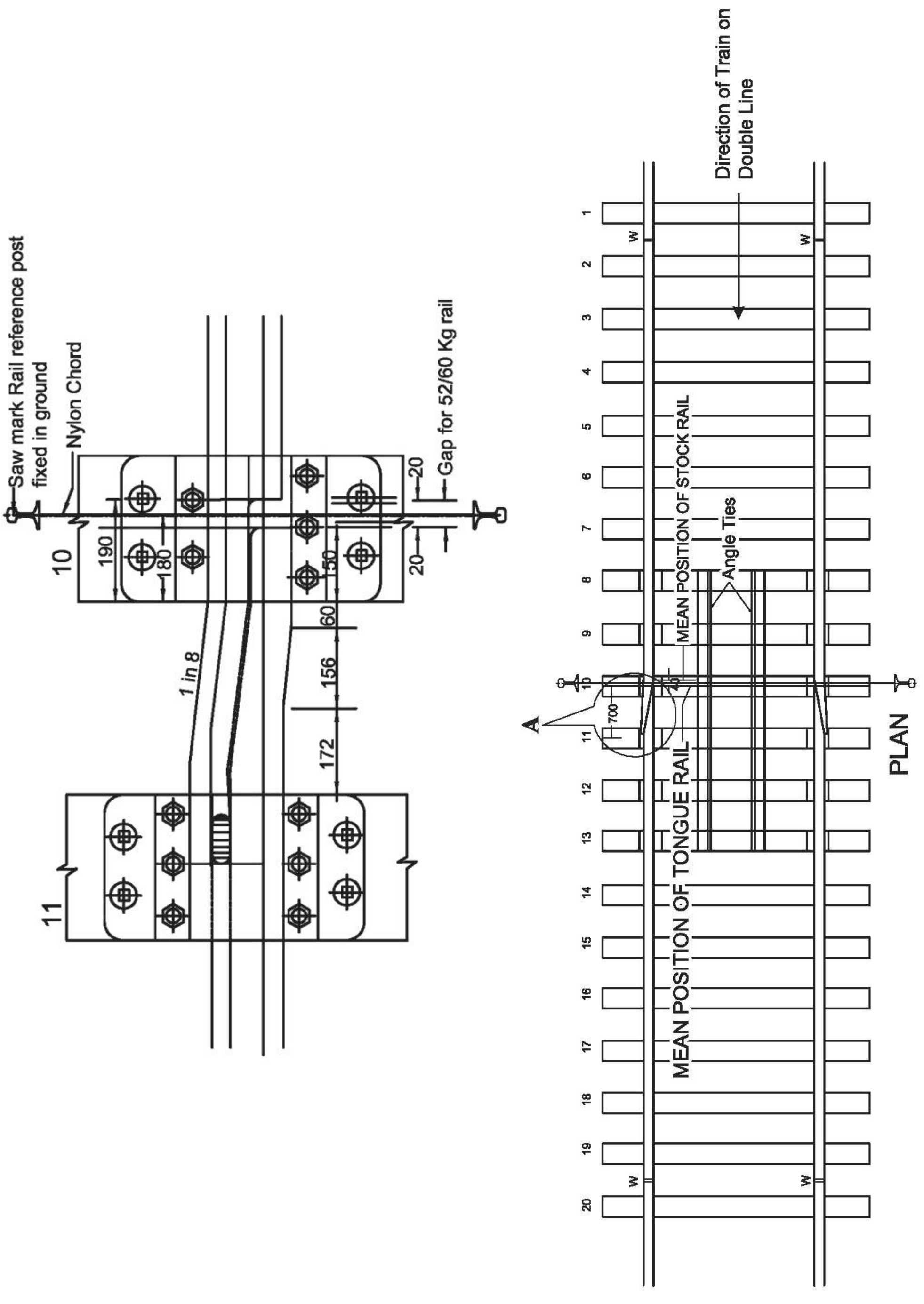


Fig 3.16

(b) The gaps between the reference mark and tongue rail tip/stock rail corner, which is attached to the LWR/CWR side at various rail temperatures, shall not differ by more than ±10 mm from the theoretical range as shown in **Annexure - 3/9** for conventional PSC sleepers and Annexure – 3/9B for wider base PSC sleepers.

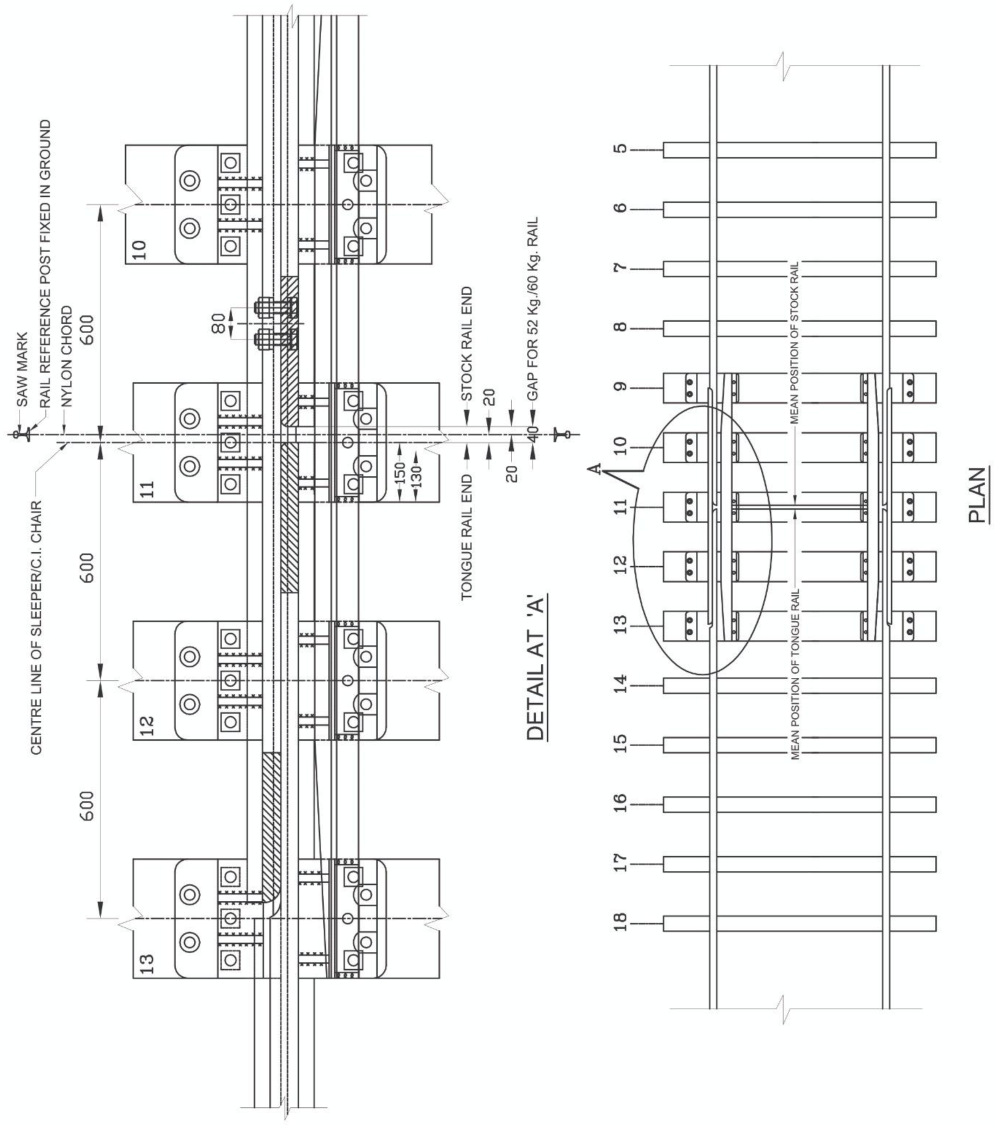
(c) Where fish-plated or SWR track is joined on one side of SEJ, the gap between the reference mark and tongue rail tip/stock rail corner on SWR/Fish plated track side shall not be measured.



Note -
(i) All dimensions are in milimetres.
(ii) At tthe time of initial laying/destressing, the tip of tongue rail should coincide with mid point of Central Bolts of C.I. Chair.
Reference line shall be kept at 20 mm from Central Bolt of C.I. Chair
(iii) Reference line shall be kept at 20 mm from Central Bolt of C.I. Chair

Fig 3.17 Setting of Gap at SEJ (IRS Design) to Drawing nos. RDSO/T-412, RDSO/T-4160, RDSO/T-4165, RDSO/T-5478, RDSO/T-5586, RDSO/T-5748, RDSO/T-6257, RDSO/T-6782 at De-stressing temperature (t_d)

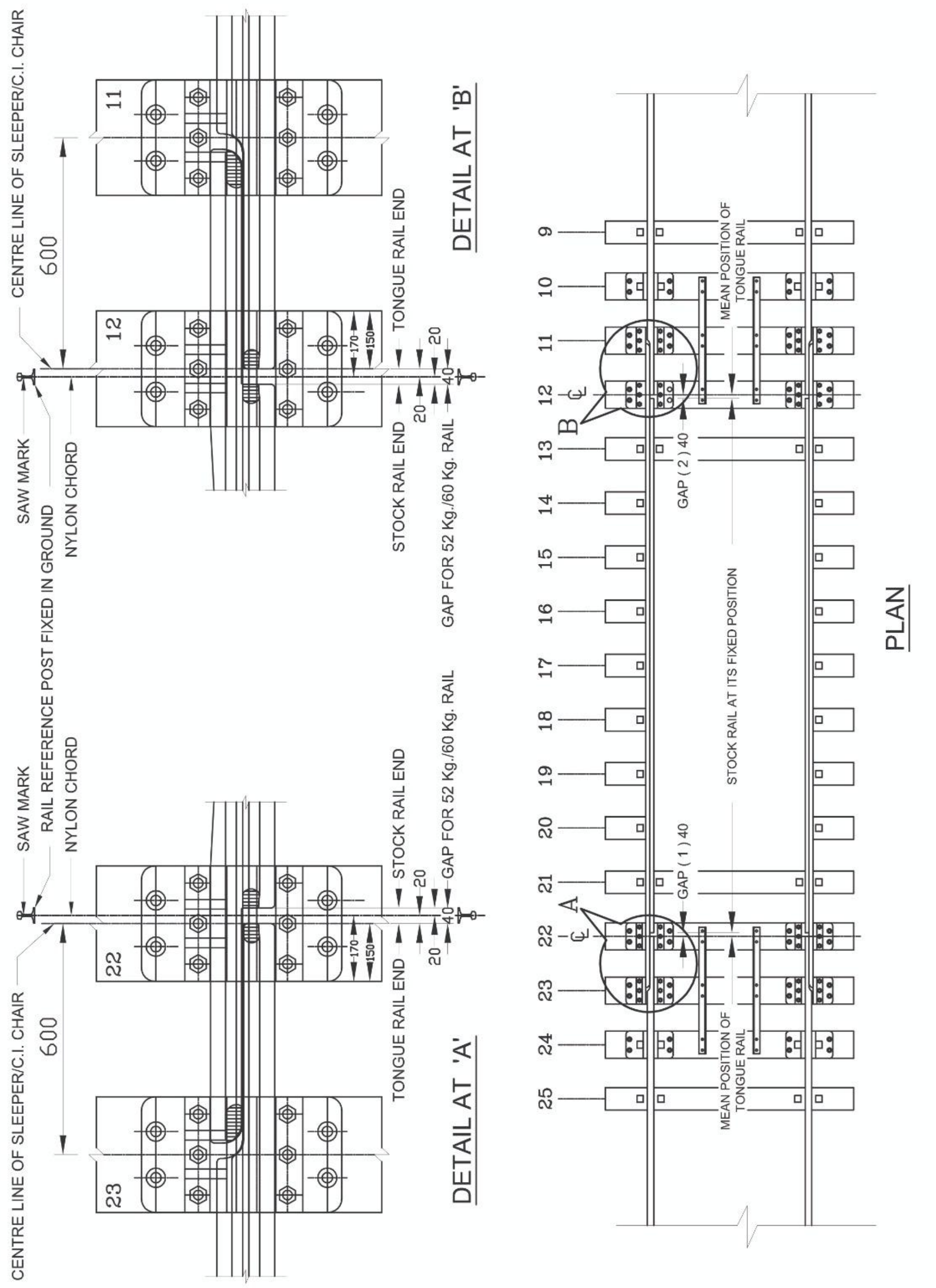
*Back to **Para 338***



Note –
i) All dimensions are in millimetres.
ii) At the time of initial laying/destressing, the tip of tongue rail should coincide with mid point of Central Bolts of C.I. Chair.
iii) Reference line shall be kept at 20 mm from Central Bolt of C.I. Chair.

Fig 3.18 Setting of Gap at Improved SEJ with Single gap of max. 80mm (SG 80 Design) to Drawing no. RDSO/T-6902 (60 Kg) & RDSO/T-6914 (52 Kg) (Applicable for both rails) at De-stressing temperature (t_d)

*Back to **Para 338***



Note –

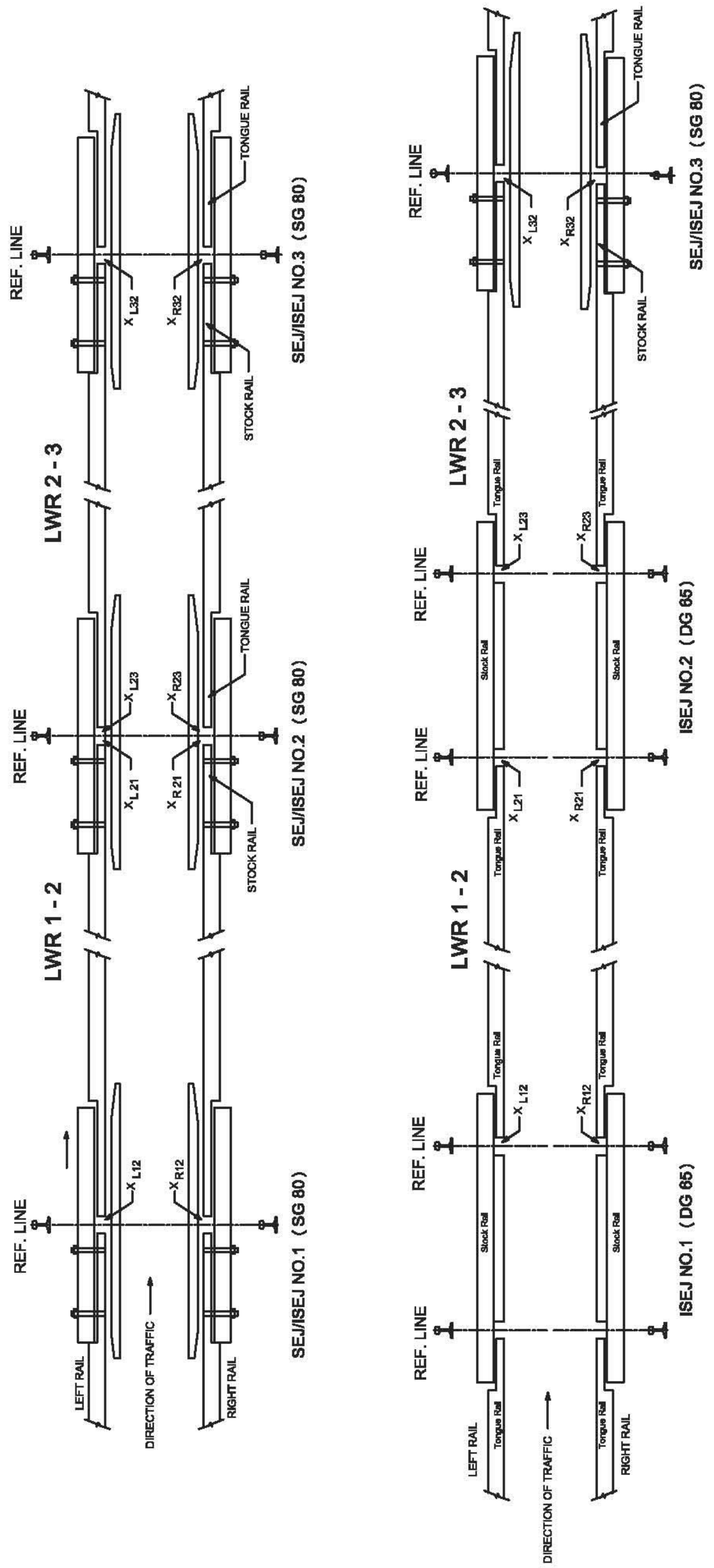
i) All dimensions are in millimetres.

ii) At the time of initial laying/destressing, the tip of tongue rail should coincide with mid point of Central Bolts of C.I. Chair.

iii) Reference line shall be kept at 20 mm from Central Bolt of C.I. Chair.

Fig 3.19 Setting of Gap at Improved SEJ with Double gap of max. 65mm each (DG 65 Design) to Drawing no. RDSO/T-6922 (60 Kg) & RDSO/T-6930 (52 Kg) (Applicable for both rails) at De-stressing temperature (t_d)

Back to ***Para 338***



LEFT/RIGHT RAIL	LWR No. 1 - 2		LWR No. 2 - 3	
	DISTANCE BETWEEN TONGUE/STOCK RAIL & REF. LINE AT SEJ No. 1 (COLUMN No. 5)	DISTANCE BETWEEN TONGUE/STOCK RAIL & REF. LINE AT SEJ No. 2 (COLUMN No. 7)	DISTANCE BETWEEN TONGUE/STOCK RAIL & REF. LINE AT SEJ No. 2 (COLUMN No. 5)	DISTANCE BETWEEN TONGUE/STOCK RAIL & REF. LINE AT SEJ No. 3 (COLUMN No. 7)
L/R R/R	X_{L12} X_{R12}	—	X_{L23} X_{R23}	—
L/R R/R	—	X_{L21} X_{R21}	—	X_{L32} X_{R32}

SEJ - IRS DESIGN/CONVENTIONAL SEJ

ISEJ (SG 80) - IMPROVED SEJ WITH SINGLE GAP OF MAX. 80 mm

ISEJ (DG 65) - IMPROVED SEJ WITH DOUBLE GAP OF MAX. 65 mm EACH

Fig 3.20 Illustration for measurement of gap at SEJ for observation of movement of LWR/CWR

*Back to **Para** **338***

339 De-stressing Operation of LWR – The work of de-stressing shall be done during a traffic block under the personal supervision of JE/SSE/P.Way.

De-stressing shall be done when rail temperature falls between the range provided for t_d. If required temperature cannot be obtained in field, de-stressing can be done at a little lower temperature than the targeted stress-free temperature t_o with the use of rail tensors.

340 De-stressing without Rail Tensors – (*Back to* ***Para 337, 346, 351***) In case rail temperature at the time of de-stressing is within the range specified for t_d, detailed procedure as given below may be adopted.

(1) The LWR, if longer than manageable lengths that cannot be de-stressed at a time, then, the LWR shall be de-stressed in parts by tackling manageable lengths depending on the availability of Block, labour etc.

(2) Remove impediments to free movement of rail such as rail anchors, guard rails, check rails etc.

(3) A traffic block of adequate duration should be arranged at such a time that the rail temperature will be within the temperature range specified for t_d during the fastening down operations of fittings.

(4) Before the traffic block is actually taken, a speed restriction of 30 Kmph should be imposed and fastenings on alternate sleepers loosened.

(5) When the traffic block is taken, a closure rail near the SEJ shall be cut and removed, the SEJs adjusted as per **Para 338(1) (b)** and fastened.

(6) The remaining fastenings on both running rails shall be loosened/removed starting from the ends near the SEJs and proceeding towards the centre of LWR. The rail shall be lifted and placed on rollers **Fig. 3.14** at every 15th sleeper to permit the rails to move freely. While de-stressing on curved track, provision of side rollers as per **Para 341(6) (a) & (b)** may be adopted. The rails shall be struck horizontally with wooden mallets to assist in their longitudinal movement.

(7) The rollers shall then be removed, the rails lowered to correct alignment and fastenings tightened, starting from the middle of LWR and proceeding towards both ends simultaneously. The tightening of fastenings shall be completed within the temperature range for t_d**.** The actual range of temperature during the period of tightening shall be recorded by JE/SSE/P.Way along with the time and date.

(8) Simultaneously with the tightening of fastening, arrangements for insertion of cut rails, 4 metre or longer, between the SEJ and LWR shall be started. The four gaps shall be measured individually and the rails of required length cut by saw keeping required gaps for AT welding. The cut rails shall then be placed in position, fastened to the sleepers and welded at each end. Fastenings for 20 m on each end of the LWR shall be removed before welding.

341 De-stressing with Rail Tensors – (*Back to* ***Para 337, 346, 351***)

For de-stressing of LWR with the use of rail tensor, the following procedure shall be adopted:

(1) The LWR, if longer than manageable lengths that can be de-stressed at a time, then, the LWR shall be de-stressed in parts by tackling manageable lengths depending on the availability of Block, labour and the capacity of the tensor available etc.

(2) Remove impediments to free movement of rail such as rail anchors, guard rails, check rails etc.

(3) During the traffic block, create a gap of 1 m at location ‘B’ i.e. centre of the first segment of the LWR (Fig. 3.21).

(4) Mark the anchor length A1 A2 and C1 C2 each equal to la at either end of the length A2 C2 to be de-stressed (Fig. 3.21 (a)).

Note: *The anchor length 'l_a' should be determined on the basis of the lowest value of t_p at which the de-stressing is likely to be carried out. Anchor length shall be increased suitably based on the condition of the fastenings, rubber pads, liners or ballast*

(5) Erect marker pillars W_0 W_1 etc., on each of the length A_2 B and C_2B. Transfer the marks W_0 onto the rail foot (Fig: 3.21 (a)).

Note: *The distances W_0 W_1, W_1 W_2 etc. shall be marked at about 100 m intervals, the distance from the previous pillars and the last pillar W_B may be less than 100 metre.*

(6) when t_P is less than the desired t_o (Fig. 3.21 (b)), de-stressing operation shall be carried out for the lengths A_2 B and C_2 B as described below:- (*Back to* ***Para 340(6)***)

(a) Unfasten and mount on rollers the portion from A_2 C_2.

Note: *Side rollers on the inside of curve shall also be used while undertaking de-stressing on curved track these should be spaced at every n^{th} sleeper,*

$$\text{Where, } n = \frac{\text{Radius of curve (R) x No. of sleepers per rail length}}{50 \times (t_o - t_p)}$$

(b) Outside supports shall be used in addition at the rate of one for every three inside supports.

(c) Fix the rail tensor across the gap at 'B' and apply tension so as to obtain some movement at W_0 to remove any kinks or misalignment and to minimize the friction in the rollers etc. Release the tension and note the movement Y_0 at W_0.

(d) Transfer marks W_1, W_{2},....... onto the rail foot and note temperature t_p.

(e) Calculate the required movement at W_1 = Y_o + elongation of length W_0 W_1 (L) due to temperature difference (t_o - t_p) = Y_0+ Lα (t_o - t_p)

(f) Calculate the required movement at W_2 = Movement at W_1 + elongation of length W_1W_2 (L) due to temperature difference (t_o - t_p). Similarly, calculate the required movements successively at each of the remaining points.

(g) Mark the above calculated extensions with respect to the transferred marks referred at (d) above on the rail foot on the side away from the tensor.

(h) Apply the tension by means of rail tensor till the mark of required extension comes opposite to the mark on the marker pillar W_1. Fasten down the segment W_0W_1

(i) Then check at W_2, bring the mark of required extension at this location opposite to the mark on the marker pillar W_2, by adjusting the tensor either by reducing or increasing tension and fasten down the segment W_1W_2. Similarly, check the remaining marks, adjust the tension as required and fasten down each segment before proceeding to the next segment.

Note:

(i) ***Annexure - 3/11*** *gives the value of Lα (to - tp) for different values of L and (to - tp).*

(ii) Only one value of tp has to be taken at the time of marking W1, W2 etc. on the rail foot. The values of tp is not required to be taken thereafter. The variation of temperature, if any during the de-stressing operation shall automatically be taken care of by reducing or increasing the tensile force from the tensor, while coinciding the reference mark on rail with the corresponding mark on pillars.

(iii) If for any reason, both the lengths A2B and C2B cannot be fastened down simultaneously, the final adjustment in pull and fastening down of the individual segments may be done in series, first from A2 to B and then, from C2 to B.

(j) After the fastening down of the last length A2B and C2B is completed, make a paint mark near free end of one rail at a distance of (X metre + 2 x 25 mm -1 mm), measured from the end of the other rail across the gap spanned by the rail tensor.

(k) Remove the tensor, close the 1 m gap temporarily and allow traffic at restricted speed (Fig. 3.21 (c)).

(7) During traffic block, cut the rail at the paint mark, insert a rail closure of length exactly equal to X metre and weld one end thereof (Fig. 3.21 (d)). If the gap at the other end is also 25 mm, it can be welded in the same block. Otherwise, fasten with special fishplates and clamps and allow traffic at restricted speed. In the latter case, during a subsequent block, when t_p is not greater than t_o, release rail fastenings on either side to the required extent of about 50 to 75 m and pull the rails with rail tensor to get the desired gap of 25 mm (Fig. 3.21 (e)); refasten the rail and weld the joint. Release the tensor after a lapse of a minimum of 30 minutes after pouring of the weld metal.

Note: - (i) X=4 metre or longer

(ii) **In case gap at the time of the second weld as above is less than the desired welding gap, additional cutting of rail shall NOT be done to create correct gap for welding.** In such cases, the welding should be done below t_d and the requisite gap for welding shall be created by using rail tensor and equalization of forces as described below shall be done.

(8) During a traffic block, when tp is less than td, equalize the forces in the rail by releasing the fastenings over a length of minimum 125 m on either side of location 'B' and tapping with wooden mallets etc. (Fig. 3.21 (f)). Fasten down the rail and allow traffic.

(9) The above procedure should be repeated for the remaining segments, if the entire LWR is to be de-stressed.

(10) During another traffic block, when tp is within the range of temperature specified for t_d, destress the end 125 metre from SEJ. Thereafter, weld the closure rail next to SEJ duly ensuring setting of the gaps at SEJ as per **Para 338**.

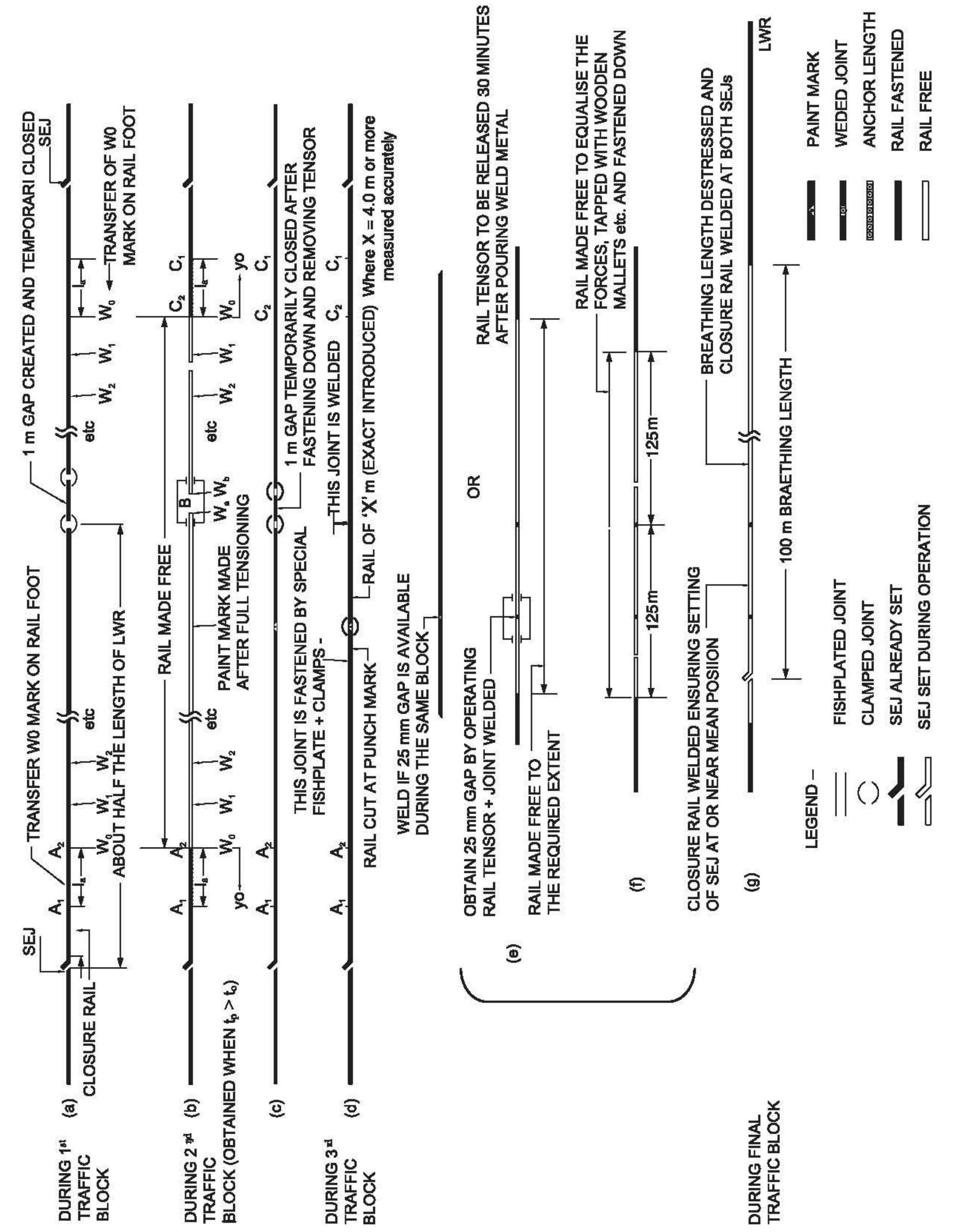


Fig 3.21 Destressing of LWR using Rail Tensor

Back to ***Para 341***

342 Joining of LWRs: (*Back to* ***Para 346***)–Detailed procedure for joining of LWRs is as given below (**Fig. 3.22 (a) to (f)**):-

(1) During traffic block, replace the existing SEJs between the LWRs with ordinary rails, of which there should be two temporary rails about 4 metre or longer for each of left and right sides. Leaving the temporary rails fish-plated, weld the other rails and traffic passed.

*Note**:** Where fluctuations of temperatures during the period of joining are likely to be small, only one temporary rail instead of two may suffice.*

(2) Provide W_0 marker pillars for each of the LWRs at a distance of 100 m from the centre of temporary rails, to mark the ends of the breathing lengths.

(3) Keep ready two rails of standard length. Measure their lengths 'l' correct to the nearest mm.

(4) Transfer the marks W_0 to the rail flange for both the LWRs.

(5) During the traffic block when t_p is less than desired t_0,remove the fishplates and fish-bolts connecting the temporary rails to the breathing lengths, release the fastenings of LWRs between the W_0 marks, mount the rails on rollers and note the movements Y_0 and Y'_0 at the marker pillars W_0, for LWRs 1 and 2 respectively.

*Note**:** The movements of Y_0 and Y'_0 should be away from the ends of LWR, if the LWRs are in a state of correct de-stressing.*

(6) Note t_p and mark the anchor length on either side as shown **Fig. 3.22 (b).**

(7) Make a paint mark near the end of either of the LWRs at a distance of $l + L\alpha(t_0\text{-}t_p) + Y_0 + Y'_0 + 2 \times 25 - 1$ mm measured from the end of other LWR. Here L = 200 m, 25 mm is the allowance for each Thermit weld and 1 mm is the allowance for a saw cut. The value of $L\ \alpha\ (t_0\text{-}t_p)$ may be read from ***Annexure - 3/11***.

(8) Remove the rollers, fasten down the length 'L', cut the rail at the paint mark, remove the temporary rails, insert the rail of length 'l' and weld one end of it. If the gap at the other end is 25 mm, it can also be welded during the same block. If the required 25 mm gap is not available, fasten the rails with fishplates and clamps and allow traffic at restricted speed.

(9) During the next traffic block (**Fig. 3.22 (e)**), weld the other joint if the gap is 25 mm. If the gap is more than 25 mm, release the rail fastenings on either side to the required extent and pull the rails with rail tensor to get the desired gap of 25 mm. Re-fasten and weld the rail. Release the tensor after the lapse of a minimum of 30 minutes after pouring of the weld metal.

(10) During the block (**Fig. 3.22 (f)**), equalize the forces in the rail by releasing the fastenings over the portion marked 'L' and over the anchor lengths on either side and tapping with wooden mallets, etc. Fasten down the rail and restore traffic.

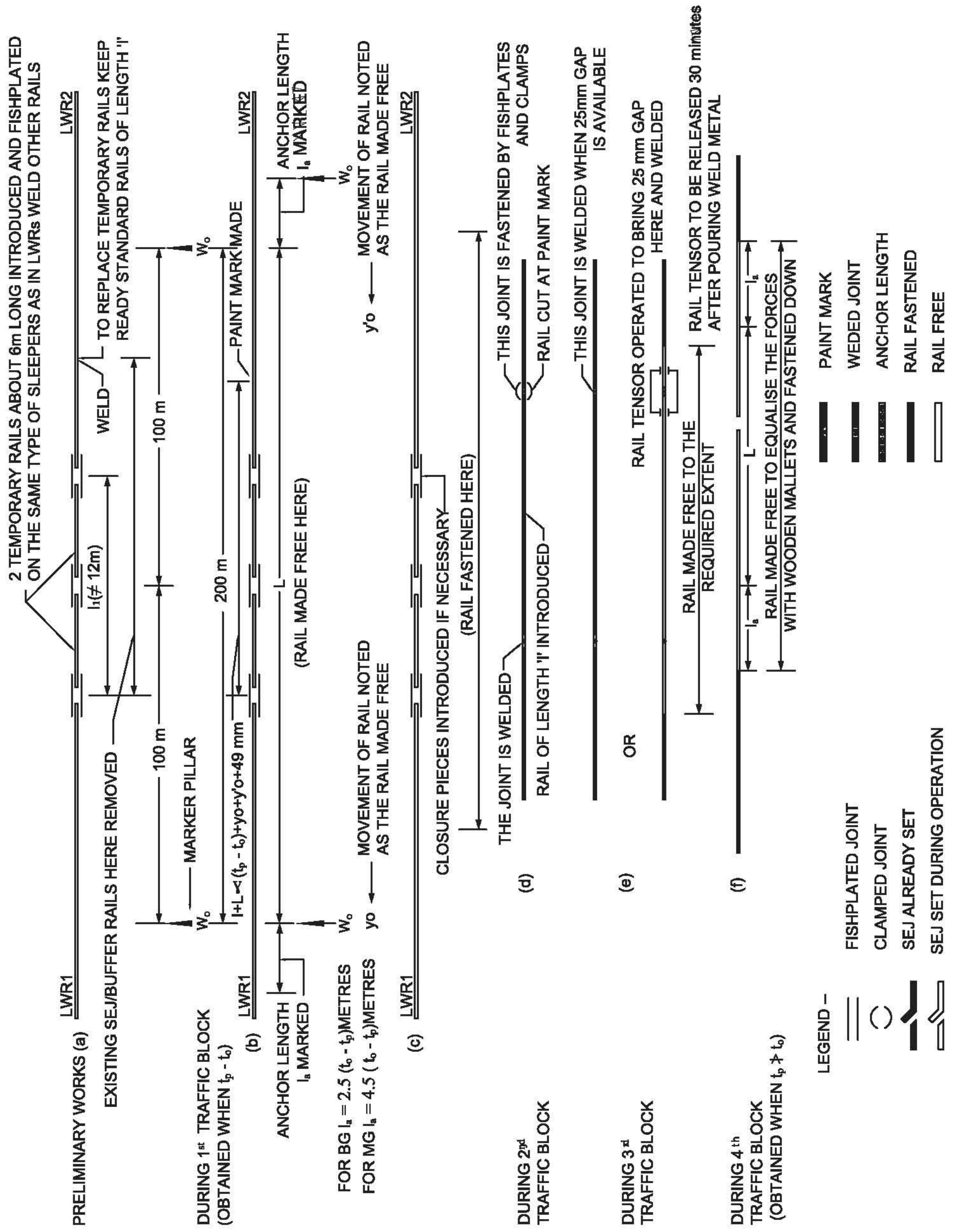


Fig 3.22 JOINING OF LWR (*Back to* ***Para 342***)

343 Reference Marks –

(1) Reference marks shall be fixed at each SEJ and at the centre of LWR/CWR, on the reference pillars erected for this purpose.

(2) While the reference marks on the reference pillars shall be saw marks, corresponding marks on the running rails shall be paint marks on the non-gauge face of the rail.

(3) In no case, a saw mark shall be made on the running rail. Reference marks are required to be fixed immediately after de-stressing of LWR/CWR and shall not be shifted or tampered with thereafter.

(4) Additional reference marks in fixed portion and breathing length may be provided to know the behaviour of LWR/CWR.

344 Maintenance of LWR/CWR –

An important prerequisite for proper functioning of LWR/CWR is its initial laying to a high standard and its subsequent maintenance by trained personnel possessing valid competency certificates as per **Annexure - 14/2** and level of authorization not lower than what is laid down in **Annexure - 3/10**.

345 Regular Track Maintenance: (*Back to* ***Para 609***)

Regular track maintenance in LWR/CWR includes following operations:-

(i) Tamping/packing

(ii) Lifting

(iii) Aligning including minor realignment of curves

(iv) Shallow screening/shoulder cleaning

(v) Renewal of fastenings requiring lifting

(vi) Maintenance of SEJ

(1) *General:* *(Back to* ***Para 345(2)****)*

(a) The regular track maintenance in LWR/CWR shall be confined to hours when the rail temperature is between t_d+10°C and t_d-30°C and shall be completed well before onset of summer. However, for LWR on wider base sleepers, regular track maintenance shall be confined to hours when the rail temperature is between t_d+15°C and t_d-30°C.

(b) If rail temperature after the maintenance operation exceeds t_d+20°C for conventional PSC sleeper and t_d+25°C for wider base sleepers during the period of consolidation, then the speed restriction of 50 Km/h shall be imposed.

(c) Ballast section shall be properly maintained, especially on pedestrian & cattle crossings, curves and approaches to level crossings and bridges. Cess level should be correctly maintained. Dwarf walls may be provided on pedestrian and cattle crossings to prevent loss of ballast.

(d) Replenishment of ballast shall be completed before onset of summer. Shortage of ballast in the shoulder at isolated places shall be made up by the Gang Mate by taking out minimum quantity of ballast from the centre of the track between the two rails over a width not exceeding 600 mm and a depth not exceeding 100 mm.

(e) Sufficient quantity of ballast shall be collected to provide full ballast section before commencing any maintenance operation, specially lifting.

(f) When crowbars are used for slewing, care shall be taken to apply these in a manner so as to avoid lifting of track. In this connection, the instructions in **Para 607 (d)** shall be followed.

(g) Special attention shall be paid to maintenance of track at following locations:

- SEJs/breathing lengths
- Approaches of level crossings, points & crossings and un-ballasted deck bridges
- Horizontal and vertical curves

(h) All fastenings shall be complete and well secured in position.

(2) *Mechanised Maintenance* –

(a) Tamping in LWR/CWR with general lift not exceeding 50 mm including correction of alignment shall be carried out during the period when prevailing rail temperatures are as per **Para 345 (1) (a) & (b)** together with precautions laid down therein.

(b) Lifting where needed, in excess of 50 mm shall be carried out in stages with adequate time gap in between successive stages such that full consolidation of the previous stage is achieved prior to taking up the subsequent lift.

(c) Mechanised cleaning of shoulder ballast shall be undertaken when prevailing rail temperatures are within the limits prescribed together with the precautions mentioned therein.

(3) *Manual maintenance* –

(a) At no time, not more than 30 sleepers spaces in a continuous stretch shall be opened for manual maintenance or shallow screening with at least 30 fully boxed sleeper spaces left in between adjacent openings. Maintenance of in between lengths shall not be undertaken till passage of traffic for at least 24 hours in case of BG carrying more than 10 GMT or 2 days in case of other BG routes.

(b) For correction of alignment, the shoulder ballast shall be opened out to the minimum extent necessary and that too, just opposite the sleeper end. The ballast in shoulders shall then be put back before opening out crib ballast for packing.

(c) In exceptional circumstances when more than 30 sleeper spaces have to be opened for any specific work, like through screening of ballast etc. during the period of the year when minimum daily rail temperature is not below t_d-30°C or maximum does not go beyond t_d+10°C, upto 100 sleeper spaces may be opened under the direct supervision of JE/SSE/P.Way.

(d) It should however, be ensured that rail to sleeper fastenings on the entire length of LWR including SEJs are functioning satisfactorily.

(4) *Casual renewal of sleepers* – Not more than one sleeper in 30 consecutive sleepers shall be replaced at a time. Should it be necessary to renew two or more consecutive sleepers in the same length, they may be renewed one at a time after packing the sleepers renewed earlier duly observing the temperature limits specified in **Para 345 (1) (a) & (b)** together with precautions mentioned therein.

(5) *Renewal of fastenings* – The work of renewal of fastenings shall be carried out when rail temperature is within the limits specified in **Para 345 (1) (a) & (b)** with following additional precautions:-

(a) Renewal of fastenings not requiring lifting of rail – (*Back to **Para 116 (7) (b)***) Fastenings not requiring lifting of rails, shall be renewed on not more than one sleeper at a time. In case fastenings of more than one sleepers are required to be renewed at a time, then at least 15 sleepers in between shall be kept intact. Work shall be done under supervision of Keyman.

(b) Renewal of fastenings requiring lifting of rail – Fastenings requiring lifting of rails i.e., grooved rubber pads, etc. shall be renewed on not more than one sleeper at a time. In case fastenings of more than one sleeper are required to be renewed at a time, then at least 30 sleepers in between shall be kept intact. Work shall be done under supervision of Gang Mate.

Alternatively, if prevailing rail temperature is lower than td-10, fastening up to 5 sleepers on either side may be removed for replacement of rubber pad under the rail.

(6) *Maintenance of SEJs* –

(a) Once in a fortnight SEJs shall be checked, packed and aligned if necessary. Oiling and greasing of tongue and stock rails of SEJ and tightening of fastenings shall be done simultaneously.

(b) During his daily patrolling, Keyman shall keep special watch on the SEJs falling in his beat.

(7) *Renewal of defective rails/welds* –

The procedure laid down in **Para** 349(2) of this manual for repairs to track after rail fracture shall be followed.

346 Special Track Maintenance: (*Back to **Para** 347, 628, 638, 639, 714*)

Special track maintenance in LWR/CWR includes following operations:-

(a) Through fittings renewal

(b) Deep screening/mechanised cleaning of ballast

(c) Lowering/Lifting of track

(d) Major realignment of curves

(e) Sleeper renewal other than casual renewals

(f) Rehabilitation of bridges and formation causing disturbance to track

(1) *Through fittings renewal* – Whenever it is decided to carry out through renewal of fittings, the LWR shall be de-stressed immediately after the TFR is completed of complete or part LWR.

(2) *Deep screening/mechanised cleaning of ballast:*

(a) Provisions laid down in ***Para 637 (2)*** shall apply to LWR/CWR regarding the sequence of operations of Ballast Cleaning Machine (BCM).

(b) Ballast Cleaning Machine (BCM), tamping machine and Dynamic Track Stabilizer (DTS) shall, as far as possible, be deployed in one consist.

(c) Temperature records of the sections where deep screening is to be undertaken, shall be studied for the previous and the current year. The maximum and minimum rail temperature attainable during the period of deep screening and during the period of consolidation shall be estimated. Any of the following two methods may be adopted for carrying out the work of deep screening/mechanised cleaning:

(i) If range of rail temperature falls within t_d+10°C to t_d-20°C, deep screening may be done without cutting or temporary de-stressing.

(ii) If range of rail temperature falls outside (a) above, temporary de-stressing shall be carried out 10°C below the maximum rail temperature likely to be attained during the period of work.

(d) Constant monitoring of rail temperature shall be done during the progress of work. Should the temperature rise more than 10°C above t_d / temporary de-stressing temperature, adequate precautions shall be taken including another round of temporary de-stressing as required.

Note: *Deep screening shall be undertaken within a reasonably short period of temporary de-stressing so as to ensure that the temperature range as prescribed at Sub-**Para (2)(c) (ii) above** is ensured, failing which temporary de-stressing may become due again.*

(e) During the period of deep screening, if there is any possibility of minimum temperature falling 20°C below td / temporary de-stressing temperature, cold weather patrol as per ***Para 1005 (3)*** should be introduced to detect / guard against rail fractures.

(f) Sequence of operation: -

(i) Deep screening of LWR may be done from one end of LWR to other end.

(ii) After deep screening and consolidation, de-stressing of LWR shall be undertaken as per ***Para 340 / 341.***

(3) *Other special maintenance*

(a) Other types of special track maintenance constitute jobs like lowering of track, major realignment of curves, renewal of large number of sleepers or rehabilitation of formation/ bridges causing disturbance to track.

(b) For carrying out such maintenance, the affected length of track may be isolated from LWR/ CWR by introducing SEJs as needed.

(c) After completion of work, the affected length of track shall be de-stressed at the required de-stressing temperature and joined with rest of the LWR/CWR in accordance with ***Para 342.***

347 Destressing during Maintenance – (*Back to **Para 714***)

(1) Abnormal behaviour of LWR/CWR can be inferred by observing one or more of the following –

(a) When the gap observed at SEJ

(i) Differs beyond limits specified in ***Annexure - 3/9***.

(ii) Exceeds the maximum designed gap of SEJ

(iii) When tip of tongue rail/corner of Stock Rail crosses the reference line

(b) In case of excessive creep of more than 20 mm in the central portion of LWR is noticed.

(c) In ideal condition, stress free temperature is same as destressing temperature. However, during service, various stresses get locked up due to maintenance activities, creep of rail, deterioration of track geometry, traffic conditions etc. The locked-up stresses alter the Stress-Free Temperature (SFT) of the rail. Determination of actual SFT by use of any RDSO approved Non-Destructive Technique will be helpful in monitoring behaviour of LWR.

(2) In such cases as in Sub *Para (1)* above, LWR/CWR shall be inspected by ADEN for

(a) Deficiency of ballast,

(b) Poor compaction / consolidation of ballast,

(c) Deficiency of fittings,

(d) Poor toe load of ERC

(e) Formation trouble if any,

(f) Whether procedures as per ***Para 349*** were followed during permanent repairs after earlier rail fracture(s),

(g) The possibility of defective thermometers being used by the staff.

After the above inspection, the deficiency shall be made good at the earliest by suitable corrective action, to improve the track resistance. Thereafter, the SEJ/LWR shall be kept under close observation by active monitoring by the JE/SSE/P.Way. If LWR/CWR still behaves abnormally, a decision shall be taken by ADEN for de-stressing of LWR/CWR.

(3) After special maintenance operations mentioned in ***Para*** **346,** de-stressing shall be undertaken.

(4) After restoration of track following an unusual occurrence mentioned in ***Para*** **348,** de-stressing shall be undertaken.

(5) If number of locations where repairs by way of replacement of rail / weld have been done, exceed three per km, de-stressing of affected portion of LWR / CWR shall be done.

348 Unusual Occurrences: List of unusual occurrences: (*Back to* ***Para 347***)

(a) Rail fractures or replacement of defective rail/ glued joint.

(b) Damage to SEJ.

(c) Buckling or tendency towards buckling.

(d) Factors causing disturbance to LWR/CWR such as accidents, breaches etc.

349 Rectification of Rail Fractures: (*Back to* ***Para 347, 351***)

(1) *Equipment required –*

(a) Special 1 m long fishplates with screw clamps and joggled fishplates with bolted clamps (for fractures at welded joints) as per arrangement shown in Fig. **3.9**, **3.10**, **3.11** & **3.12**.

(b) Steel tape capable of reading upto one mm

(c) Alumino-thermic welding and finishing equipment

(d) Equipment for de-stressing

(e) 4 metre or longer sawn rail cut piece of the same section as LWR duly tested by USFD

(f) Rail closures of suitable lengths

(g) Equipment for protection of track

(2) *Procedure for repairs – (Back to* ***Para 345****)*

If any fracture takes place on LWR/CWR, immediate action shall be taken by the official who detected the fracture to suspend the traffic and to protect the line. He shall report the fracture to the Gang Mate /Keyman/JE/ SSE/P.Way. Repairs shall be carried out in four stages as described below:

(a) Emergency repairs

(b) Temporary repairs

(c) Permanent repairs

(d) De-stressing.

(3) *Emergency repairs –*

The fractured rails shall be joined by using the arrangements shown in Fig. **3.9**, **3.10**, **3.11** & **3.12**. with or without insertion of closure rail piece as per site conditions and feasibility. The traffic may then be resumed at a speed as mentioned in ***Annexure - 3/8*** and by authority as mentioned in ***Annexure - 3/10***.

(4) *Temporary repairs* – (*Back to* ***Para 351***)

If a welding party is not readily available, the fracture shall be repaired by using a cut rail (4 metre or longer) and clamped/bolted as per arrangement shown in Fig. **3.9, 3.10, 3.11 & 3.12**.

(a) A traffic block shall be taken as soon as possible preferably when the rail temperature is within the range specified for t_d or as near as possible to td.

(i) Two points on either side of the fracture shall be marked on the rail such that the length of closure rail to be inserted is equal to the total length of the rail pieces removed from the track minus allowances for two welds and saw cut (normally 51 mm). See **Fig. 3.23.**

(ii) Alternately, two points on either side of the fracture shall be marked on the rail at a distance equal to the length of the available closure rail. The length of closure rail should not become less than 4 m at the time of permanent repairs. See **Fig. 3.23**.

(b) The rails shall then be cut through at these points simultaneously, if possible. The closure rail shall then be inserted and joined See **Fig. 3.24**. After joining, the traffic shall then be resumed at restricted speed in accordance with **Annexure - 3/8**.

(c) In case closure rail as per *Sub Para* (4) (a) (i) above is inserted, one of the joints may have to be provided with closure piece of adequate width and joined by one metre fishplate and clamps.

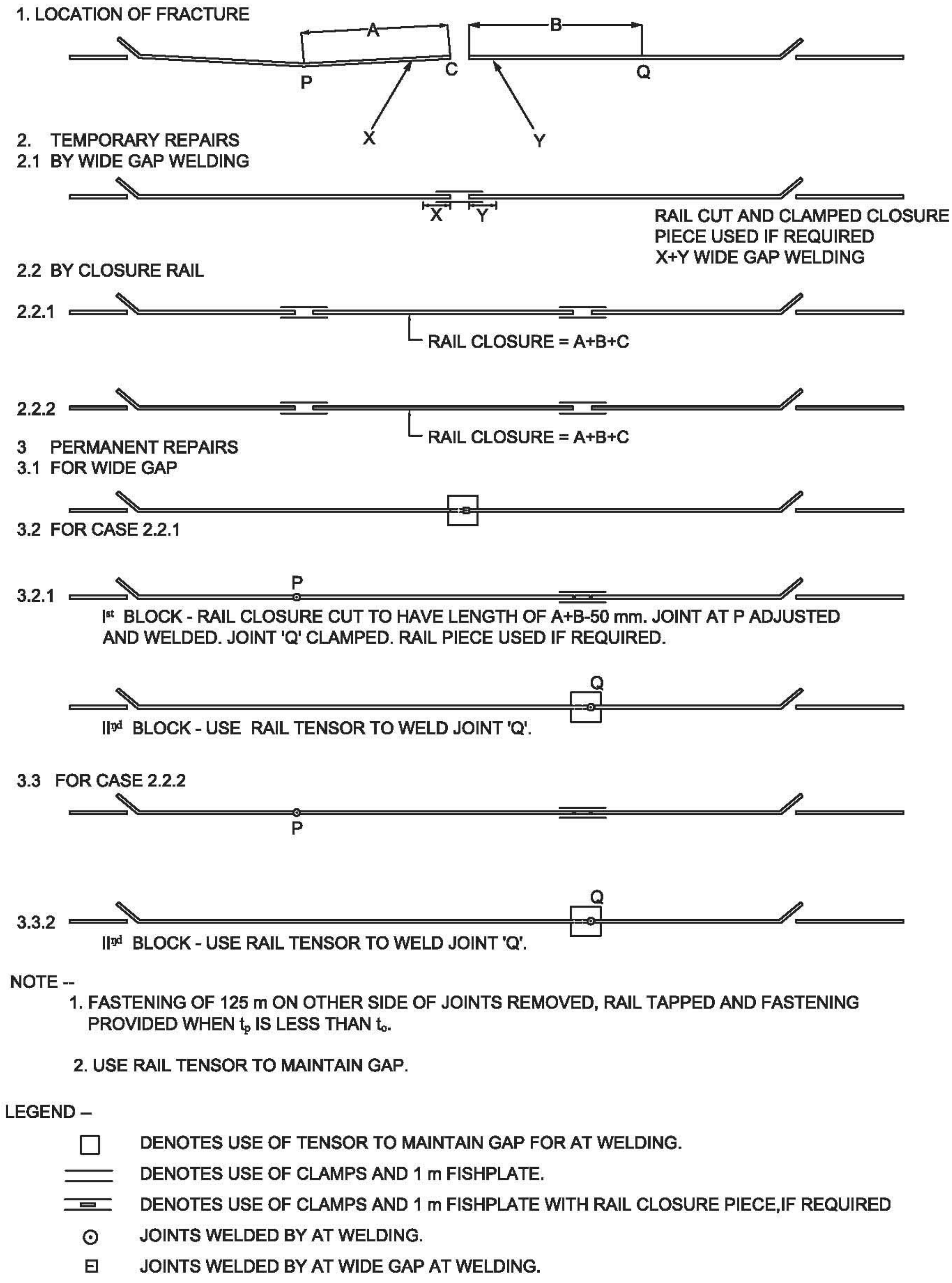
(5) *Permanent Repairs* – (*Back to* ***Para 351***)

(a) If the fracture is such that, wide gap AT welding can be adopted, then the total length of fractured ends to be cut shall be equal to the gap required for wide gap welding. Once the two ends are cut, a gap required for wide gap welding will be created by using rail tensors and joint welded by wide gap AT welding technique.

(b) In case rail closure as per *Sub Para (4) (a) (i)* has been provided for temporary repairs, one joint of the closure rail shall be welded without rail tensor after setting correct gap for welding. However, to ensure correct gap during welding of the other joint, tensor shall be used.

(c) In case rail closure as per Sub Para (4) (a) (ii) has been provided at the time of temporary repairs, the rail closure shall be suitably cut such that the length of the rail to be finally inserted in track is equal to length of rail removed from track after fracture minus allowances for two welds i.e. 50 mm. Once the closure rail is cut, the closure rail will be welded as given in *Sub Para (5)(b).*

(d) It is necessary to carry out local destressing of 125 m on either side for equalization of stresses, induced in LWR due to permanent repair. Explanatory note is given in **Annexure - 3/17**. After welding of joints, at rail temperature below t_d, a length of track equal to 125 m on either side be unfastened and tapped to ensure equalization of stress and then refastened. The details of equalization of forces shall be entered in to TMS under local destressing in weld fracture report.



3.23 TEMPORARY AND PERMANENT REPAIRS OF RAIL FRACTURE WITH USE OF RAIL TENSOR (*Back to* ***Para*** ***349***)

350 Damage to Switch Expansion Joint –

(1) The damaged/broken SEJ shall be replaced with a new SEJ. The gap at the new SEJ shall be adjusted to the mean gap as provided in **Annexure - 3/9** depending of the rail temperature prevailing at the time of replacement.

(2) If another SEJ is not available for replacement, both the damaged SEJ and the undamaged SEJ on the opposite rail at the same location, shall be replaced by a closure rail and connected to LWR/CWR with special clamps and fishplates.

The traffic over the clamped joints may be permitted at a restricted speed as per ***Annexure - 3/8***. The restriction may be relaxed only after the new SEJ has been inserted in the correct position and the clamped joint has been replaced with in-situ weld.

351 Buckling of Track –

(1) *General:*

Buckling or a tendency towards buckling may occur, among others, in the following circumstances:

(a) Failure to adhere to the temperature ranges specified for various laying and maintenance activities on LWR/CWR.

(b) Inadequate resistance to longitudinal, lateral and vertical movement of track due to deficiencies in ballast section or/and inadequate ballast consolidation.

(c) Use of ineffective fastenings or missing fastenings resulting in loss of creep resistance and torsional resistance.

(d) Excessive settlement of formation.

(e) Repair to fractures or replacement of defective rails not as per procedure prescribed in ***Para 349***, which can lead to the disturbance to the force diagram in the LWR as explained below **(Fig. 3.24 (a), (b) (c)).**

(i) Normal Force diagram in a good LWR:

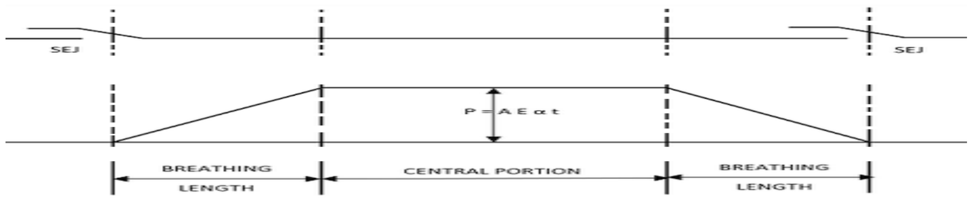


Fig. 3.24 (a)

(ii) In case rail fracture occurs, the force diagram gets altered instantaneously as under:

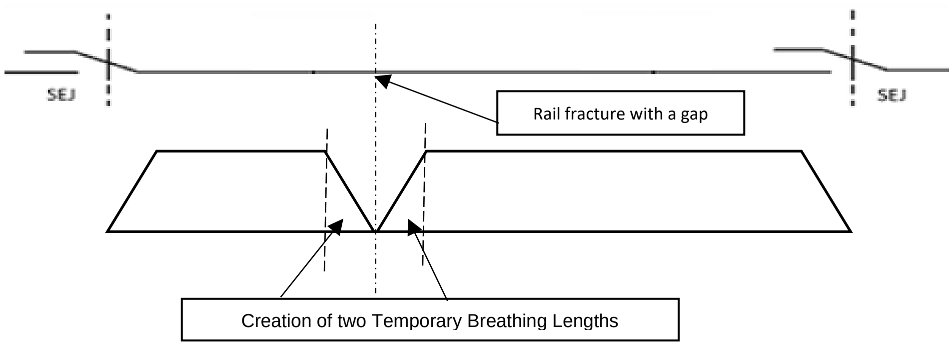


Fig 3.24 (b)

(iii) If rail introduced during repairs to rail fracture is not as per the provisions of ***Para 349*** the force diagram is altered as under:

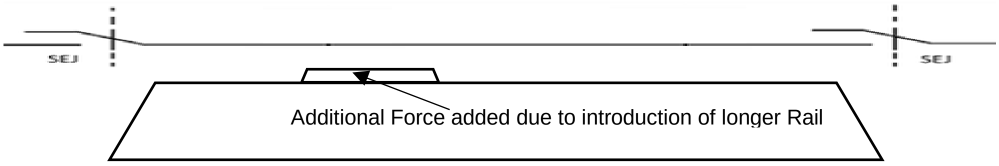


Fig 3.24 (c)

(2) *Buckling and its investigation -*

(a) Tendency towards buckling will usually manifest itself through kinks in track. Kinks may also arise from incorrect slewing or lifting operations. By tapping sleepers for hollowness, it may be possible to notice if there is any tendency towards vertical buckling.

(b) As soon as the tendency for buckling is detected, the traffic shall be suspended and the track protected. The track shall then be stabilized by heaping ballast on the shoulders upto the top of the web of the rail obtaining the ballast from inter-sleeper spaces between the rails. Thereafter full investigation shall be made to find out the cause of the tendency for buckling.

(c) Each case or buckling shall be investigated by ADEN soon after its occurrence and a detailed report submitted to DEN/Sr. DEN.

(3) *Repairs to buckled track -*

(a) When the track actually buckles, the traffic shall be suspended and the cause of buckling ascertained.

(b) The rectification shall normally be carried out in the following stages under the supervision of JE/SSE/P.Way:-

(i) *Emergency repairs* - The buckled rails shall preferably be gas cut adequately apart not less than 6.5 m. The track shall then be slewed to the correct alignment and cut rails of the required lengths shall be inserted to close the gaps making due provision for welding of joints on both sides. The cut rails shall then be connected by use of special fishplates and screw clamps and the line opened to traffic with speed restriction as indicated in ***Annexure - 3/8***.

(ii) *Permanent repairs* - As soon as possible, the clamped joints shall be welded adopting the same procedure as in ***Para 349(4) and (5).*** Additional pair of cut rails and rail cutting equipment shall also be required to adjust the gaps in case they have been disturbed in the intervening period.

The speed restriction shall be removed after welding.

(iii) The length of track of minimum 500 m on either side of the location of buckling of the affected LWR shall be de-stressed as soon as possible as per ***Para 340/ Para 341*** and complete LWR shall be inspected by ADEN and further action as deemed necessary shall be taken.

352 Breaches, Temporary Girders and Diversions -

(1) The affected portion shall be isolated by insertion of SEJs preferably within the temperature range specified for t_d.

(2) The track thus isolated shall be replaced by fish plated / SWR track, which shall be provided with ERC with adequate toe load to arrest creep.

(3) In the breached sections where the new banks are constructed, the formation shall be fully consolidated before laying LWR again.

(4) In case of diversions and insertion of temporary girders, SEJ shall be inserted to

isolate the portion where such work is required to be done.

(5) The LWR panels in the affected portion shall be de-stressed immediately after the LWR are restored.

353 Hot and Cold Weather Patrolling - Hot and Cold Weather Patrolling shall be introduced and carried out in accordance with the provisions contained in **Para 1005**.

354 Inspection and Records -

(1) **Inspection** -

While requiring less maintenance, LWR/CWR necessitate intensive inspection at supervisory and officer's level.

(a) The profile of the ballast section shall always be as per **Para 212**. This should be checked, especially at pedestrian / cattle crossings, curves, approaches of level crossings, points and crossings and bridges. Cess level should be correctly maintained. Replenishment of ballast shall be completed before the onset of summer.

(b) Inspection shall be more frequent in the afternoons during summer months. During inspections, look out shall be kept for kinks, incipient buckles and checks made on functioning of the patrols.

(c) Knowledge of staff in regard to prescribed maintenance practices shall be periodically checked and it shall be ensured that the work is done accordingly.

(d) Ultrasonic examination of rails should not be in arrears. Defective rails/welds should be replaced expeditiously.

(e) Inspections of gaps at SEJ and creep/movement at central portion of LWR/CWR by Permanent Way officials would be done as per prescribed schedule by JE/SSE/P.Way (Sectional), SSE/P.Way (In-charge) and ADEN.

(2) **RECORDS -**

(a) The Record of LWR/CWR shall be maintained by the JE/SSE/P.Way in TMS database. Format is as per **Annexure - 3/12, 3/13, 3/14 and 3/15**.

(b) An indication plate similar to that suggested in **Para 661 (6)** shall be fixed on the cess at each SEJ showing the date of de-stressing, de-stressing temperature t_d/t_o and length of LWR/CWR.

(c) ADEN will analyse the observation of each LWR/CWR and give a certificate before onset of summer regarding satisfactory behaviour of all LWR/CWR.

(d) The DEN/Sr.DEN will scrutinise TMS records and shall countersign certificate given by ADEN and send to Chief Track Engineer.

Annexure - 3/8 (*Para 326, 337, 349, 350, 351, 618*)

SCHEDULE OF SPEED RESTRICTIONS

S. No.	Conditions of track	Restriction imposed in Km/h
1 (a)	When 1 metre long slotted fishplates **(Fig. 3.9)** with screw clamps **(Fig. 3.10)** & M.S. clamp **(Fig. 3.11)** or joggled fishplates with bolted clamps **(Fig. 3.12)** are used at a temporary rail joint and there is 24 hrs. watch. However, if the above arrangement is not under round the clock watch, speed restriction of 20 Kmph should be imposed, as mentioned in drawings.	**30**
1 (b)	Approved High Performance Rail Clamps should be used progressively for improved safety. When approved High Performance Rail Clamps are used at a temporary rail joint and there is 24 hrs watch, a speed restriction of 50 kmph shall be imposed. However, if the above arrangement is not under round the clock watch, speed restriction of 30 Kmph should be imposed.	**50**
2	When sleeper fastenings on alternate sleepers are loosened before de-stressing	**30**
3 (a)	At fracture after emergency repairs are completed	
(i)	First train	**STOP DEAD & 10**
(ii)	Subsequent trains	**20**
3 (b)	At fracture after emergency repairs are completed with approved high performance rail clamps and there is 24 hrs watch	
(i)	First train	**STOP DEAD & 10**
(ii)	Subsequent trains	**50**
4	After emergency repairs to track after buckling	
(i)	First train	**STOP DEAD & 10**
(ii)	Subsequent trains	**20**
5	Speed restriction during consolidation period of track, after regular track maintenance operations when rail temperature exceeds t_d + 20°C:	
(i)	When shoulder and crib compaction has been done:-	**50**
(ii)	When shoulder and crib compaction has not been done	**30**

Annexure - 3/9 (*Para 338, 347, 350*)

Gaps at SEJ for various Rail Temperatures and Conventional PSC Sleeper (RDSO/T-2495 & 2496) Track in mm

ZONE – I

Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
t_d + 25°	15	14	16	15
t_d + 20°	15 to 17	14 to 17	16 to 18	15 to 17
t_d + 15°	15 to 19	15 to 19	16 to 19	15 to 19
t_d + 10°	16 to 21	15 to 21	16 to 21	16 to 21
t_d + 05°	16 to 22	16 to 23	17 to 22	17 to 22
t_d	17 to 24	17 to 24	18 to 23	18 to 24
t_d - 05°	19 to 25	18 to 25	19 to 24	19 to 25
t_d - 10°	20 to 26	20 to 26	20 to 25	20 to 26
t_d - 15°	21 to 27	22 to 27	21 to 26	21 to 26
t_d - 20°	23 to 27	24 to 28	23 to 26	23 to 27
t_d - 25°	25 to 27	26 to 28	24 to 26	25 to 27
t_d - 30°	27	28	26	27

ZONE – II

Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
t_d + 30°	13	12	14	13
t_d + 25°	13 to 15	12 to 15	14 to 16	13 to 15
t_d + 20°	13 to 18	12 to 17	14 to 18	13 to 18
t_d + 15°	13 to 20	13 to 20	14 to 20	14 to 20
t_d + 10°	14 to 22	14 to 22	15 to 22	14 to 22
t_d + 05°	15 to 24	15 to 24	16 to 23	15 to 23
t_d	16 to 25	16 to 26	17 to 24	16 to 25
t_d - 05°	18 to 26	17 to 27	18 to 26	18 to 26
t_d - 10°	19 to 28	19 to 28	19 to 27	19 to 27
t_d - 15°	21 to 28	21 to 29	21 to 27	21 to 28
t_d - 20°	23 to 29	23 to 30	22 to 28	23 to 29
t_d - 25°	25 to 30	26 to 31	24 to 28	25 to 29
t_d - 30°	27 to 30	28 to 31	26 to 29	27 to 30
t_d - 35°	30	31	28 to 29	29 to 30
t_d - 40°	-	-	-	-

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm.*

Annexure - 3/9 *(Para 338, 347, 350)*

Gaps at SEJ for various Rail Temperatures and Conventional PSC Sleeper (RDSO/T-2495 & 2496) Track in mm

ZONE – III

Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
t_d + 35°	10	9	11	10
t_d + 30°	10 to 13	9 to 12	11 to 14	10 to 13
t_d + 25°	10 to 16	9 to 15	12 to 16	11 to 16
t_d + 20°	11 to 18	10 to 18	12 to 19	11 to 18
t_d + 15°	12 to 21	11 to 21	13 to 21	12 to 21
t_d + 10°	12 to 23	12 to 23	13 to 22	13 to 23
t_d + 05°	14 to 25	13 to 25	14 to 24	14 to 25
t_d	15 to 27	14 to 27	16 to 26	15 to 26
t_d - 05°	16 to 28	16 to 29	17 to 27	17 to 28
t_d - 10°	18 to 30	18 to 31	18 to 28	18 to 29
t_d - 15°	20 to 31	20 to 32	20 to 29	20 to 30
t_d - 20°	22 to 32	23 to 33	22 to 30	22 to 31
t_d - 25°	25 to 32	25 to 34	24 to 31	25 to 32
t_d - 30°	27 to 33	28 to 34	26 to 31	27 to 32
t_d - 35°	30 to 33	31 to 35	29 to 31	30 to 33
t_d - 40°	33	34 to 35	31	32 to 33
t_d - 45°	-	-	-	-

ZONE – IV

Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
t_d + 33°	11	10	12 to 13	11 to 12
t_d + 30°	11 to 13	10 to 13	12 to 14	11 to 14
t_d + 25°	11 to 15	10 to 15	12 to 16	12 to 15
t_d + 20°	11 to 17	10 to 17	12 to 17	12 to 17
t_d + 15°	12 to 20	11 to 20	13 to 20	12 to 20
t_d + 10°	12 to 23	12 to 23	13 to 22	13 to 23
t_d + 05°	13 to 25	12 to 26	14 to 24	14 to 25
t_d	14 to 27	14 to 28	15 to 26	15 to 27
t_d - 05°	15 to 30	15 to 31	16 to 28	16 to 29
t_d - 10°	17 to 31	17 to 33	17 to 30	17 to 31
t_d - 15°	19 to 33	18 to 34	19 to 31	19 to 32
t_d - 20°	21 to 35	21 to 36	20 to 33	20 to 34
t_d - 25°	23 to 36	23 to 37	22 to 34	22 to 35
t_d - 30°	25 to 37	25 to 39	24 to 35	25 to 36
t_d - 35°	27 to 38	28 to 40	26 to 35	27 to 37
t_d - 40°	30 to 38	31 to 40	29 to 36	29 to 37
t_d - 48°	33 to 39	34 to 41	31 to 36	32 to 38

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm.*

Annexure - 3/9A *(Para 331(7))*

Gaps at SEJ provided at the Far end approach of Bridge using Rail Free Fastenings Over Girder Bridge and Conventional PSC Sleepers (RDSO/T-2495 & 2496) at Approaches for Various Rail Temperatures in mm

Zone-I								
Rail	60 kg/m				52 kg/m			
Sleeper Density	1660		1540		1660		1540	
Ballast Resistance (kg/cm/rail)	12.98		11.76		12.98		11.76	
Initial gap at SEJ (mm)	65	40	65	40	65	40	65	40
t_d + 25°	(-19)-(-19)	0-1	(-19)-(-19)	0-1	(-18)-(-19)	1-1	(-19)-(-19)	1-1
t_d + 20°	(-7)-(-9)	3-6	(-8)-(-10)	3-5	(-7)-(-9)	4-6	(-7)-(-9)	4-6
t_d + 15°	0-4	7-10	0-4	6-10	0-4	7-11	0-4	7-10
t_d + 10°	10-15	10-15	9-15	10-15	10-15	10-15	10-15	10-15
t_d + 05°	20-26	14-20	19-26	13-20	20-25	14-19	20-26	14-19
t_d	30-36	17-24	30-37	17-24	30-36	17-23	30-36	17-24
t_d - 05°	40-47	21-28	40-47	21-28	40-46	21-27	40-46	21-28
t_d - 10°	51-57	26-32	51-57	26-32	50-56	25-31	51-56	26-31
t_d - 15°	62-67	30-35	62-67	30-36	61-66	29-34	61-66	30-35
t_d - 20°	73-76	35-39	73-77	35-39	72-75	34-38	72-76	35-38
t_d - 25°	84-86	39-42	84-87	40-43	83-85	38-41	83-86	39-41
t_d - 30°	95	44-45	96	45-46	94	43-44	94-95	44

Zone-II								
Rail	60 kg/m				52 kg/m			
Sleeper Density	1660		1540		1660		1540	
Ballast Resistance (kg/cm/rail)	12.98		11.76		12.98		11.76	
Initial gap at SEJ (mm)	65	40	65	40	65	40	65	40
t_d + 30°	(-13)-(-20)	(-2)-(6)	(-14)-(-22)	(-3)-(5)	(-12)-(-18)	0-7	(-13)-(-20)	(-1)-6
t_d + 25°	(-4)-(-11)	2-9	(-4)-(-13)	1-9	(-3)-(-10)	4-10	(-4)-(-11)	3-10
t_d + 20°	(-2)-(5)	6-13	(-3)-(5)	5-13	(-1)-(5)	7-13	(-2)-(5)	6-13
t_d + 15°	7-13	10-16	6-13	9-16	8-13	11-16	7-13	10-16
t_d + 10°	16-22	14-19	15-22	13-20	16-21	14-19	16-22	14-19
t_d + 05°	25-30	18-22	25-30	17-23	25-29	18-22	25-30	18-22
t_d	34-38	21-25	34-38	21-26	34-37	21-24	34-37	21-25
t_d - 05°	43-45	25-28	43-46	26-28	42-44	25-27	43-45	25-27
t_d - 10°	52-53	29-30	53-54	30-31	51-52	28-29	52-52	29-29
t_d - 15°	60-61	32-33	61-62	33-34	59-60	31-32	60-60	32-32
t_d - 20°	67-70	34-37	68-71	35-38	66-68	33-35	67-69	33-36
t_d - 25°	74-79	36-41	75-81	37-42	73-77	34-39	73-78	35-40
t_d - 30°	81-88	37-44	82-90	38-46	79-86	36-42	80-87	36-43
t_d - 35°	87-97	38-48	88-99	39-50	86-94	37-45	87-96	38-47

Annexure - 3/9A *(Para 331(7))*

Gaps at SEJ provided at the Far End Approach of Bridge using Rail Free Fastenings Over Girder Bridge and Conventional PSC Sleepers (RDSO/T-2495 & 2496) at Approaches for Various Rail Temperatures in mm

Zone-III				
Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
Initial gap at SEJ (mm)	70	70	70	70
t_d + 35°	(-3)-(-3)	(-4)-(-4)	(-2)-(-2)	(-3)-(-3)
t_d + 30°	1-4	0-3	2-5	1-4
t_d + 25°	5-11	4-10	6-11	6-11
t_d + 20°	10-17	9-17	11-17	10-17
t_d + 15°	14-24	14-24	16-24	15-24
t_d + 10°	19-30	19-30	20-29	20-30
t_d + 05°	25-36	24-36	25-35	25-36
t_d	30-42	29-42	31-41	30-41
t_d - 05°	36-47	35-48	36-46	36-47
t_d - 10°	41-53	41-54	42-51	41-52
t_d - 15°	47-58	47-59	47-56	47-57
t_d - 20°	54-63	54-64	53-61	53-62
t_d - 25°	60-67	60-69	59-66	60-67
t_d - 30°	67-72	67-73	66-70	66-71
t_d - 35°	73-76	74-78	72-75	73-76
t_d - 40°	80-81	81-82	78-79	79-80

Zone-IV				
Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
Initial gap at SEJ (mm)	70	70	70	70
t_d + 33°	5	4-5	6-7	6-6
t_d + 30°	7-9	6-9	8-10	7-10
t_d + 28°	8-12	7-12	10-13	9-13
t_d + 25°	10-16	9-16	12-17	11-16
t_d + 20°	14-22	13-22	15-22	14-22
t_d + 15°	18-28	17-28	19-28	18-28
t_d + 10°	22-34	21-34	23-33	22-34
t_d + 05°	26-39	25-40	27-38	26-39
t_d	30-45	30-46	31-43	31-44
t_d - 05°	35-50	35-51	36-48	35-49
t_d - 10°	40-54	40-56	40-53	40-54
t_d - 15°	45-59	45-61	45-57	45-58
t_d - 20°	50-64	51-65	50-61	50-63
t_d - 25°	56-68	56-70	55-65	56-67
t_d - 30°	61-72	62-74	60-69	61-71
t_d - 35°	67-76	68-77	65-73	67-75
t_d - 40°	73-79	74-81	71-77	72-78
t_d - 43°	77-81	78-83	75-79	76-80
t_d - 48°	83-85	85-86	80-82	82-84

Gaps at SEJ for Various Rail Temperatures and Wider Base PSC Sleeper (RDSO/T-8527 & 8746) Track in mm

Rail	60 Kg/m			
Sleeper Density	1660			
Ballast Resistance	12.77 Kg/cm/rail			
Temp. Zone	**Zone – I**	**Zone – II**	**Zone – III**	**Zone – IV**
Range of t_d (°C)	T_m–5 to T_m	T_m–5 to T_m	T_m–5 to T_m	T_m to T_m+5
t_d+40	-	-	7-7	-
t_d+38	-	-	-	8-8
t_d+35	-	10-10	7-10	8-10
t_d+33	-	-	-	8-11
t_d+30	12-13	10-13	7-13	8-13
t_d+28	-	-	-	8-14
t_d+25	13-15	10-15	7-15	9-16
t_d+20	13-17	11-17	8-18	9-19
t_d+15	13-19	11-19	9-20	10-21
t_d+10	14-20	12-21	10-22	11-24
t_d+5	15-21	13-22	12-24	12-26
t_d	16-23	15-24	13-25	14-28
t_d-5	18-24	16-25	15-27	16-29
t_d-10	19-24	18-26	17-28	18-31
t_d-15	21-25	20-27	19-29	20-32
t_d-20	23-25	22-27	22-29	22-33
t_d-25	25	25-27	24-30	25-34
t_d-30	-	28	27-30	27-35
t_d-35	-	-	30	30-35
t_d-38	-	-	-	32-35
t_d-40	-	-	-	33-36
t_d-43	-	-	-	35-36

Note – The above values have been calculated with initial setting of gaps at SEJ as 40mm.

Annexure - 3/9C *(Para 331(7))*

Gaps at SEJ provided at the Far End Approach of Bridge using Rail Free Fastenings Over Girder Bridge and Wider Base PSC sleepers at Approaches (RDSO/T-8527 & 8746) for various Rail Temperatures in mm

Rail	60 Kg/m					
Sleeper Density	1660					
Ballast Resistance	12.77 Kg/cm/rail					
Temp. Zone	**Zone – I**		**Zone – II**		**Zone – III**	**Zone – IV**
Initial gap at SEJ (mm)	**65**	**40**	**65**	**40**	**70**	**70**
$t_d + 35°$	-	-	-	-	(-4)-(-4)	-
$t_d + 33°$	-	-	-	-	-	5-5
$t_d + 30°$	-	-	(-21)-(-13)	(-2)-6	1-4	7-9
$t_d + 28°$	-	-	-	-	-	8-12
$t_d + 25°$	(-19)-(-19)	0-1	(-12)-(-4)	2-9	5-11	10-16
$t_d + 20°$	(-10)-(-7)	3-6	(-2)-5	6-13	9-17	14-22
$t_d + 15°$	0-4	7-10	7-13	10-16	14-24	18-28
$t_d + 10°$	10-15	10-15	16-22	14-19	19-30	22-34
$t_d + 05°$	20-26	14-20	25-30	17-22	24-36	26-39
t_d	30-36	17-24	34-38	21-25	30-42	30-45
$t_d – 05°$	40-47	21-28	43-45	25-28	35-47	35-50
$t_d – 10°$	51-57	26-32	52-53	29-30	41-53	40-55
$t_d – 15°$	62-67	30-35	60-61	32-33	47-58	45-59
$t_d – 20°$	73-77	35-39	67-70	34-37	54-63	50-64
$t_d – 25°$	84-86	40-42	74-79	36-41	60-68	56-68
$t_d – 30°$	95-95	44-45	81-88	37-45	67-72	62-72
$t_d – 35°$	-	-	87-97	38-48	73-77	67-76
$t_d – 40°$	-	-	-	-	80-81	73-79
$t_d – 43°$	-	-	-	-	-	77-82
$t_d – 48°$	-	-	-	-	-	83-85

Annexure - 3/10 (*Para 344, 349*)

WORK CHART AND AUTHORISED LEVEL OF SUPERVISION

S. No.	Nature of work	Lowest level of staff/Supervisor in charge of work
1	**Maintenance operation**	
(a)	Mechanised Tamping, Lifting (general lift), Alignment, Minor alignment of curves, Deep screening etc.	JE/P.Way
(b)	Manual Packing, Alignment	Gangmate
(c)	Lifting/Lowering of track	JE/P.Way
(d)	Lifting, aligning, packing etc., in case of emergencies at temperatures higher than those permitted	JE/P.Way
2	**Rails, sleepers and fastenings**	
(a)	Packing or renewal of single isolated sleeper not requiring lifting or slewing of track	Gangmate
(b)	Renewal of fastenings not requiring lifting	Keyman
(c)	Renewal/recoupment of fastenings requiring lifting	Gangmate
(d)	Casual renewal of sleepers and fastenings over long stretches	JE/P.Way
(e)	Renewal of Defective rails	JE/P.Way
(f)	Carrying out welding of rail joints at site	JE/P.Way
3	**Ballast**	
(a)	Making up of shortage of ballast in shoulders at isolated places	Gangmate
(b)	Replenishment of ballast & Checking ballast section before the onset of summer	JE/P.Way
(c)	Screening of ballast other than Deep screening	JE/P.Way
(d)	Deep Screening	JE/P.Way
4	**Curve Realignment**	
(a)	Minor Realignment of curves	JE/P.Way
(b)	Major realignment of curves under special instructions from ADEN	JE/P.Way
5	**Hot weather work**	
(a)	Imposing speed restriction if the temperature exceeds (t_d + 20°) Celsius after maintenance work is completed, manually or by machines	Gangmate
(b)	Organizing hot weather patrolling during summer months	JE/P.Way
(c)	Ensuring that hot weather patrolman turns out promptly for duty during the required period of patrolling and during other periods when rail temperature exceeds (t_d + 20°) Celsius	Gangmate
(d)	Hot weather patrolling, watching stability of track, presence of large number of sleepers with defective packing, alignment of track, checking if the profile of ballast is disturbed, tendency for lateral/vertical deformation of track	Hot weather patrolman
(e)	Inspection in summer months and checking on the working of hot weather patrols	JE/P.Way
6	**Cold weather patrolling**	Cold weather patrolman
7	**De-stressing - all operations regarding De-stressing**	JE/P.Way
8	**Rail fracture**	
(a)	Emergency repairs	Keyman. Trackmen with valid competency Certificate
(b)	Temporary repairs	JE/P.Way
(c)	Permanent repairs	JE/P.Way

9	**Buckling**	
(a)	Protection of track and secure safety of trains in case of buckling, rail fractures, or any abnormal behaviour of track	Patrolman
(b)	Emergency repairs	JE/P.Way
(c)	Permanent repairs	JE/P.Way
10	Emergencies- Action in case of damage to track following derailments, breaches etc.	JE/P.Way
11	**SEJ**	
(a)	Checking of SEJ, oiling and greasing and re-tightening/ renewal of fittings once a fortnight	Keyman
(b)	Inspection of SEJ	JE/P.Way

Annexure - 3/11 *(Para 341, 342)*

EXTENSION TABLE

(°C)	L in metres													
t_0 -t_p	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**200**	**300**	**400**	**500**
1	-	-	-	-	1	1	1	1	1	1	2	3	5	6
2	-	-	1	1	1	1	2	2	2	2	5	7	9	11
3	-	1	1	1	2	2	2	3	3	3	7	10	14	17
4	-	1	1	2	2	3	3	4	4	5	9	14	18	23
5	1	1	1	2	3	3	4	5	5	6	11	17	23	29
6	1	1	2	3	3	4	5	6	6	7	13	21	28	34
7	1	2	2	3	4	5	6	6	7	8	16	24	32	40
8	1	2	3	4	5	6	6	7	8	9	18	28	37	46
9	1	2	3	4	5	6	7	8	9	10	21	31	41	52
10	1	2	3	4	6	7	8	9	10	11	23	35	48	57
11	1	3	4	5	6	7	9	10	11	13	25	38	50	63
12	1	3	4	5	7	8	9	11	12	14	28	41	55	69
13	1	3	4	6	7	9	10	12	13	15	30	45	60	75
14	2	3	5	6	8	10	11	13	14	16	32	48	64	80
15	2	3	5	7	9	10	12	14	16	17	34	52	69	86
16	2	4	6	7	9	11	13	15	17	18	37	55	74	92
17	2	4	6	8	10	12	14	16	18	19	39	59	78	98
18	2	4	6	8	10	12	14	17	19	21	41	62	83	103
19	2	4	6	9	11	13	15	18	20	22	44	66	87	109
20	2	5	7	9	11	14	16	18	21	23	46	69	92	115
21	2	5	8	10	12	14	17	19	22	24	48	73	97	121
22	3	5	8	10	13	15	18	20	23	25	51	76	101	126
23	3	5	8	11	13	16	19	21	24	26	53	79	106	132
24	3	6	8	11	14	17	20	22	25	28	55	83	110	138
25	3	6	9	12	14	17	20	23	26	29	57	86	115	144
26	3	6	9	12	15	18	21	24	27	30	60	90	120	149
27	3	6	9	12	16	19	22	25	28	31	62	93	124	155
28	3	6	10	13	16	19	23	26	29	32	64	96	129	161
29	3	7	10	13	17	20	23	27	30	33	67	100	133	167
30	3	7	10	14	17	21	25	28	31	34	69	103	138	172

Extension in mm, based on formula $e = L\ \alpha\ (t_o - t_p)$

Annexure - 3/12 *(Para 354)*

Details of structure of LWR/CWR

Division: Sub - Division:
SSE/P.Way (In-charge): LWR./CWR No.:
Details of structure of LWR/CWR as laid:

1. **General**
   (a) Kilometers to
   (b) Between stations and
   (c) Up/Down/Single line
   (d) Date of laying
2. **Track Structure**
   (a) Rails
      (i) Sectional weight
      (ii) Rolling mark
      (iii) Year of laying
      (iv) Length of rails as rolled
      (v) Plant where rails welded
      (vi) Types of depot welding - Flash Butt
      (vii) Length welded into panels at depot
      (viii) Whether fish-bolt holes provided Yes/No
      (ix) Thermit welding done in-situ/on cess by SKV/ FB by Mobile plant
   (b) Sleepers
      (i) Type
      (ii) Density or No. per km.
      (iii) Type of fastenings
   (c) Ballast and Sub-Ballast
      (i) Size (mm)
      (ii) Depth of cushion (mm)
      (iii) Date of last deep screening of ballast
   (d) SEJ
      (i) Location (km)
      (ii) Date of laying
      (iii) Maximum gap possible (mm)
      (iv) Drawing No.
      (v) Manufactured by
      (vi) Whether joined to LWR/CWR welded joint
   (e) Girder Bridges
      (i) Location and No.
      (ii) Lengths and spans of bridges with LWR/CWR – yes / no
      (iii) Type of fastenings used
      (iv) Any other remarks
   (f) Level Crossings
      Location and No.
3. **Grades, Alignment and Formation:**
      (i) Steepest gradient
      (ii) Maximum degree of curvature
      (iii) Formation (indicate type of soil)
      (iv) Particulars of trouble with formation and treatment given, if any, at the time of laying.
      (Sketch showing grades and curves with locations to be attached)

Annexure - 3/13*(Para 354)*

Annual Record of LWR/CWR Maintenance and Performance

1. **Maintenance Details:**

Year/Year/Year/Year

(i) Method of packing at the time of laying, manual/by machines
(ii) If by machine, type of machine/ tamper used
(iii) Packing during maintenance - manual beater/manual MSP/by machines
(iv) If by machines, type of machine/ tamper used
(v) Whether directed maintenance/ systematic through packing is done and if the latter, the period when it is done
(vi) Location requiring repeated maintenance, if any
(vii) Quantity of ballast recouped

2. **Climatic Details:** (Measurements shall be taken on representative LWR only)

(i) Maximum daily variation in temperature, vide *Para 334*
(ii) Max. rail temperature °C
(iii) Max. ambient temperature °C
(iv) Minimum rail temperature °C
(v) Minimum ambient temperature °C

3. **Details of Installation, De-stressing etc.:**

Items (i) to (iv) to be entered soon after LWR is laid and de-stressed for the first time.

(i) Installation temperature
(ii) Mean rail temperature for the locality
(iii) Temperature at the time of de-stressing t_d
(iv) Reasons for carrying out the de-stressing
(v) Subsequent de-stressing done - Temperature and date

4. **Unusual Occurrences:**

(i) Rail fractures
(ii) Buckling (Location and reasons for buckling)
(iii) Replacement of components in SEJ assembly
  a) Fastenings
  b) Bolts
  c) Sleepers
  d) Longitudinal ties
  e) MS bracket
  f) Chairs
  g) Rubber pads
  h) Tongue rails
  i) Stock rails
(iv) Derailments and accidents on the LWR/ CWR portion (give km of the affected portion)
(v) Replacement of sleepers (give km and the number of sleepers replaced and reasons)
(vi) Replacement of rails (indicate length, km and reasons)

5. **Formation:**

Any trouble subsequent to laying and the treatment given.

Chart of Movement of LWR/CRW No. ____________

SEJ at the ends of this LWR: SEJ No. ____________ at km ____________ SEJ No. ____________ at km ____________

Date of measurement	Time of measurement	Rail Temp.	Right or Left Rail	Distance (mm) between tongue/stock rail & reference line at SEJ No. _______ (see Note 2 & 3)		Distance (mm) between tongue/stock rail & reference line at SEJ No. _______ (see Note 2 & 3)		C/C Spacing (mm) between the two central sleepers		Measured by	Rectification carried out		Remarks
				Observed (a)	Permissible Range	Observed (a)	Permissible Range				On Date	by	
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Note –

1. *(a) and (b) at column 5 and 7 respectively almost always be positive. Except when tongue/stock rail crosses the reference line. In such a case, a (-ve) sign will be prefixed.*
2. *For IRS Design (Conventional) SEJ and Improved SEJ with Single gap of max 80 mm i.e. SG80 Design (refer Fig 3.17 & 3.19), the distance shall be measured between tongue/stock rail & reference line at SEJ. For Improved SEJ With Double Gap of max. 65 mm each i.e. DG65 Design (refer Fig 3.18), distance shall be measured between tongue rail & reference line in the gap adjacent to LWR, the movement of which is being recorded.*
3. *Permissible range for IRS Design SEJ and Improved SEJ of both SG80 & DG65 designs shall be governed by Para 338.*
4. *On TMS, left and right rails, on both single line as well as double line are determined looking in the direction of increasing kilometrage.*
5. *If centre to centre spacing of two central sleepers of IRS Design i.e. Conventional SEJ defer by more than 700 ± 10 mm, immediate rectification will be made.*

Annexure - 3/15*(Para 354)*

Chart of Movement in Central Portion of LWR/CRW No. ____________

Right or Left Rail	Distance (mm) between Ref. mark & mark on Rail at various Ref. Pillars in non-breathing length of LWR/CWR*					Measured by	Rectification carried out		Remarks
	Centre of LWR/CWR at km ________	Km _______	Km _______	Km _______	Km _______		On Date	by	
1	2	3	4	5	6	7	8	9	10

Note – Movement of rail shall be positive in the direction of increasing km on double line as well as on single lines when entered in TMS.

Annexure - 3/16 *(Para 335)*

BREATHING LENGTHS ON PRC SLEEPERS

Zone	Sleeper Density	Breathing Length (in meters)		
		60 Kg/m Conventional PSC sleeper	52 Kg/m Conventional PSC sleeper	60 Kg/m Wider PSC sleeper
I	1540	60	52	-
	1660	58	50	44
II	1540	69	59	-
	1660	66	57	52
III	1540	74	64	-
	1660	77	66	59
IV	1540	82	71	-
	1660	79	68	56

Note: *Breathing lengths given above are indicative and are likely to vary as per site conditions.*

Need for Equalization of Stresses after Permanent Repair in LWR/CWR

If there is a fracture or rail replacement on any account, the thermal stresses over a length of two temporary breathing lengths (BLs) will be altered. This will alter the **Stress Free Temperature (SFT)** of rail in the affected portion of track. If repairs are done in such a manner that the length of rail removed from track is exactly same as the length of rail inserted (including welding), and the equalisation of stresses is done for a length of at least two temporary BLs (one temporary BL on either side of the location of rail replacement), then the forces in LWR, and hence the SFT, will get restored to very close to original level (effect of hysteresis is ignored in this analysis). However, if during rail replacement the length of rail inserted in track is different from the length of rail removed the pattern of thermal stresses in the affected portion of LWR will change altering the SFT in the affected portion. The magnitude of change in SFT can be calculated as below.

If length of rail inserted in track varies by δL from the length of rail removed from track, and equalization of stresses is done, say over 250 meters (125 metres on either side), then the force change in LWR would be

F = (δL / 250) * EA (From Hooke's Law)

The equivalent temperature can be calculated by equating F with AEα δt

Thus, δL can be calculated as under, δt = δL / (250 * α)

If repairs are done, say at prevailing rail temperature of (t_d – 30), then the length of rail inserted in track would be more than the length of rail removed by an amount of contraction of LWR over two temporary BLs corresponding to (t_d -30).

This can be calculated by formula = $\boldsymbol{L_b}$ = AEαt / R

Using standard values for 60 kg rail and 60cm sleeper spacing,

$L_b = 76.86 * 2.15 * 10^6 * 1.152 * 10^{-5} * 30 / 13.74$ =4156 cm = 41.56 m

Total contraction of rail (for both temporary BLs) = δL = 2 *(Lb αt)/2

= (2 * 41.56 *100 * $1.152 * 10^{-5}$ * 30) /2

= 1.44 cm = 14.4 mm

Therefore, rail replaced at (t_d – 30) will result in insertion of extra 14.4 mm rail in track. This extra length may slightly vary on either side due to effect of hysteresis.

The equivalent temperature effect corresponding to 14.4 mm extra length of rail, assuming equalisation of stresses is done for 125 metre of track on either side of the location of rail replacement, can be calculated by formula: δt = δL / (250 m * α)

= 14.4/ (250* 1000 * $1.152 * 10^{-5}$)

= 144 / (25 * 1.152) = 5 degrees

Thus, if repairs are done at t_d – 30, then the effective SFT of rail will get lowered by 5 degree Celsius. If two such overlapping repairs are done, then the effective lowering of SFT will be about 10 degree Celsius in the overlapping portion. Such situation makes track vulnerable to buckling. When repairs are done at higher temperature than td, the corresponding stress free temperature in the affected portion of track would become higher in a similar manner; and track would become vulnerable to fractures.

If equalisation of stresses is not done (over 125 m on either side) then the SFT at the location of rail replacement will get altered to the temperature at which repairs are completed. This makes track much more vulnerable for buckling or fractures depending upon whether the repairs are done at rail temperature lower than td or higher than td.

In above example the rail replacement being done at td-30 without equalisation of stresses, hence the SFT at the location of rail replacement would be reduced to (t_d – 30) degree Celsius. However, if equalisation of stresses is done over 125 m on either side, the change in SFT will only be 5 degree Celsius as the effect is distributed over a length of 250 metres.

Test Plan and technical criteria for fastening systems for Ballastless Track

The rail fastening system shall be tested in accordance to the following specifications for different technical parameters and should meet the acceptance criteria as mentioned in the following table. The testing shall be done for Category-C as specified in EN-13481-1 : 2012 & EN-13481-5 : 2022 with rail section to be used in proposed BLT system.

SN	Technical Parameters	Test Method	Acceptance Criteria	Remarks
1	Longitudinal Rail Restraint	EN-13146-1:2019	15 KN/m/rail (Min.)	This has to be tested before repeated load test.
2	Vertical static stiffness of complete fastening system assembly	EN-13146-9:2020	52 KN/mm (Max.)	No sliding, yield or cracking is allowed for the fastener parts.
3	Dynamic/Static stiffness ratio	EN-13481-5:2022	1.4 (Max.)	Ratio is calculated by dividing the dynamic stiffness to static vertical stiffness.
4	Clamping force	EN-13146-7:2019	18 KN per rail seat (Min.)	This has to be tested before repeated load test.
5	Electrical Resistance	EN-13146-5:2012	5 KΩ (Min.)	Higher value may be specified, if required by railways for track circuit.
6	Effect of severe environmental conditions	EN-13146-6:2012	The fastening assembly shall be capable of being dismantled, without failure of any component & reassembled using manual tools provided for this purpose after exposure to the salt spray test.	-
7	Effect of repeated loading	EN-13146-4:2020	No wear or deformation.	-
7A	On vertical Static Stiffness	EN-13146-4:2020	Variation ≤25% of the initial value	No sign of bond failure/fracture/slippage.
7B	On longitudinal Rail Restraint	EN-13146-1:2019	Variation ≤20% of the initial value	Except the rail and fastener, no sliding, yield or cracking is allowed for fastener parts. Longitudinal load/deformation curve shall fall in the envelope of upper and lower limit which is to be submitted along with the report.
7C	On Clamping Force	EN-13146-7:2019	Variation ≤20% of the initial value	-

Annexure – 3/19 (Para 326)

Instructions for Continuation of LWR on Sharp Curves and Steep Gradients on Indian Railways

A. General Instructions:

Continuation of LWR on sharp curves and steep gradients upto limits stipulated in the table below for all four temperature zones shall be permitted by Principal Chief Engineer either through PCE circular or on case-to-case basis subject to fulfilment of all stipulations mentioned herein and in IRPWM considering the site-specific conditions:

Temp. Zone	Sharpest permitted degree of curve	Steepest permitted gradient	Sharpest permitted degree of curve with steepest gradient
Zone – I	6.5	1 in 65	5 degree with 1 in 65
Zone – II	6.5	1 in 65	5 degree with 1 in 65
Zone – III	6.0	1 in 65	5 degree with 1 in 65
Zone – IV	6.0	1 in 80	4 degree with 1 in 80

Head Hardened rails should preferably be used whenever available in future to reduce the lateral and vertical wear for longer life of rails on wear account.

B. Continuation of LWR on curves sharper than 4° (& upto 5°):

Following shall be ensured before laying LWR on curves sharper than 4° (upto 5°)

1.0 Track Structure -

1.1 Track structure consists of minimum 60 Kg 90 UTS rails, PSC sleepers with elastic fastening (ERC/MK-V) and density 1660 nos. per Km.
1.2 Full ballast cushion as per provisions of IRPWM.
1.3 Full component of fittings in track.
1.4 Joggling of all good AT and Flash Butt Welds with four clamps.
1.5 Joggling of all defective AT and Flash Butt Welds should be done with two clamps and two far end bolts in terms of Para 307 of IRPWM.

2.0 **Pre-requisites -**

2.1 Pre-conditions for laying of LWR in Para 336(1) (b) of IRPWM is strictly followed especially the work of realignment of curve, lifting or lowering of track to eliminate sags and humps, introduction and improvement of vertical curves, stabilization of troublesome formation shall be completed before laying LWR.
2.2 Precautions laid in Para 326(2)(b) of IRPWM before laying LWR.

3.0 **Other stipulations**
3.1 Vertical and lateral wear shall not be allowed to exceed 8 mm and 6 mm respectively.
3.2 Alignment defects on curves and its approaches should be within 10 mm over 10m chord.

3.3 Creep shall be measured regularly at least once a month and total creep at any point of time shall not exceed 50 mm per track Km. If so, creep shall be adjusted through de-stressing process. Creep post shall be provided at regular interval for its monitoring.

3.4 ERC Mark-V and composite rubber pads shall be used with full ballast as per the stipulated profile to ensure the effective toe load and adequate creep resistance. However, toe load of such ERCs shall not be less than 600kg in any case.

3.5 Gauge face lubrication shall preferably be done using automatic track mounted mechanized lubricators as per IRS:T-48, 2022.

3.6 USFD testing at curve portion of proposed LWR shall be done as under:

3.6.1 USFD testing of inner rail shall be continued as per existing provisions of "Manual for Ultrasonic Testing of Rails and Welds", Revised-2022 with latest addendum and corrigendum.

3.6.2 To detect development of fast fatigue on non-gauge side of outer rail, ultrasonic testing shall be done as under:

3.6.2.1 USFD testing of outer rail shall be done as per procedure given in "Manual for Ultrasonic Testing of Rails and Welds", Revised-2022 with latest addendum and corrigendum with increased frequency of 4 GMT.

3.6.2.2 If loss of back wall echo is more than 20% of full screen height, additional testing of non-gauge side of head of outer rail shall be done by hand probing and the acoustic coupling needs to be ensured under all circumstances to detect the flaws.

C. Continuation of LWR on curves sharper than 5°:

LWR on curves sharper than 5° as mentioned in the Table given in Para (A) above, shall be permitted after ensuring following **additional** measures over those mentioned under Para (B) above.

1.0 On curves sharper than 5 degree, slack gauge sleepers shall be used.

2.0 Creep shall be measured regularly at least once a month and total creep at any point of time shall not exceed 50 mm per track km . If so, creep shall be adjusted through de-stressing process. Creep post shall be provided at regular interval for its monitoring.

3.0 SSE/P. Way (In-charge) once in a month and ADEN once in three months shall monitor the behavior of LWR and track conditions with respect to the parameters mentioned in Para F. In hottest and coldest months, inspection of LWR on sharp curves and steep gradients shall be done as per schedule prescribed in IRPWM.

4.0 Rail temperature records shall be maintained and scrutinized for any significant change in values of mean rail temperature (t_m) and range. It is imperative to compile temperature records of such section for 5-10 years to plan maintenance activities and deployment of patrolling.

Sectional Sr. DEN/DEN shall ensure that temperature records are properly maintained, particularly for area where LWR has been permitted on sharp curves and steep gradients. He should analyse the rail temperature data at least twice in a year (in hottest and coldest months) at his level for cross verification of Temperature data with those considered for LWR stability analysis.

5.0 On curves sharper than 6 degree, slack gauge sleepers shall be used and inter-braced as per arrangement contained in RDSO's drawing no. RDSO/T-8329 (Annexure-'3/19A'). Such slack gauge sleepers shall be provided with additional dowels for fixing angle section to cross brace the successive sleepers in curves.

D. Continuation of LWR on gradients steeper than 1:100.

LWR on gradients steeper than 1:100 as mentioned in the Table given in Para (A) above, shall be permitted, after ensuring following additional measures.

1.0 Track Structure -

1.1 Track structure consists of minimum 60 Kg 90 UTS rails, PSC sleepers with elastic fastening (ERC/MK-V) and density 1660 Nos. per Km

1.2 Full ballast cushion as per provisions of IRPWM.

1.3 Full component of fittings in track.

1.4 Joggling of all good AT and Flash Butt Welds with four clamps.

1.5 Joggling of all defective AT and Flash Butt Welds should be done with two clamps and two far end bolts in terms of Para 307 of IRPWM

2.0 Pre-requisites -

2.1 Pre-conditions for laying of LWR in Para 336(1)(b) of IRPWM should be strictly followed especially the work of realignment of curve, lifting or lowering of track to eliminate sags and humps, introduction and improvement of vertical curves, stabilization of troublesome formation shall be completed before laying LWR.

2.2 Precautions laid in Para 326(2)(b) of IRPWM shall be taken before laying LWR.

2.3 LWR on gradients steeper than 1:100 shall be considered only in sections where surface damage to rails in the form of wheel burn, scabs etc., are not prevalent. The surface damage on Rails in the form of wheel burns, scabs etc., can be controlled by adequate powering of freight trains.

3.0 Other stipulations -

3.1 Vertical and lateral wear shall not be allowed to exceed 8 mm and 6 mm respectively.

3.2 Alignment defect on curves and its approaches should be within 10 mm over 10m chord.

3.3 Creep shall be measured regularly at least once a month and total creep at any point of time shall not exceed 50 mm per track km. If so, creep shall be adjusted through de-stressing process. Creep post shall be provided at regular interval for its monitoring.

3.4 ERC Mark-V and composite rubber pads shall be used with full ballast as per the stipulated profile to ensure the effective toe load and adequate creep resistance. However, toe load of such ERCs shall not be less than 600 kg in any case.

3.5 Gauge face lubrication shall preferably be done using automatic track mounted mechanized lubricators as per IRS:T-48, 2022.

3.6 SSE/P.Way (In-charge) once in a month and sectional ADEN once in three months shall monitor the behavior of LWR and track conditions with respect to the parameters mentioned in Para-F. In hottest and coldest months, inspection of LWR on sharp curves and steep gradients shall be done as per schedule prescribed in IRPWM.

3.7 Rail temperature records shall be maintained and scrutinized for any significant change in values of mean rail temperature (t_m) and range. It is imperative to compile temperature records of such section for 5-10 years to plan maintenance activities and deployment of patrolling.

Sectional Sr. DEN/DEN shall ensure that temperature records are properly maintained, particularly for area where LWR has been permitted on sharp curves and steep gradients. He should analyze the rail temperature data at least twice in a year (in hottest and coldest months) at his level for cross verification of Temperature data with those considered for LWR stability analysis.

E. Continuation of LWR at sharp curves associated with steep gradients:

Continuation of LWR on sharp curves (more than 4°) associated with steeper gradients (steeper than 1:100) as mentioned in the Table given in Para (A) above, shall be permitted after ensuring following measures –

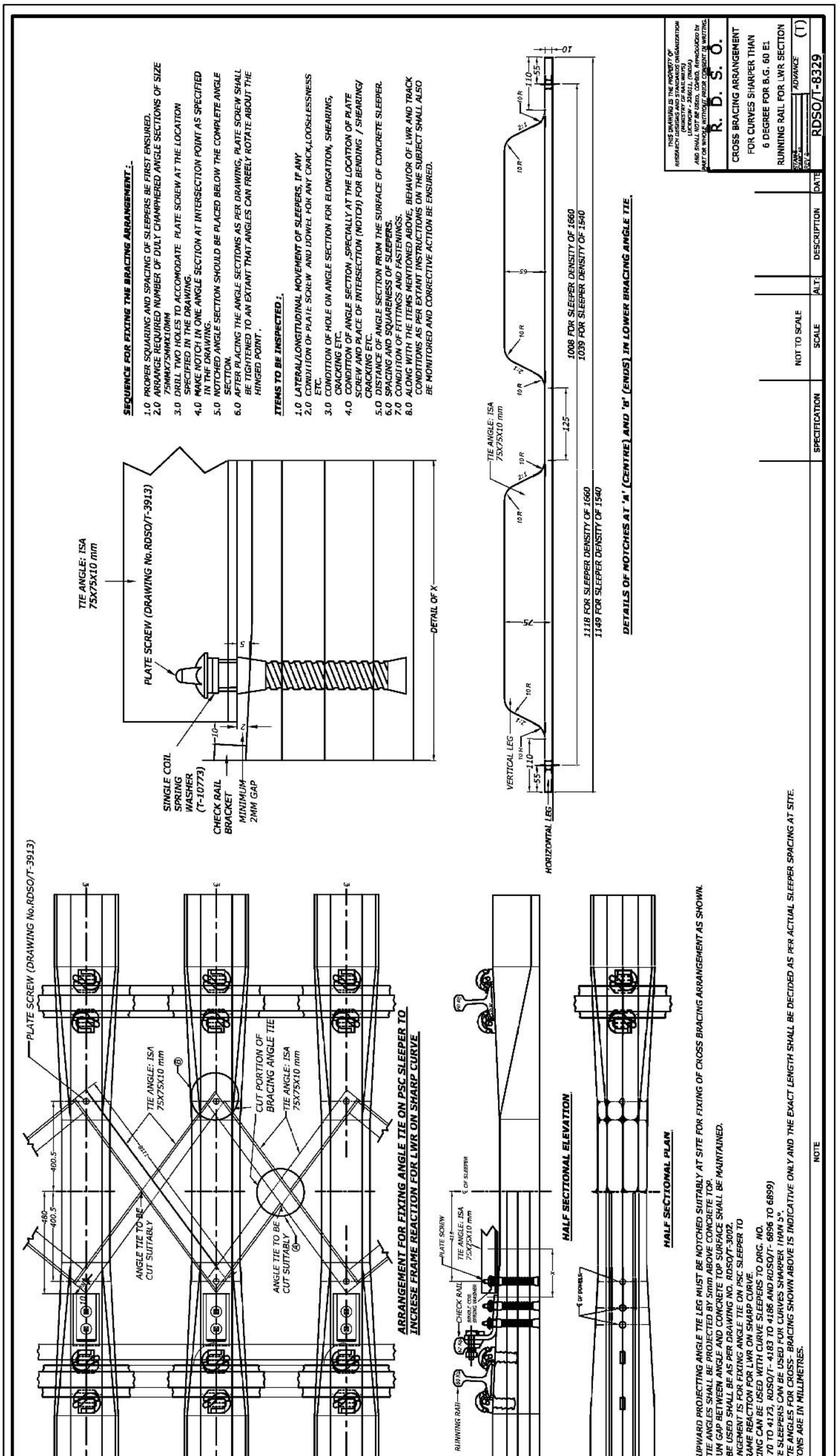
1.0 All the measures indicated separately for sharp curves and steep gradients under Para (B) or (C) as the case may be and (D) above, shall be taken before laying LWR.

2.0 In Temperature Zone – III, De-stressing temperature may be raised by 5°C to improve the level of factor of safety against static buckling keeping in view the rail/weld fracture history and temperature records.

F. In addition to the regular inspections and duties, following shall also be monitored **by SSE/P. Way (In-charge) once in a month and by ADEN once in three months** for proper behavior of LWR and track conditions.

a. Availability of full ballast as per stipulated profile. In case, loosening of ballast is noticed, suitable speed restriction should be imposed.
b. Alignment defect of curves and approaches.
c. Measurement of total creep and its timely adjustment through de-stressing process.
d. Requirement of de-stressing of LWR for other than creep adjustment.
e. Vertical and lateral wear of rails.
f. Condition of joggled fish plates with clamps.
g. Condition and functioning of arrangement for inter-bracing of sleepers, where provided.
h. Gauge face lubrication.
i. Completeness of fittings and measurement of toe load of sample ERCs as per site conditions.
j. USFD testing of non-gauge face at prescribed frequency as mentioned in Para B (3.6).
k. Repairs to surface defects on rails.
l. Looking for signs of out of squaring of sleepers, if any, and taking immediate remedial measures of recoupment of ballast in deficient areas.

Annexure – 3/19A



CHAPTER – 4
CURVES & TURNOUTS

PART A – CURVES
SECTION – I: General

401 Determination of Radius:-

(1) The radius of a curve is determined by measuring the versine on a chord of known length, from the equation,

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

Where;

R = Radius in metres;

C = Chord length in metres; and

V = Versine in millimetres.

(2) Curves can be designated by the radius in metres or by its degree. The angle subtended at the centre by a chord of 30.5 metres, is the degree of the curve.

1° curve is thus of $\frac{360 \times 30.5}{2\pi} = 1750$ metres radius

2° curve has a radius of $\frac{1750}{2} = 875$ metres and so on.

(3) Curves shall be described by the radius in metres.

(4) For measuring versines of a curve, 20 metres overlapping chords should normally be used with stations at 10 metres intervals. For checking the radii of turnout and turn-in curves overlapping chord of 6 metres should be used and the versine measuring stations should be located at every 3 metres. (The turnout curve can also be checked by offsets from the straight).

(5) The versine is obtained by stretching a fishing/ nylon cord or wire stretched between the end of chord length decided upon, and the measuring distance between the cord/wire and gauge face of the rail at the middle point of the chord. Care should be taken that the cord or wire is applied to the side of the head of the rail at the gauge point.

402 The Reference Rail for Level:-

The level of inner rail of any curve is taken as reference level. The super-elevation is provided by raising the outer rail. For reverse curves, however, stipulation as laid down in ***Para 406(3)*** shall apply.

403 Safe Speed on Curves:- (*Back to **Para 409***)

(1) *Fully transitioned curves* – The maximum permissible speed for transitioned curves should be determined (based on the assumption that the centre-to-centre distance between railheads is 1750 mm) using the following formulae:

$$V = 0.27\sqrt{R \times (C_a + C_d)}$$

Where,

V = Speed in Kmph.
R = Radius in metres.
C_a = Actual cant in mm.
C_d = Permissible cant deficiency in mm.

(2) *Non transitioned curves with cant on virtual transition* – (*Back to* ***Para 405***)

The determination of the maximum permissible speed on curves without transition involves the concept of the virtual transition.

The change in the motion of a vehicle from straight to curve conditions takes place over the distance between the bogie centres, commencing on the straight at half the distance before the tangent point and terminating on the curve at the same half distance beyond the tangent point.

Normally, the length of virtual transition is taken as 14.785 m over which Super-elevation is gained with maximum permissible cant gradient as per ***Para 405***.

(3) For curves laid with inadequate length of transition or without transition, the safe permissible speed should be worked out on the basis of actual cant/cant deficiency, which can be provided taking into consideration the limiting values of cant/cant deficiency gradient and the rate of change of cant and cant deficiency.

(4) The speed as determined above shall not exceed the maximum permissible speed of the section.

404 Super-elevation, Cant Deficiency and Cant Excess:-

(1) *Super-elevation/cant* –

(a) The equilibrium super elevation/cant necessary for any speed is calculated from the formula.

$$C = \frac{(GV^2)}{127 \times R}$$

Where,

C is cant /Super-elevation in mm,
G is the dynamic gauge (nominal gauge of track + width of railhead) in mm;
R is the radius of the curve in metres.
V is speed of train in kmph.

(b) The equilibrium speed for determination of cant to be provided shall be decided by the Chief Engineer, after taking into consideration the maximum speeds which can be actually attained by fast and slow trains, the proximity of permanent speed restriction in the route, junctions, stopping places, gradients which may reduce the speeds of goods trains, without appreciably affecting the speed of fast trains and their relative importance.

For this purpose, the entire section may be divided into certain number of sub sections with a nominated equilibrium speed for each sub section, fixed on the basis of speeds which can be actually attained by fast or slow trains over the sub section, so that the need for imposing any speed restrictions for limiting the cant excess for slow trains and cant deficiency for fast trains is avoided.

On sections where all trains run at about the same maximum permissible speeds like suburban section, it will be preferable to provide cant for that speed.

(c) The amount of super-elevation to be actually provided will be calculated by the formula given in **Sub-Para (a)** for the equilibrium speed determined on the basis of **Sub-Para (b)** above. The calculated cant shall be rounded off in the multiple of 5 mm.

(d) ***Maximum design cant on curved track shall be as under*** **–** (*Back to* ***Para 405***)

(i) *Broad Gauge – Group 'A' and 'B' routes* – 185 mm.

Note 1 – On existing track of Group A and B routes, maximum cant of 185 mm to be considered on case-to-case basis with the approval of Chief Track Engineer based on clearance study and feasibility of increasing the transition length with/

without acquisition of land.

Note 2 – On new lines/diversion/multi tracking works on A and B routes, exceptional cases of not achieving full speed potential due to non-exploitation of permitted cant should be submitted to Principal Chief Engineer for approval with justification.

(ii) *Broad gauge* – Other routes – 165 mm.

Note – On all routes, maximum design cant to be limited to 140 mm on track with turnouts.

(e) In every case, the Super-elevation to be provided should be specified when the line is originally laid and thereafter altered only with the prior approval of the Chief Engineer.

(2) *Cant Deficiency* – Maximum value of cant deficiency:

(a) For 'nominated' rolling stocks – 100 mm/150 mm

Note 1 - For rolling stocks permitted with 150 mm cant deficiency, cant deficiency to be limited to 115 mm on track with turnout with crossing on outer rail and on track with expansion device.

Note 2 – Nominated stock shall be permitted cant deficiency of 100 mm/115 mm/ 150 mm after found satisfactory during oscillation trial and specified as such in Speed Certificate issued by RDSO.

(b) For other rolling stocks not covered above – 75 mm

(3) *Cant Excess* – The cant excess should not be allowed to exceed 75 mm for all types of rolling stock. The cant excess should be worked out taking into consideration the booked speed of goods trains on a particular section.

In the case of a section carrying predominantly goods traffic, the cant excess should be preferably kept low to minimize wear on inner rail.

405 Length of Transition Curve and Setting-out Transitions:- (*Back to* ***Para 403, 410, 419***)

(1) The desirable length of transition 'L' shall be maximum of the following three values –

(a) $L = 0.0056\ C_a \times V_m$

(b) $L = 0.0056\ C_d \times V_m$

(c) $L = 0.72 \times Ca$

Where,

L = Length of transition in metres.

V_m = max. permissible speed in Kmph.

C_d = cant deficiency in mm.

C_a = actual Super-elevation on curve in mm.

The formula (a) and (b) are based on rate of change of cant and of cant deficiency of 50 mm per second. The formula (c) is based on the maximum cant gradient of 1 in 720 or 1.4 mm per metre. The length of transition so calculated should be rounded off to the next higher value in multiple of 10 m.

Note - For non transitioned curve (designed with virtual transition), the rate of change of cant and cant deficiency shall be taken as 35 mm/s while cant gradient to be taken as 1 in 720. The formula (a) above therefore shall be $L = 0.008\ C_a \times V_m$ and formula (b) above shall be $L = 0.008\ C_d \times V_m$. Formula (c) shall remain same as above.

(2) For the purpose of designing future layouts of curve, future higher speeds (such

as 160 Kmph for Group ‘A’ routes and 130 Kmph for Group ‘B’ routes) may be taken into account for calculating the length of transitions. The provision given in ***Para 404 (1) (d)*** may also be considered while deciding the transition length.

(3) In cases where ground conditions do not permit provision of the desirable transition length in accordance with the above, the length may be reduced to a minimum of 5/6 of the desirable length as worked out on the basis of formula (a) and (b) above or ½ of the desirable length as worked out on the basis of (c) above, whichever is greater, with approval of Chief Track Engineer. This is based on the assumption that a rate of change of cant/cant deficiency will not exceed 60 mm per second and the maximum cant gradient will be limited to 2.8 mm per metre or Maximum upto 1 in 360.

Note – For non-transitioned curve (designed with virtual transition), in exceptional cases and with the approval of Chief Track Engineer, the rate of change of cant and cant deficiency may be taken as 55 mm/s and cant gradient as 1 in 360. The length of transition therefore may be reduced to a minimum of 2/3 of the desirable length as worked out on the basis of formula (a) and (b) of note of Sub-para (1) above or 1/2 of the desirable length as worked out on the basis of formula (c) above, whichever is greater.

(4) At locations where length of transition curve is restricted, and therefore, may be inadequate to permit the same maximum speed as calculated for the circular curve, it will be necessary to select a lower cant and/or a lower cant deficiency which will reduce the maximum speed on the circular curve but will increase the maximum speed on the transition curve. In such cases, the cant should be so selected as to permit the highest speed on the curve as a whole.

(5) In case of doubling and New lines, if a curve is not possible to be designed for 160 Kmph for Group ‘A’ and 130 Kmph for Group ‘B’ routes, approval of PCE shall be obtained.

An example is illustrated with calculations below –

A curve of 600 metres radius has a limited transition of 40 metres length, the calculation of maximum permissible speed and super-elevation is as follows –

Speed on transition curve = Speed on circular curve

$$\frac{(Rate\ of\ change\ of\ cant)\ \times L \times 3.6}{C_a} = 0.27\sqrt{R \times (C_a + C_d)}$$

(3.6 is a factor used for converting m/sec to Kmph)

Best values of speed are obtained when $C_a = C_d$

Adopting the same units and the maximum value of rate of change of cant of 60 mm per second for Broad Gauge –

$$\frac{60\ \times 40\ \times 3.6}{C_a} = 0.27\sqrt{600\ \times 2C_a}$$

Solving C_a = 94.85 or 95 mm

Limiting the value of C_d to 75 mm

$$Maximum\ Speed\ = 0.27\ \sqrt{R \times (C_a + C_d)}$$

$$Maximum\ Speed\ = 0.27\ \sqrt{600 \times (95 + 75)}$$

Maximum speed = 86.23 say 85 Kmph

Cant gradient = (95/40000) = 1/421, which is within the permissible limits

The rate of change of cant at 85 Kmph works out to 56.07 mm/second, which is also within the permissible limits.

(6) Laying Transition –

(a) A transition curve is laid out as a cubic Parabola and to accommodate this, the main circular arc is moved inwards by an amount called the *"Shift"*.

The *"Shift"* is calculated from the formula: $$S = \frac{L^2}{24R}$$

Where,

S = shift in metres

L & R being in metres.

(b) The offset in metres from the straight to any point on the transition curve is calculated from the formula – $$Y = \frac{X^3}{6RL}$$

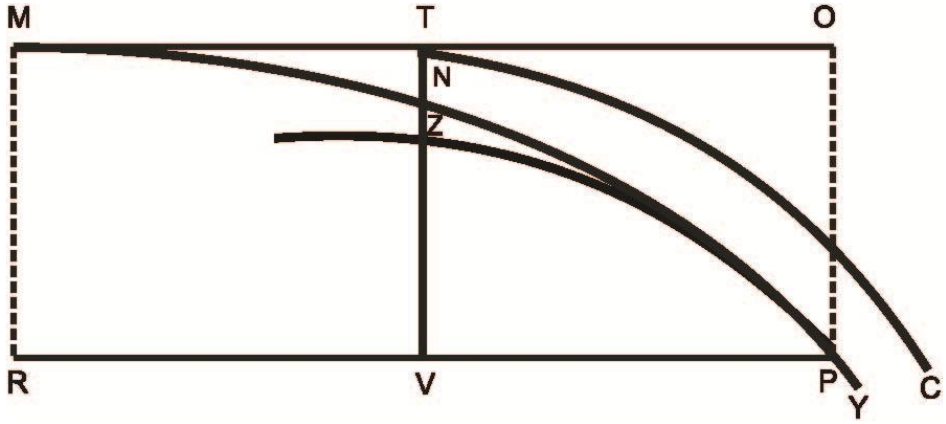
Where,

Y = offset from the straight in metres.

X = distance from the commencement of the curve in metres, and

L & R length of transition and radius of curve respectively in metres.

(c) The arrangement of a transition curve is shown in the figure below –



The original circular curve TC is tangential to the straight at T. The curve is shifted to ZY and TZ is the amount of shift. The transition curve MNP bisects the shift TZ at N.

(7) When realigning old curves, transition curves on approaches should invariably be provided wherever feasible. It should be ensured that there is no change of grade over the transition.

(8) *Compound Curves* – In case of a compound curve, which is formed, by two circular curves of different radii but curving in the same direction, common transition curve may be provided between the circular curves. Assuming that such compound curve is to be traversed at uniform speed, the length of the transition connecting the two circular curves can be obtained from –

(a) $L = 0.0056 (C_{a1} - C_{a2}) \times V_m$

(b) $L = 0.0056 (C_{d1} - C_{d2}) \times V_m$

Whichever, is greater.

Where,

C_{a1} and C_{d1} are cant and cant deficiency for curve No.1 in mm;

C_{a2} and C_{d2} are cant and cant deficiency for curve No.2 in mm;

L is length of transition in metres; and

V_m is max. permissible speed in Kmph.

The Cant gradient should be within the permissible limits as stated in *Sub Para (1) & (3) above.* Common transition may be provided when the length of common transition as worked out above is more than the length of virtual transition as specified in ***Para 403 (2).***

(9) *Reverse Curves –*

(a) In case of a reverse curve, which is formed by two circular curves in opposite directions, common transition curve may be provided between circular curves. The total length of common transition, i.e., from first circular curve to second circular curve, may be obtained from –

(i) $L = 0.0056\ (C_{a1} + C_{a2}) \times V_m$

(ii) $L = 0.0056\ (C_{d1} + C_{d2}) \times V_m$

Whichever is greater;

Where,

C_{a1} and C_{d1} are cant and cant deficiency for curve No.1 in mm;

C_{a2} and C_{d2} are cant and cant deficiency for curve No.2 in mm;

L is length of transition in metres; and

V_m is max. permissible speed in Kmph.

Cant gradient should be within the permissible limits as stated in *Sub Para (1) & (3)* above.

(b) For high speeds, in Group ‘A’ and ‘B’ routes, a straight with a minimum length of 50 m shall be kept between two transitions of reverse curves.

(i) On groups ‘A’ and ‘B’ routes on straights less than 50 metres between reverse curves should be eliminated by suitably extending the transition lengths.

In doing so, it should be ensured that the rate of change of cant and versine along the two transitions so extended is kept the same.

(ii) Whenever such straights between reverse curves can neither be eliminated nor the straight length increased to over 50 metres, speed in excess of 130 Kmph should not be permitted.

406 Running out Super-elevation:- (*Back to **Para 402***)

(1) On transitioned curves, cant should be run up or run out on the transition, not on the straight or on the circular curve, increasing or decreasing uniformly throughout its length.

(2) On non-transitioned curves, cant should be run up or run out on the ‘virtual transition’.

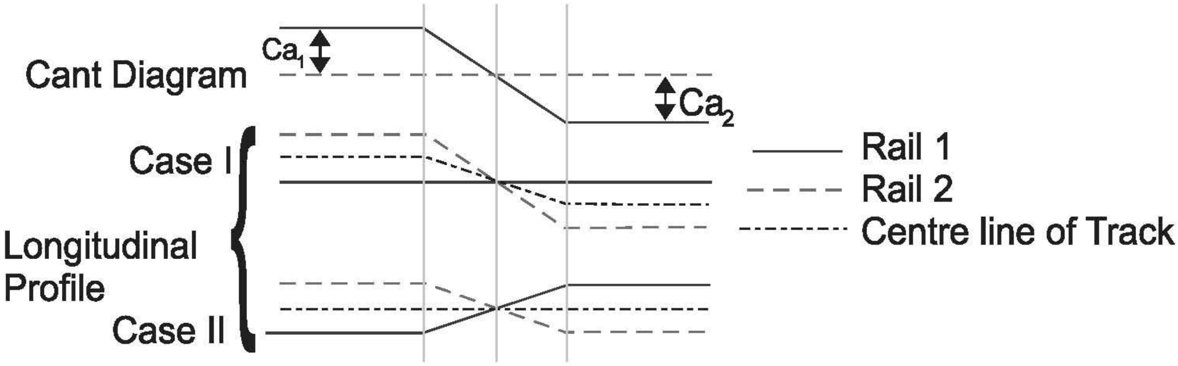
(3) Longitudinal profile of transition on the reverse curve may be from one of the following two alternatives-

(a) In case I, the level of one of the rails is maintained and the super elevation is run out on the other rail by lowering it over half the transition length and raising it to the required amount of cant over the remaining half portion of the transition.

(b) In case II, the level of the centre line of the track is maintained the same throughout, and the cant is provided by raising one rail by half the amount of cant and lowering the other rail by the equal amount. Cant is run out or gained over the length of the transition by raising and lowering both the rails by equal amount symmetrically, with respect to the level of the centre line track.

In case I, the level of the centre of the track gets disturbed whereas in case II, it is maintained the same throughout.

VERSINE OR CANT DIAGRAM



(4) Special cases of Super-elevation run out may be approved by the Chief Track Engineer.

407 Indicators/Boards Provided in Curves:-

(1) *Curve Board* – Each approach of a curve should be provided with a curve board at the tangent point fixed on the outside of the curve. This Board should indicate the radius of the curve, the length of the curve, length of transition in metres and the maximum cant provided on the circular portion of curve in millimetres.

Note - Separate speed restriction boards for 'nominated' stock and other stock (Goods/normal) respectively as defined in Para 404 (2) to be provided on each such curves where restriction is to be imposed.

(2) *Rail Posts Indicating Tangent Points* – On the inside of the curve, rail posts should be erected on each approach of the curve, to indicate the positions of the beginning and end of transition curves. These rail posts may be painted in red and white colours respectively. In the case of non-transitioned curve, similar rail post should be erected on the tangent track and on the circular curve over which the cant is run out, indicating the beginning and end of the virtual transition.

(3) *Indication of Cant on Track – Super-elevation* or cant should be indicated by painting its value on the inside face of the web of the inner rail of the curve and at every versine station, beginning with zero at the commencement of the transition curve.

The value of cant should be indicated on the circular curve at its beginning and at the end. In the case of long circular curve, the cant value should be indicated at intermediate stations at a distant not exceeding 250 metres.

(4) When curves are realigned, the repositioning of the curve boards and posts and repainting of values of Super-elevation at intermediate points should be done, as required.

408 Speed over Turnout on Curves:- (*Back to **Para 426***)

(1) *Provision in **General Rules** – Relevant **Para 4.10** of "General Rules, 1976 Edition"* is reproduced below –

(a) The speed of trains over non-interlocked facing points shall not exceed 15 Kmph in any circumstances and the speed over turnout and crossovers shall not exceed 15 Kmph, unless otherwise prescribed by approved special instruction, which may permit a higher speed.

(b) Subject to provision of sub-rule (a) above, a train may run over interlocked facing points at such speed as may be permitted by the standard of interlocking.

(2) ***Turnouts on Running Lines with Passenger Traffic –*** (*Back to **Para 408***)

(a) Turnouts in running lines over which passenger trains are received or dispatched should be laid with 1 in 12 curved switch or flatter.

(b) 1 in 8.5 turn out with curved switches can be laid in exceptional circumstances taking off from straight track with the approval of PCE.

(c) Emergency crossovers between double or multiple straight lines, which are laid only in the trailing direction, may be permitted to be laid with 1 in 8.5 crossings.

(d) For snag dead end, 1 in 8.5 symmetrical split turnouts may be used.

(e) The turnouts have inbuilt curvature as a part of the design. Therefore, it is desirable that laying of turnouts should normally be avoided on curved main line from the consideration of maintainability & comfort. If the laying of turnout on curved main line is inevitable due to site constraints, following stipulations shall be followed:

(i) for laying of turnouts with 1 in 12 or flatter crossings taking off from curve, it shall be ensured that the resultant lead curve radius as well as the radius of main line curve shall not be less than 350m.

(ii) 1 in 8.5 turnout shall not be laid from inside of a curved track.

(iii) 1 in 8.5 turnout with curved switches may be laid from outside of a curve up to five degree in exceptional circumstances with the approval of PCE, where due to limitation of room it is not possible to provide 1 in 12 turnout.

Note: 1) The existing turnouts not conforming to the stipulations given in Sub-Para (e) above may continue. However, efforts shall be made to eliminate such layouts in a planned manner/during yard remodeling.
2) During Yard remodeling in existing yards, under exceptional circumstances, where due to site constraints and techno economic reasons, it is not practicable to adhere to the stipulation given in Sub-para 408(2)(e)(i), laying of 1 in 12 or flatter turnout with curved switch may be allowed from inside of curved main line so that the resultant lead curve radius is not less than 290m, with the personal approval of PCE.

(f) Radius of turn-in-curve should generally be not less than 350 metre however, where it is not practicable to achieve the radius of curvature of turn-in curves as 350 m on account of existing track centres for the turnout taking off from curves, the turn-in curves may be allowed upto a minimum radius of 220 m subject to the following –

(i) such turn-in curves are provided on PSC sleepers only, with sleeper spacing same as that for the main line.

(ii) full ballast profile, same as that for the main line, is provided.

(3) *Speed over interlocked turnouts –*

(a) Speed in excess of 15 Kmph may be permitted for straights of interlocked turnouts only under approved special instructions in terms of **Para 4.10** of “General Rules, 1976 Edition”.

(b) In the case of 1 in 8.5, 1 in 12 and flatter turnouts provided with curved switches, higher speeds as permitted under approved special instructions may be allowed on the turn- out side, provided the turn-in curve is of a standard suitable for such higher speeds. While permitting speed beyond 15 Kmph, provisions of ***Para 408 (4)*** below may be kept in view.

(c) The permissible speed on turnouts taking off on the inside of the curve should be determined by taking into consideration the resultant radius of lead curve which will be sharper than the lead curve for turn-outs taking off from the straight.

(4) *Up-gradation of Speeds on Turnouts and Loops above 15 kmph-* (ACS – 11)

(a) *Length of Section* – Up-gradation of speeds on turnout should cover a number of contiguous stations at a time so as to derive a perceptible advantage of the higher speed in train operation. The works described below should cover all the running loops on the stretch of line taken up.

(b) *Turnouts* – Speed, in excess of 15 Kmph, should be permitted on turnouts laid on PSC sleepers only. All turnouts on the running loops shall be laid with curved switches, with minimum rail section being 52 kg/m. All rail joints on these turnouts should also be welded to the extent possible.

For different type of curved switches permissible speed are as under –

SN	Type of Turnout	Permissible Speed
1 (a)	1 in 8.5 curved switch (Over-riding & Thick Web)	15 kmph
1 (b)	1 in 8.5 thick web curved switch on emergency crossover for freight stocks not in Exception List	25 kmph
2 (a)	1 in 8.5 symmetrical split with curved switches (Over-riding & Thick Web)	30 kmph
2 (b)	1 in 8.5 thick web symmetrical split with curved switches and compliance of provisions of Para 408(5)	40 kmph
3 (a)	1 in 12 curved switch (Over-riding & Thick Web)	30 kmph
3 (b)	1 in 12 thick web curved switch with compliance of provisions of Para 408(5)	40 kmph

(c) *Track on Running Loops* – The minimum track structure on the running loops should be 52 Kg/m rails laid as Short Welded Panels, sleeper density 1540 Nos. per km. Proper drainage of the area should also be ensured.

(d) *Turn-in curves* – Turn-in curves should be laid with the same rail section as on the turnout with PSC sleepers with sleeper spacing being 65 cm centre to centre (maximum).

Turn-in curve should conform to ***Para 408(2)*** and especially so in respect of curvature of the lead curve. Extra shoulder ballast of 150 mm should be provided on outside of the turn-in curve.

The frequency of inspection of turn-in curves should be same as that for main line turnouts.

(5) *For raising of speed on 1 in 12 thick web curved switch turnouts, 1 in 8.5 symmetrical split turnouts and loop lines to 40 kmph, following should be ensured:*

(i) *Turnouts* – Speed of 40 kmph should be permitted on 1 in 12 turnouts and 1 in 8.5 symmetrical split turnouts laid with thick web curved switches on pre-stressed concrete (PSC) sleepers. Minimum clean ballast cushion of 150 mm should be ensured. All rail joints on these turnouts should be welded. Joints of the CMS crossing may be fishplated.

(ii) *Turnout taking off from curved track:* The permissible speed of turnout curve may be lesser than 40 kmph in case the turnout is taking off from curved track. The speed potential of such turnout curves should be determined as per the resultant radius of the turnout curve and the cant provided, if any, which may be negative for turnout in contrary flexure as per site conditions. For laying of thick web switches on curved track, instructions given under Para 411(2) & 412(3) should be followed.

(iii) *Turn-in/Connecting curve* – Turn-in/Connecting curve should have speed potential of more than or equal to 40 kmph. Radius of turn-in curve should not be lesser than the radius of the turnout curve. Turn-in curves should be laid with the same rail section as that of the turnout. Turn in curve should be laid on PSC sleepers with maximum sleeper spacing of 65 cm centre to centre. Extra shoulder ballast of 150 mm should be provided on outside of the turn-in curve. These provisions shall also be applicable on any connecting curve of two turnouts in a crossover between two main lines or between main line and loop line.

(iv) The layout of the turnout and crossover should be checked for correct laying and geometry.

(v) Derailing switch - Derailing switch, if available in loop lines should be replaced with turnout of speed potential 40 kmph or more.

(vi) *Track on running loops* - The minimum track structure on the running loops including turn-in curve for permitting 40 kmph speed should be 52 kg rails laid on PSC sleepers with minimum sleeper density of 1540 Nos. per km. The minimum ballast cushion should be 250 mm with minimum clean cushion of 150 mm.

(vii) Speed of 40 kmph may also be permitted on loop lines provided with ballastless track laid per the guidelines contained in RDSO's Report No. CT-31B.

(vii) Platform clearances should be verified before raising the speed to 40 kmph.

(ACS – 11)

409 Permissible Speed over Curved Main Line at Turnouts: - Subject to the permissible run through speed governed by the interlocking standard, speed over the main line will be determined taking into consideration the maximum cant that can be provided on the main line and the permissible amount of cant deficiency.

(1) In the case of turnout of similar flexure, the maximum cant that can be provided, on the main line will be the sum of equilibrium cant for the turnout and permissible cant excess.

(2) In the case of turnouts of contrary flexure, the maximum cant on the main line (negative Super-elevation on turnout) will be the difference between the maximum permissible cant deficiency and cant determined for turnout from the formula given in Schedule of Dimensions as indicated in ***Para 411 below***.

(3) In both the cases, the permissible speed on the main line will be worked out by the formula as given in ***Para 403(1).***

410 No Change of Super-elevation over Turnouts:-There should be no change of cant between points 20 metres outside the toe of the switch and 20 m beyond the nose of the crossing. Normally, turnouts should not be taken off the transitioned portion of a main line curve. However, in exceptional cases, when such a course is unavoidable a specific relaxation may be given by the Chief Track Engineer of the Railway maintaining uniform cant over the length mentioned above.

411 Curves of Contrary Flexure: - (*Back to* ***Para 429*****)**

(1) On the main line curve from which a curve of contrary flexure takes off, the cant of the main line (which is the negative Super-elevation on the turnout), should be calculated from the formula given in the Schedule of Dimension and the permissible speed on the main line determined from the allowable cant deficiency and cant on the main line. The speed so determined shall be subject to limitations governed by the standard of interlocking and the sectional speed.

(2) For turnouts laid on curves with Thick Web Switches, pre-curving of stock and tongue rails shall be done during their manufacturing. Pre-curving and sleeper spacing shall be as given in Annexure-4/6.

412 Curves of Similar Flexure:- (*Back to* ***Para 429*)**

(1) *Not Followed by Reverse Curves* – On a main line curve from which a curve of similar flexure takes off, not followed immediately by a reverse curve, the turnout curve shall have the same cant as the main line curve.

(2) *Followed by Reverse Curves* – A change of cant on the turnout may be permitted starting behind the crossing (after the last exit sleeper) and being run out at a rate not steeper than 2.8 mm per metre and subject to the maximum cant on the main line turnout being limited to 65 mm.

The permissible speed on the main line is then determined from the allowable cant-deficiency and subject to limitations governed by the standard of interlocking and the safe speed limit.

(3) For turnouts laid on curves with Thick Web Switches, pre-curving of stock and tongue rails shall be done during their manufacturing. Pre-curving and sleeper spacing shall be as given in Annexure-4/7.

413 Curves with Cross Overs: - On curves on double line connected by cross over road, the speed and the cant for both roads are governed by the inner road to which the cross over road is a curve of contrary flexure. On the outer road, it is a curve of similar flexure.

The permissible speed and the necessary cant on the inner road shall be calculated in accordance with ***Para 411 above*****.** The same speed and the same cant shall be allowed on the outer road.

The outer track shall be raised so that both roads lie in the same inclined plane in order to avoid change in cross level on the cross over road. Where this is not possible, both main line and the turnout should be laid without cant and suitable speed restriction imposed.

414 Curves with Diamond Crossing: - Normally straight diamond crossings should not be provided in curves as these produce kinks in the curve and uniform curvature cannot be obtained.

However, where provision of such diamonds cannot be avoided or in case where such diamonds already exists in the track, the approach curves of these diamonds should be laid without cant for a distance of at least 20 metres on either side of the diamond crossings.

The cant should be uniformly run-out at the rate specified in ***Para 405*** beyond 20 metres.

The speed restrictions on the approach curve shall be decided in each case by the Chief Track Engineer taking into consideration the curvature, cant deficiency and lack of transition but shall in no case be more than 65 Kmph.

In the case of diamond crossings on a straight track located in the approach of a curve, a straight length of minimum 50 m between the curve and the heel of acute crossing of diamond is necessary for permitting unrestricted speed over the diamond, subject to maximum permissible speed over the curve from considerations of cant deficiency, transition length etc.

415 Extra Clearance on Curves: - On curves, additional lateral clearances, in excess of the fixed dimensions should be provided as laid down in the *Schedule of Dimensions* –

(1) Between adjacent tracks and

(2) Between curved track and fixed structure.

416 Compensation for Curvature on Gradient: - Compensation for curvature should be given in all cases where the existing gradient when added to the curve compensation exceeds the ruling gradient.

The compensation to be allowed should ordinarily be (70/R) %. (i.e., 0.04% per degree of curvature), where R is the radius of curvature in metres.

Thus, for a ruling gradient of 0.5% or 1 in 200, the gradient for 583 metre radius of curvature should be flattened to 0.5% - {(70/583)*or*(3° x 0.04 %)} = 0.38% or 1 in 264.

417 Vertical Curve: - (*Back to **Para 657***)

A vertical curve shall be provided only at the junction of the grade when the algebraic difference between the grades is equal to or more than 4 mm per metre or 0.4%.

The minimum radius of the vertical curve shall be kept as under:

Group A	Group B	Group C, D & E
4000 metres	3000 metres	2500 metres

SECTION – II: Re-Alignment of Curves

418 Running on Curves:-

(1) For smooth and satisfactory running on curves –

(a) There should be no abrupt alteration of curvature and/or Super-elevation (cant), and

(b) The Super-elevation should be appropriate to the curvature, at each point.

(2) The versines, Super-elevation and gauge should be checked by the JE/SSE/P.Way(Sectional), SSE/P.Way(In-charge) and ADEN as per prescribed schedule for inspection and also whenever the running over curves is found to be unsatisfactory as a result of inspection by locomotive or by carriage or as a result of Track Recording.

(3) The results of the inspections shall be recorded as per the proforma given in ***Annexure - 4/1*** and necessary entries made in TMS.

(4) Based on the results of the inspections the decision to realign should be taken by the SSE/P.Way in-charge or Assistant Divisional Engineer.

(5) The criteria for realignment of a Curve, based on service limit for station to station versine variation, shall be as per ***Para 524.***

419 String lining Operations:-

(1) The work of realigning and transitioning curves consists of the following three main operations –

(a) Survey of the existing curve by measurement of versines.

(b) Determination of the revised alignment and computation of slews, including provision of correct Super-elevation.

(c) Slewing of the curve to the revised alignment.

(2) *Operation No. 1 – Versine survey of curve –*

(a) Versine readings shall be taken along the gauge face of the outer rail.

(b) To ensure inclusion of the point of commencement of the curve, a mark is made on the gauge face of the outer rail at a distance of at-least 30 m (three stations) behind the beginning of curve, and at the end of curve as indicated by station markings on the rails. i.e., station number zero/last station (or apparent tangent point, if no such markings exist on track).

(c) If station markings at every 10 m interval are not available on track, it shall be marked at every 10 m (half-chord distance) interval beginning from the marking made before beginning of the curve (vide *Sub-Para (b)* above) till the marking beyond end of the curve (vide *Sub-Para (b)* above),

(d) These "stations" should be marked and numbered in white paint on the rail.

(e) With a fishing cord or wire stretched out over the full length of the cord, the versines are measured to 1 mm accuracy serially at each station from one end of the curve to the other with the rule held normal to the line and recorded.

(f) Certain features, which restricts slewing of the track either inwards or outwards should also be recorded, indicating the maximum extent inwards or outwards to which slewing is possible-

(i) under existing circumstances; and

(ii) if a moderate expenditure could be incurred in removing the "*restriction*".

(g) The existing Super-elevation should also be measured and recorded against each "Station".

(h) The record obtained would be in the following form:

Curve from km...........................to km...........……………….................
Between station..................................…and station....................................
Date of survey...
Jurisdiction of JE/SSE/P.Way (In-Charge) / (Sectional) ………………………..

Station No	Versine (mm)	Cant Existing	Remarks regarding restrictions to Slewing
0	0	Zero	
1	2	5 mm	
2	4	10 mm	
3	4	20 mm	
4	10	25 mm	
5	11	28 mm	1.6 metres
6	23	25 mm	G B obligatory point
7	30	28 mm	High Bank, Moorum etc

(i) In the case of reverse curves, the versine survey should be continuous, but transferred to the outer rail at points where the curvature changes sign.

It is probable that the exact point will not be definite; it is therefore, desirable to keep the original rail face as the base until the change is certain to enable plus or minus versines to be read from the same rail, it is only necessary to hold the fishing cord or wire 20 mm clear of the rail edge at each end by using special gadget and subtracting 20 mm from the reading at the centre.

(j) Where there are two or more lines, track centres should also be recorded at every station. After the versine-survey, the curve alignment shall not be disturbed until the realignment is commenced.

(3) *Operation No. 2 – Determination of revised alignment and computation of slews –*

(a) The basic principles of string lining are as follows –

(i) The chord length being identical, the sum total of the existing versines should be equal to the sum total of the proposed versines.

(ii) The slew in any direction at a station affects the versine values at the adjacent stations by half the amount in the opposite direction, when the track is not disturbed at the adjacent stations.

(iii) The second summation of versine difference between proposed versine and existing versine represents half the slew at any station.

(iv) At the first and at the last station, the slews should be zero.

(b) The calculations for obtaining a realignment solution are carried out in the following manner (Refer **Table-1**);

(i) After recording the versines in mm, proposed versines are selected in such a way as to obtain uniform rate of change of versines over the transition curve; and uniform versines over the circular portion of the curves.

(ii) The difference between the proposed and the existing versines are worked out for each station, the positive sign being used, if the proposed versine is greater than the existing versine and negative sign if it is less (Ref. Col. 4 -**Table 1**), at the end of this *Sub-Para (4),* wherein a solution to a realignment of curve is worked out.

(iii) First and second summations of the differences of proposed and existing versines are then worked out (Ref. Col. 5 & 6).

(iv) The first summation at any station, gives the cumulative versine difference at each station. To begin with this value for station ‘0’ is the same as the versine difference (Col. 4).

To obtain the corresponding value for station No. 1 the cumulative versine difference of station ‘0’ (Col. 5) is added to the versine difference of station No. 1 (Col. 4) diagonally downward as shown by the arrow indication and the resultant value is written against Station No. 1 (Col. 5).

Similarly, the cumulative versine difference is calculated at each station till the last station is reached. Since the sum total of the existing and the proposed versines is the same, the figure against the last station will be ‘0’ (Col. 5).

(v) The second summation at any station gives the cumulative effect of the figures of first summations upto the previous station. It can be proved theoretically that this represents half the slew required at each station to obtain the proposed versine.

To start with, this value for station no. ‘0’ is taken as zero. To obtain the corresponding value of Station No.1, the second summation value of the station ‘0’ (*i.e.,* the previous station) is added to the first summation value of the same station ‘0’, as shown by horizontal arrow. This value is shown against Station No. 1 (Col. 6).

Similarly, the second summation for Station No. 2 is the sum of the figures of the first summation and second summation of Station No. 1 (Col. 5 and 6).

The second summation is obtained against each station till the last station is reached. The slew at the last station should be zero. Otherwise, the track beyond the last station will be affected by the slew at the last station.

Normally this figure at the last station may not be zero. To make it zero correcting couples are applied.

(vi) *Method of applying correcting couples* – For correcting the half throws to zero the procedure shall be as follows –

When the final half-throw is negative, add to the versines having the lower station numbers and subtract an equal amount from the versines having the higher station numbers, selecting “station” in pairs such that the sum of the products of the difference of the “station” numbers taken in pairs and the amount added to the versines, equals the numerical amount of the negative half-throw to be cleared.

When the final half-throw is positive, subtract from the versines having the lower station numbers and add an equal amount to the versines having the higher station numbers, selecting the stations in pairs such that the sum of the product of differences of the station numbers in pairs and the amount subtracted from the versines, equals the numerical amount of the positive half throw to be cleared.

(c) *For computing slews when realigning and/or transitioning a complete curve the following procedure should be adopted* –

(i) Calculate the length of transition from ***Para 405****.* This determines the versine gradient on the transition.

(ii) Work out versine difference, first and second summations as discussed above at the initial stations with a view to foreseeing and exercising due control over the slews (col. 4, 5 and 6).

(iii) Review the figures of proposed versines (col 3), if necessary and continue the process until the transition at the other end on which the specific versine gradient should be observed.

(iv) In the process, it must be ensured that difference of versines (col. 4) should sum up to zero.

(v) Apply correcting couples to control the slew at obligatory points and to close the slew at the end to zero.

(vi) The slews must be limited to the minimum possible.

(vii) Determine correct cant to be provided, points of zero and maximum cant and the cant run-off.

(viii) Alternatively, suitable computer softwares, where available may be used to determine the final values of slew.

(d) *Maximum Slew* – Maximum slew at any station is usually limited by practical considerations. The distance between tracks and adequate clearance to existing structures must be maintained and track must not be slewed too near the edge of the formation. At certain locations like bridges, it may not be possible to slew the curve at all.

(e) In carrying out the calculations for the realignment of a long curve of more than 50 stations, it is best to write down values of about 10 proposed versines at a time and see that the sum is approximately the same as that of the corresponding old versines and then workout the second summation to ensure that slews are minimum. A final adjustment to ensure that the sum of the existing and proposed versines is equal and that the slew at last station is zero can then be made.

(f) For obtaining a suitable re-alignment solution, the proposed versines should be selected carefully.

(g) A numerical example is given in ***Table 1***, which will illustrate the method of working out the solution for realignment of a curve.

(4) *Operation No. 3 – Slewing the curve to revised alignment –*

(a) The revised alignment of the curve should be staked out with a steel tape by using the pegs cut from the bars (or wooden stakes with tack marks). These are fixed on the cess on the inner side of the curve square to the track and at such a distance according to the value of the slews, so that the final alignment of the track is at one gauge distance from the face of the pegs (or the tacks on wooden pegs) to the outer edges of the inner rail.

(b) In narrow cuttings with sharp curves or in tunnels it may not be possible to measure versines on the pegs driven on the inner cess of the curve due to the face of the cutting fouling the fishing cord. In such cases, the pegs may be driven on the outer cess. The correctness of the peg locations should be checked, by measuring the versines on these pegs and, verifying that they correspond to the final versines (of the re-alignment solution).

(c) In no case should these be fixed on formation that is not firm or at locations where they are liable to the disturbed or tampered with.

(d) The curve should then be correctly slewed with reference to the pegs.

(e) Along with slewing of the curve to the revised alignment correct Super-elevation should be provided at each station to accord with the curvature, particular attention being paid to the run-off on the transition. Repositioning of posts on the cess to indicate zero and maximum Super-elevation and remarking of cant values on the inside web of the inner rail should be done.

420 Realigning Curves on Double or Multiple Lines:- On double or multiple tracks, each curve should be string-lined independently. No attempt should be made to realign any curve by slewing it to a uniform centre to centre distance from the realigned curve as –

(1) The existing track centres may not be uniform and relatively small slew on one may entail a much larger (even prohibitively large) slew on the adjacent track.

(2) The transitions at the entry and exit may be of different lengths, which make it impracticable to maintain uniform track centres on them even though the degree of the circular curves may be nearly the same.

421 Cutting of Rails on Curves:- (*Back to **Para 715***)

Rails are usually laid with square fish plated joints on curve. On curved track the inner rail fish plated joints gradually lead over the outer rail joints. When the inner rail of the curve is ahead of the outer rail by an amount equal to half the pitch of boltholes, cut rails should be provided to obtain square joints. Cut rail is a rail, which is shorter than the standard length of rail by an amount equal to the pitch of the boltholes. The excess length 'd' by which the inner rail gains over the outer rail is calculated by the formula–

$$d = \frac{L \times G}{R}$$

where,

'd' is the length in mm by which the inner rail joint is ahead of the outer rail joint over the entire length of the curve, if cut rails are not provided.

L = Length of the curve in metre

R = Radius of the curve in metre

G = The gauge + width of the rail head in mm

422 Joints on Curves:- (*Back to* ***Para 715***)

(1) It must be ensured that fish plated rail joints are square at beginning and at the end of the curve.

(2) On the sharp curves less than 400 metres the rail joints may be staggered, where elbows/kinks are likely to develop if rail joints are laid square.

423 Check Rails on Curves:-

Check rail reduces the risk of derailment on the sharp curves.

(1) Check rail should be provided on the inside of the inner rail of the curve, with appropriate clearances between the checkrail and the running rail, as stipulated in the **"Schedule of Dimensions".**

(2) Locations where checkrail should be provided shall be decided by the Divisional Engineer taking into consideration the negotiability of the rolling stock and the curve geometry.

424 Wear on Outer Rail of Curves:- (*Back to* ***Para 613***)

(1) The wear on the outer rail on the curve can be reduced effectively by-

(a) Lubricating the gauge face of outer rails on the curves.

(b) Maintaining correct curve geometry and Super-elevation.

(c) Provision of suitable checkrail.

(d) Adopting slack gauge PSC sleeper as per RDSO drawings depending on curvature of track.

(2) Track mounted automatic Gauge Face Lubricators should be provided on curves of radius 875 m (2°) and sharper to reduce rail gauge face wear. On routes where rail grinding is in practice, track mounted automatic Gauge Face Lubricators should be provided on curves of radius 1400 m (1.25°) and sharper. Lubrication should be done on new rails or on old rails, which do not have Gauge Corner Cracking or head checks.

While deciding the location of lubricators, following should be considered:-

(a) It is located on tangent track at the beginning of transition curve where wheel flanging is just beginning to occur.

(b) On single lines, the lubricator shall be located in the direction of heaviest traffic.

(c) Lubricators should be located away from switches, crossings and other areas where discontinuity in LWR track may exist.

425 Measurement of Rail Wear on Sharp Curves: -The wear of rails of curves having radius of 600 m or less shall be recorded during scheduled curve inspection by SSE/P.Way(Incharge) and JE/SSE/P.Way(Sectional) as stipulated in Table-1B of para 106 and 109. The lateral wear, vertical wear and total loss of section should be recorded and proper record of measurements maintained.

Table 1

Realignment of Curve by Stringlining Method

Station Number	Existing versine in mm on 20 m chord	Proposed versine in mm	Versine difference Column 3 – Column 2 in mm	1^{st} summation of versine difference	2^{nd} summation of versine difference or half throw in mm	Correcting Couple			Resultant half slew Column 9 + Column 6 in mm	Resultant full slew in mm	Resultant versine Column 3 + Column 7 in mm
						Correcting versine in mm	1^{st} summation of correcting versine	2^{nd} summation of correcting versine			
1	2	3	4	5	6	7	8	9	10	11	12
0	2	2	0	0	0	-1	-1		0	0	1
1	0	8	+8	+8	0	-1	-2	-1	-1	-2	7
2	14	16	+2	+10	+8	-1	-3	-3	+5	+10	15
3	28	24	-4	+6	+18	-1	-4	-6	+12	+24	23
4	30	32	+2	+8	+24	-1	-5	-10	+14	+28	31
5	36	32	-4	+4	+32	-1	-6	-15	+17	+34	31
6	36	32	-4	0	+36	-1	-7	-21	+15	+30	31
7	24	32	+8	+8	+36	-1	-8	-28	+8	+16	31
8	32	32	0	+8	+44		-8	-36	+8	+16	32
9	28	32	+4	+12	+52		-8	-44	+8	+16	32
10	36	32	-4	+8	+64		-8	-52	+12	+24	32
11	34	32	-2	+6	+72		-8	-60	+12	+24	32
12	32	32	0	+6	+78		-8	-68	+10	+20	32
13	34	32	-2	+4	+84	+1	-7	-76	+8	+16	33
14	36	32	-4	0	+88	+1	-6	-83	+5	+10	33
15	24	32	+8	+8	+88	+1	-5	-89	-1	-2	33
16	24	24	0	+8	+96	+1	-4	-94	+2	+4	25
17	28	16	-12	-4	+104	+1	-3	-98	+6	+12	17
18	0	8	+8	+4	+100	+1	-2	-101	-1	-2	9
19	6	2	-4	0	+104	+1	-1	-103	+1	+2	3
20	0	0	0	0	+104	+1	0	-104	0	0	1

+ Slew Inside **- Slew Outside**

Annexure - 4/1 (*Para 418*)

PROFORMA OF CURVE REGISTER
DETAILS OF INSPECTION

___________ **RAILWAY**

Curve No. ___________ Degree of curve ___________
From km ___________ to ___________ ___________ Section

Station No.	Prescribed (Ideal)			Date of check	Measurement recorded		
	V	SE	G		V	SE	G
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Action to be taken	Date of string-lining or local adjustment	Measurement recorded after adjustment with date of check		
		V	SE	G
(9)	(10)	(11)	(12)	(13)

PART – B

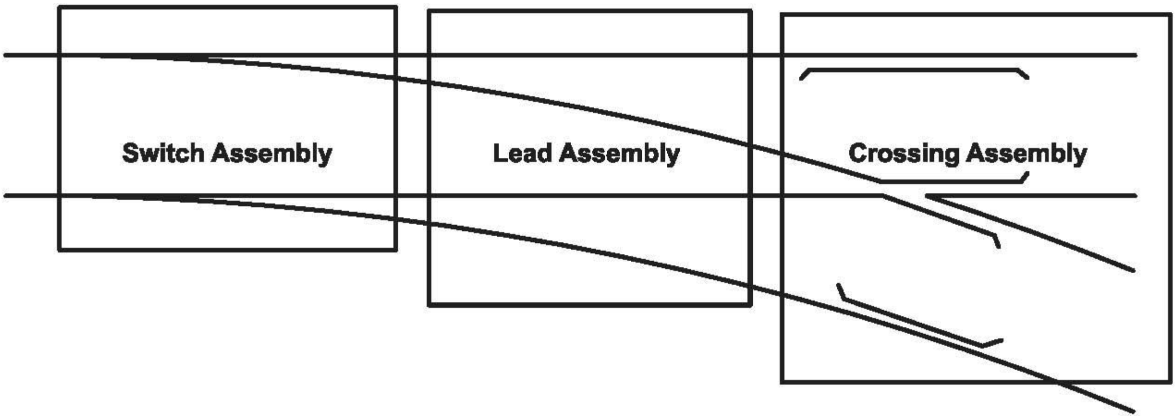
Points & Crossings

426 **(1) Turnout:-** It is a geometrical installation of track to allow movement of train from one track to another track. The turnout consists of following sub-assemblies:

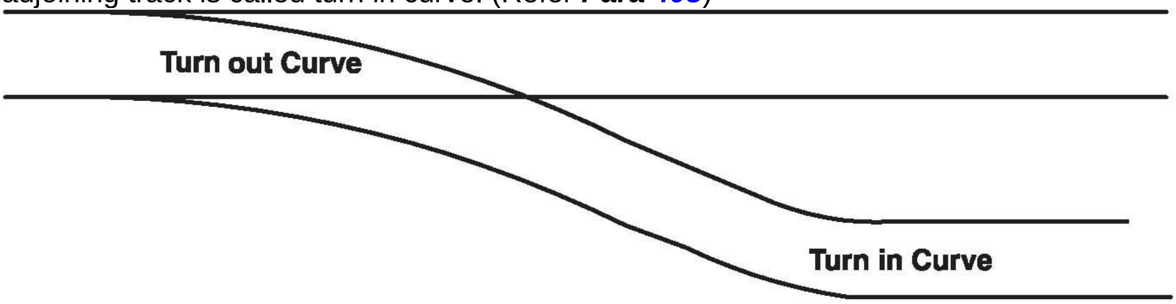
(a) Switch assembly

(b) Lead assembly

(c) Crossing assembly



(**2**)**Turn in Curve**: The curve connecting the turnout curve after heel of crossing and the adjoining track is called turn in curve. (Refer ***Para 408***)



Turn in Curve

427 Assembly drawings:-The turnout and its sub-assembly drawings numbers commonly being utilized on Indian Railways are as under:

Sl. No.	Rail Section and sleeper	Angle of Crossing	RDSO Drawing No.		
			Complete Layout	Switch sub Assembly	Crossing sub Assembly
1	52 Kg/m Rail on PSC sleeper	1 in 8½	RT-4865	RT-4866	RT-4867
2	60 Kg/m Rail on PSC sleeper	1 in 8½	RT-4965	RT-4966	RT-4967
3	52 Kg/m Rail on PSC sleeper	1 in 12	RT-4732	RT-4733	RT-4734
4	60 Kg/m Rail on PSC sleeper	1 in 12	RT-4218	RT-4219	RT-4220
5	60 Kg/m Rail on PSC sleeper	1 in 16	RT-5961	RT-5962	RT-5963
6	60 Kg/m Rail on PSC sleeper	1 in 20	RT-5858	RT-5859	RT-5860
7	60 Kg/m Rail on PSC sleeper Thick web Switch with Zu – 1 – 60 rails	1 in 8½	RT-6279	RT-6280	RT-4967
8	52 Kg/m Rail on PSC sleeper Thick web Switch with Zu – 2 – 49 rails	1 in 12	RT-5268	RT-5269	RT-4734
9	60 Kg/m Rail on PSC sleeper Thick web Switch with Zu – 1 – 60 rails	1 in 12	RT-6154	RT-6155	RT-4220
10	52 Kg/m Rail on PSC sleeper	1 in 8½ symmetrical split	RT-5353	RT-5354	RT-4867
11	60 Kg/m Rail on PSC sleeper	1 in 8½ symmetrical split	RT-5353	RT-5354	RT-4967
12	52 Kg/m Rail on PSC sleeper	1 in 12 symmetrical split	RT-5553	RT-5554	RT-4734
13	60 Kg/m Rail on PSC sleeper	1 in 12 symmetrical split	RT-5553	RT-5554	RT-4220

428 LWR through Points and Crossings: - The turnouts shall be isolated from LWR/CWR by provision of SEJs on either side. However, in case of LWR/CWR taken through turnouts the provisions contained in RDSO report no. **CT-48** shall be followed.

(ACS – 9)

429 Inspection and Maintenance of Points and Crossings:-

(1) Maintenance – General

(a) Points and crossings should be laid without the 1 in 20 cant except canted turnouts as per approved designs.

(b) There should be no junction fishplates at stock rail joints or at the heel of crossings.

(c) 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.

(d) It is desirable to weld stock and lead joints on the Points and Crossings assembly.

(e) The use of spherical washer is necessary, where the shank of the bolt is not at right angles to the axis of the rail to obtain flush fit of the head of the nut of the bolt with the web of the rail. The spherical washers are used on skew side.

(f) Notwithstanding the provisions of *Sub-Para (e)* above, the spherical washer should invariably be provided on the left side in switch assembly; as the orientation of fish-bolt hole is made accordingly. On crossing tapered washers are to be used on both sides.

(g) Correct spacing of sleepers should be ensured according to the standard layout drawings. The standard spacing of sleepers for 1 in 8.5 and 1 in 12 turnouts are given in ***Annexure - 4/2***. For canted Turnouts, the spacing of sleepers as per approved RDSO design shall be used.

(h) The track geometry at the turnout should not be inferior to that applicable for the route.

(i) The clearance, at the toe, heel of switch, at checkrail and wing rail must be maintained within the tolerances prescribed in the schedule of dimensions.

(j) The chairs and fastenings and all other fittings must be properly secured.

(k) Packing under the sleepers must not be loose/ defective especially under crossing and the switch.

(l) Cess should be low enough to permit efficient drainage and adequate depth of ballast cushion should be provided.

(m) In case creep is observed at such layouts, the condition of elastic fastenings may be examined and suitable action be taken.

(n) Where large number of Points and Crossings are being maintained within a specific area such as marshalling yards, large layouts of sidings, terminal stations etc., regular cycle of maintenance covering all Points and Crossings should be organized.

(2) *Maintenance of Switches –*

(a) The tongue rail and stock rail shall be fabricated in workshop as per standard RDSO drawings. Field officials should check the curvature of Stock Rail and Tongue Rail before laying. In case of Turn out taking off from curve suitable curvature as per resultant lead radius to be provided both in Stock Rail and Tongue Rail.

(b) For information of field officials, the location of 13 mm head of tongue rail, Junction of head (JOH), location of level point of stock rail and tongue rail and its head thickness from ATS is given in ***Annexure - 4/5***

(c) The condition of stock & tongue rails should be carefully examined and badly worn and damaged stock and tongue rails should be replaced. A tongue rail may be classified as worn/ damaged when- (*Back to **Para 717***)

(i) it is chipped/cracked over small lengths aggregating to 200 mm within a distance of 1000 mm from ATS in case of 1 in 8.5 switches and within a distance of 2000 mm from ATS in case of 1 in 12 and 1 in 16 switches. Chipped length will be the portion where tongue rail has worn out for a depth of more than 10 mm over a continuous length of 10 mm. (The tongue rail can, however, be reused after reconditioning of the broken/worn/ damaged tip by welding)

(ACS – 8)

(ii) it is badly twisted or bent and does not house properly against the stock rail causing a gap of 5 mm or more at the toe, the limit described in the **IRSEM**.

(iii) wear on stock rail shall not exceed the limits laid down in ***Para 702 (1) (b).*** However, proper housing of tongue rails is to be ensured. Burred stock rail likely to obstruct the lock bar, should be replaced, if necessary.

(d) Rail Gauge ties, rodding etc. hinder proper packing and hence at the time of packing points and crossing the signal staff should take out the rods and stretcher bars etc.to facilitate proper tamping.

(e) To check the housing of the tongue rail and also the throw of the switch, all non – interlocked points should be operated by hand lever and other Points from the signal frame, when traffic permits doing so.

(f) If the tongue rail is found to be not housing properly against the stock rail, the defect must be rectified by the Permanent Way Staff in case of non- interlocked points and jointly with signal and telecommunication staff, in case of interlocked or partially interlocked points.

(g) Tongue rail should, preferably bear evenly on all the slide chairs.

(h) When the tongue rail is in closed position, it must bear evenly against slide blocks.

(i) Slight wide gauge at the toe of switch over and above the required widening to house the tip of the tongue rail, may be adjusted by providing suitable steel packing between the web of the stock rail and the lug of the slide chair wherever feasible.

(j) The Stretcher bar connected to the pull rod shall be maintained jointly by the Permanent Way Staff and the Signalling Staff. The gap between the top of the leading stretcher bar and bottom of stock rail should be between 1.5 mm to 5 mm.

(k) All other stretcher bars shall be maintained by the JE/SSE/P.Way. Stretcher bars insulated for track circuit purposes shall not be interfered with unless signal staff are present.

(l) Wear on switches can be reduced by lubrication of the gauge face of tongue rail.

(3) *Maintenance of Crossings –*

(a) If any damage to the nose of crossing is noticed, its cause must be traced, which might be due to tight gauge or due to excessive clearance at the checkrail.

(b) To avoid hitting of nose, it shall be ensured that the checkrail clearance should be between 41 to 45 mm for fan-shaped turnout.

(c) In obtuse Crossings, the distance between the throat and the nose must be maintained correctly.

(d) In diamond crossings, obtuse crossings should be laid square to each other with respect to the centre line of the acute Crossings.

(e) Maximum permissible vertical wear on wing rails or nose of crossing shall be 10 mm (Except Weldable CMS Crossing for which limit will be 8mm). However, on Rajdhani/Shatabdi routes, as a good maintenance practice, crossing and the wing rails should be planned for reconditioning/resurfacing by welding on reaching the following wear limits: (*Back to* ***Para 717***)

(i) Built up/Welded Crossing – 6 mm

(ii) CMS crossings – 8 mm

(iii) WCMS Crossings – 6mm

Note –

In case of CMS/WCMS/heat-treated welded crossings, following dimensions should be deducted (to account for slope in casting of wing rails to 1 in 20 cant) from the wear measurements to find out the actual wear of wing rails and nose of crossing.

For wing rail wear
(a) for Built up/heat-treated welded crossing – 0 mm.
(b) for CMS crossing of 52 kg section – 2.0 mm
(c) for CMS / WCMS crossing of 60 kg section – 2.5 mm

For nose wear at ANC
(d) for Built up / heat-treated welded crossing – 6.0 mm
(e) for CMS crossing of 52 kg section – 8.0 mm.
(f) for CMS / WCMS crossing of 60 kg section – 8.5 mm

For nose wear at 100 mm behind ANC
(g) for Built up crossing – 0 mm
(h) for heat-treated welded crossing – 3.5 mm
(i) for CMS crossing of 52 kg section – 2.0 mm.
(j) for CMS crossing of 60 kg section – 2.5 mm.
(k) for WCMS crossings (1 in 12, 60 kg) – 6.0 mm.
(l) for WCMS crossings (1 in 8.5, 60 kg) – 5.7 mm.

(4) *Maintenance of Lead Portion and Turn-in Curve –*

(a) At the time of laying, the correct sleeper spacing should be ensured to achieve correct alignment of the lead curve. During maintenance, stations at 3.0 m intervals should be marked, versines checked, and track attended as necessary. The versine at each station in lead curve and turn in curve should not be beyond 3 mm, from its design value, as a good maintenance practice.

(b) The versines of turn-in curves on loops should be recorded at stations at 3.0 m intervals on 6.0 m chord length during the inspection of points and crossings to check the sharpness of the curve and rectified as necessary.

(c) The turn-in curve should also be checked for condition of sleepers and fastenings.

(5) *Inspections of Points and Crossings –*

(a) For Points and Crossings, the scheduled inspections shall be carried out by the designated authorities in the proforma prescribed in **Annexure - 4/3** or **4/3(A)**, at the frequency specified in Table-1A and Table-1B.

The formats for inspection of Diamond Crossings, Diamond Crossings with single slip, and Diamond Crossings with double slip are given in **Annexure - 4/4, 4/4(A),** and **4/4(B).**

For Points and Crossings laid in similar flexure, forced layouts, or locations exhibiting rapid deterioration due to high traffic or geometrical conditions, the Chief Track Engineer may prescribe higher frequency of inspection. Such enhanced frequency shall be reviewed at least once in a year. (ACS – 7)

(6) *Cleaning and Lubrication of Points* - At all interlocked and partially interlocked stations, the Signal staff will be responsible for the periodical cleaning and lubrication of those slide chairs in which signaling and interlocking gears are connected (generally upto third sleeper from toe of switch) in all points interlocked with signals or provided with locks. The SSE/JE/P. Way shall be responsible for the cleaning and lubrication of slide chairs of all hand operated points on their sections and remaining slide chairs of all points interlocked with signals or provided with locks.

(7) *Alterations of Points* – The position of points and crossings should not be changed without the written authority of the Divisional Engineer. The sanction of the Commissioner of Railway Safety is necessary in the case of alterations/insertion/removal of points and crossings in existing running lines, however, shifting of points, which does not affect nature of signalling, will not require CRS sanction.

(8) *Gauge and Super-elevation in Turnouts –*

(a) It is a good practice to maintain reasonable uniform gauge over turnouts. Tolerance in gauge at various portions of turnout during new laying/renewal and maintenance shall be as given in ***Para 520 (3) (a) & Para 525 (1)*** respectively.

(b) The gauge in crossing portion shall be -3 mm to +1 mm with respect to nominal gauge (1676 mm). (ACS – 7)

(c) If gauge of track on either side of the points and crossings is maintained wider/tighter than the gauge on the points and crossings, the gauge on either side of the track should be brought to same gauge as in the points and crossings, as a good maintenance practice.

(d) Super-elevation on turnouts with curve of similar or contrary flexure should be provided in accordance with ***Para 411 & 412***.

(9) *Interlocking of Points* – Before interlocking work is taken in hand, the JE/SSE/P.Way should –

(a) Bring the rails to correct level and alignment.

(b) Fully ballast and pack the points to be interlocked.

(c) Mark the locations where the rods and wires have to cross the lines.

(d) To avoid future adjustments of gear, see that the track at turnout, is laid to correct gauge so that switches, fittings and locks may be correctly put together.

(e) Clear cess and bring it to the correct level and section where rods and wires have to be run.

(f) Fit gauge ties wherever provided correctly to all switches.

(10) Maintenance of Interlocked Points **–** In the case of interlocked points, the JE/SSE (Signal) will be responsible for keeping the interlocking parts and apparatus in working order. As the slewing of the track at points is likely to throw them out of adjustment, such work should not be undertaken except in the presence of the Signal staff. On the advice of track defects from JE/SSE (Signal), JE/SSE/P.Way should promptly attend to them.

(11) *Date of Laying Points and Crossings* – The month and year of laying a new or second hand points and crossings should be painted in white block letters on the webs of switches about 500 mm from the heel joint and the webs of crossings about 500 mm from the joint connected to the lead rails.

When second hand points and crossings are subsequently laid at another site, the dates previously marked should not be obliterated; an indication of the total life will then be available. In the case of reconditioning of switches and crossings, the date of reconditioning should also be painted.

430 Reconditioning of Switches and Crossing:-

(1) **General –** On all routes, crossings of all types can be reconditioned in-situ or outside the track using Robotic Welding Technology. However, switches shall always be reconditioned outside the track. Manual method consisting of H3B and H3C type of electrodes can be used for reconditioning of switches.

(2) **Selection of Points and Crossings for Reconditioning.**

(a) Points and crossings to be reconditioned by welding should be in good condition and certified by the Sectional JE/SSE/P.Way for their suitability for reconditioning and should normally not have exceeded specified limit of wear.

(b) Points and Crossings containing cracks on the worn-out portion having depth more than 3 mm (as determined by gouging) beyond the condemning size shall not be selected for further reconditioning.

(c) Ultrasonic testing should be carried out to detect the serviceability. The Points & Crossings having internal defects should not be reconditioned.

(d) Reconditioning of tongue rail shall be done on level cess / depot along with stock rail.

(3) **Competency of welder**: Only skilled or highly skilled welder who has been trained and certified by competent authority in resurfacing of the crossings by welding shall be engaged.

The competency of welder should be checked by Chemist and Metallurgist of Railway or officer nominated by CTE of the concerned Railway in case of departmental welders and by RDSO in case of non-departmental welder. A copy of competency certificate with identity card should be available with welder at the site of reconditioning. Competency given by OEM of the firm approved by RDSO will be accepted.

(4) **Welding Electrodes:**

(a) Electrodes of H3B and H3C class may be used for reconditioning, which have a minimum service life of 35 GMT and 50 GMT respectively.

(b) Electrodes shall be sourced from RDSO approved vendors only.

(5) **Precautions for Using Electrode:**

(a) Welding should be done using 4 mm diameter electrodes only.

(b) The electrode shall be stored in a dry storeroom.

(c) Electrodes having cracked and damaged flux covering shall be discarded.

(d) Electrodes shall be dried at 130° C to 170° C for at least one hour immediately before use. In case, the packing of electrodes is absolutely intact and all the electrodes are consumed within six hours after the opening of the packing, then preheating of electrodes may be dispensed with.

(6) **Equipment for reconditioning**:

All the equipment as laid down in **Para 6 of "***Manual for Reconditioning of Medium Manganese (MM) Steel Points and Crossings, Switch Expansion Joints and Cast Manganese Steel (CMS)***"** should be available for reconditioning.

(7) **Reconditioning procedure:** The procedure given in **"***Manual for Reconditioning of Medium Manganese (MM) Steel Points and Crossings, Switch Expansion Joints and Cast Manganese Steel (CMS)***"** should be followed.

431 Periodical Inspection of Reconditioned Points and Crossing:-

After laying in track, the resurfaced points and crossing shall be inspected quarterly in order to record the amount of wear on the nose, left wing and right wing rail as well as stock and tongue rail and also for the structural soundness, presence of disintegration or any other defects.

The wear shall be recorded in crossing at ten different locations marked (A1, A3, B1, B3, C1, C2, C3, D1, D2 & D3) as shown in Fig: 4.1 and in tongue rails at seven different locations starting from one at toe to places each 100 mm away towards heel side and up to 600 mm from the toe.

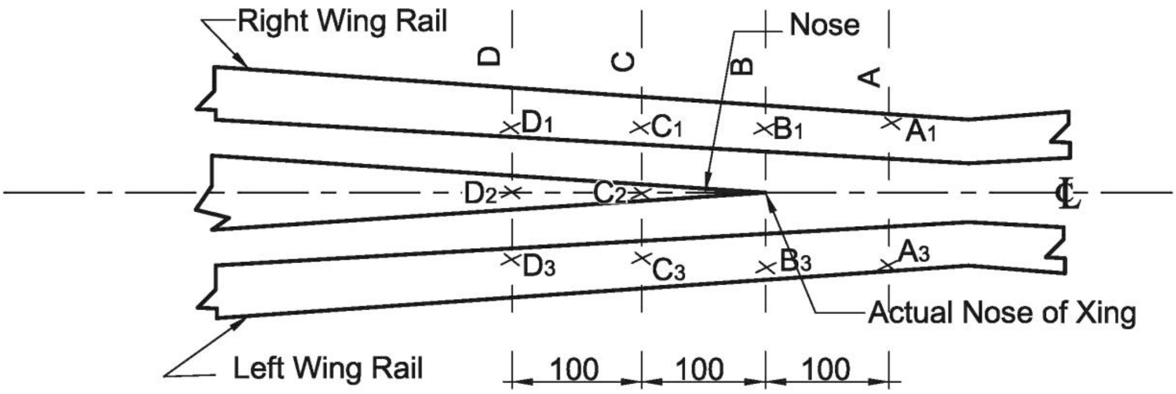


Fig: 4.1

432 Robotic Reconditioning:-

(1) The Robotic Welding technique uses a computer-controlled arc-welder that utilizes a coated wire without gas to eliminate operator exposure to weld fumes. The records of all welding Parameters and events are stored in memory for later reference.

(2) For detailed welding process the manufacturer's manual may be referred to.

433 Switch Rail Grinding Machine (SRGM) can be used to ensure grinding of turnouts, level crossings, curves with check rails and other stretches where it is not possible to use main line RGM due to track structure or geometry constraints.

Annexure - 4/2 (*Para 429*)

Table for spacing of Sleepers in 1 in 12 fan shaped Turnout (Taking off from Straight)

Sleeper No.	Spacing on gauge face on tongue rail for ML side		Spacing on gauge face of stock rail for ML side	
	Spacing	Cumulative From SRJ	Spacing	Cumulative from SRJ
	150		150	
1		150		150
	457		457	
2		607		607
	510		510	
3		1117		1117
	695		695	
4		1812		1812
	537		537	
5		2349		2349
	550		550	
6		2899		2899
	550		550	
7		3449		3449
	550		550	
8		3999		3999
	550		550	
9		4549		4549
	550		550	
10		5099		5099
	550		550	
11		5649		5649
	550		550	
12		6199		6199
	550		550	
13		6749		6749
	550		550	
14		7299		7299
	550		550	
15		7849		7849
	550		550	
16		8399		8399
	550		550	
17		8949		8949
	550		550	
18		9499		9499
	550		550	
19		10049		10049
	550		550	
20		10599		10599
	526		550	
21		11125		11149
	549		550	
22		11674		11699
	549		550	
23		12223		12249
	549		550	
24		12772		12799
	549		550	
25		13321		13349
	549		550	
26		13870		13899

	549		550	
27		14419		14449
	549		550	
28		14968		14999
	549		550	
29		15517		15549
	549		550	
30		16066		16099
	549		550	
31		16615		16649
	549		550	
32		17164		17199
	549		550	
33		17713		17749
	549		550	
34		18262		18299
	549		550	
35		18811		18849
	549		550	
36		19360		19399
	548		550	
37		19908		19949
	549		550	
38		20457		20499
	549		550	
39		21006		21049
	549		550	
40		21555		21599
	549		550	
41		22104		22149
	549		550	
42		22653		22699
	549		550	
43		23202		23249
	549		550	
44		23751		23799
	549		550	
45		24300		24349
	549		550	
46		24849		24899
	549		550	
47		25398		25449
	549		550	
48		25947		25999
	549		550	
49		26496		26549
	549		550	
50		27045		27099
	549		550	
51		27594		27649
	549		550	
52		28143		28199
	549		550	
53		28692		28749
	549		550	
54		29241		29299
	549		550	

55		29790		29849
	549		550	
56		30339		30399
	549		550	
57		30888		30949
	549		550	
58		31437		31499
	549		550	
59		31986		32049
	549		550	
60		32535		32599
	548		550	
61		33083		33149
	549		550	
62		33632		33699
	549		550	
63		34181		34249
	549		550	
64		34730		34799
	549		550	
65		35279		35349
	550		550	
66		35829		35899
	550		550	
67		36379		36449
	550		550	
68		36929		36999
	550		550	
69		37479		37549
	550		550	
70		38029		38099
	550		550	
71		38579		38649
	550		550	
72		39129		39199
	550		550	
73		39679		39749
	550		550	
74		40229		40299
	550		550	
75		40779		40849
	550		550	
76		41329		41399
	550		550	
77		41879		41949
	550		550	
78		42429		42499
	550		550	
79		42979		43049
	550		550	
80		43529		43599
	550		550	
81		44079		44149
	550		550	
82		44629		44699
	550		550	
83		45179		45249

Annexure - 4/2 (*Para 429*)

Table for spacing of Sleepers in 1 in 8.5 fan shaped Turnout (Taking off from Straight)

(ACS – 6)

Sleeper No.	Spacing on gauge face on tongue rail for ML side		Spacing on gauge Face of stock rail for ML side	
	Spacing	Cumulative from SRJ	Spacing	Cumulative from SRJ
	268		268	
1		268		268
	600		600	
2		868		868
	605		605	
3		1473		1473
	695		695	
4		2168		2168
	605		605	
5		2773		2773
	660		660	
6		3433		3433
	600		600	
7		4033		4033
	600		600	
8		4633		4633
	600		600	
9		5233		5233
	600		600	
10		5833		5833
	600		600	
11		6433		6433
	600		600	
12		7033		7033
	600		600	
13		7633		7633
	564		600	
14		8197		8233
	597		600	
15		8794		8833
	598		600	
16		9392		9433
	598		600	
17		9990		10033
	598		600	
18		10588		10633
	597		600	
19		11185		11233
	598		600	
20		11783		11833
	598		600	
21		12381		12433
	598		600	
22		12979		13033
	597		600	
23		13576		13633
	598		600	
24		14174		14233
	598		600	
25		14772		14833
	598		600	

26		15370		15433
	597		600	
27		15967		16033
	598		600	
28		16565		16633
	598		600	
29		17163		17233
	598		600	
30		17761		17833
	597		600	
31		18358		18433
	598		600	
32		18956		19033
	598		600	
33		19554		19633
	598		600	
34		20152		20233
	597		600	
35		20749		20833
	598		600	
36		21347		21433
	598		600	
37		21945		22033
	598		600	
38		22543		22633
	597		600	
39		23140		23233
	598		600	
40		23738		23833
	598		600	
41		24336		24433
	598		600	
42		24934		25033
	550		550	
43		25484		25583
	550		550	
44		26034		26133
	550		550	
45		26584		26683
	550		550	
46		27134		27233
	550		550	
47		27684		27783
	550		550	
48		28234		28333
	550		550	
49		28784		28883
	550		550	
50		29334		29433
	550		550	
51		29884		29983
	550		550	
52		30434		30533
	550		550	
53		30984		31083
	550		550	
54		31534		31633

Annexure - 4/3 (*Para 429*)

Proforma for Detailed Inspection of Points and Crossings

Station:		Point No.:	
Location:		Rail Section:	
Type of Sleepers/Assembly:		Angel of Crossing	
Nominal Gauge of T/out:		Left Hand or Right Hand:	
Laid on Straight or on curve of Radius:		Similar/Contrary Flexure:	
Date of laying sleepers (mm/yyyy):		Type of Crossing:	

Details of Deep Screening:	1st	2nd	3rd	4th
Date (mm/yyyy):				
Manual/Mechanized:				
Details of Laying new/reconditioned Crossing: (mm/yyyy):	1st	2nd	3rd	4th
Crossing Unique No.:				
Manufacture:				
Details of Laying new/reconditioned Switch: (mm/yyyy):	1st	2nd	3rd	4th
LH:				
RH:				

Particulars	Details of Inspection	Action taken with date and sign	Details of Inspection	Action taken with date and sign
1	2	3	4	5
I) General:	Date of Inspection		Date of Inspection	
1) Condition of ballast and drainage in turnout (clean cushion to be measured only once in a year)				
II) Switch Assembly and Lead:				
2) Condition of sleepers, slide chairs, plate screws, heel and distance blocks, other fittings of switch including tightness of bolts etc.				

	LH	RH	Action taken	LH	RH	Action taken
3) Condition of Tongue Rails						
a) Whether chipped or cracked over 200 mm length within 1000 mm from ATS						
b) Whether Twisted or bent (Causing gap of 5 mm or more at toe)						
c) Remark over condition of tongue rail, whether it requires reconditioning or replacement						
4) Condition of stock rail, burr formation to be mentioned specifically:						
5) Creep and squareness of tongue rail at toe switch:						
6) Straightness of straight stock rail if laid on straight (measured on 7.5 m chord):						
7) Packing conditions under the switch assembly (preferably to be observed under traffic):						

	LH	RH	Action taken	LH	RH	Action taken
8) Throw of Switch:						
9) Housing of stock and tongue rails:						
10) Gap between top edge of leading stretcher bar and bottom of rail foot:						
11) Working of SDD (if provided):						

12) Gauge and cross level in switch & lead:	Guage	XL	Guage	XL
a) At 450 mm ahead of Toe of Switch				
b) At ATS between two stock rails				

c) Gauge and cross level for ML and T/out side. Versine of stock rail for Turn Out side up to end of lead	Station No.	Main Line			T/Out		
		G	XL	V	G	XL	V
ATS/HEEL	0						
	1						
	2						
	…						

Note: 1) Station no. 0 to be marked at heel of switch for straight switch and ATS for curved switches. Subsequent stations shall be marked at every 3 m Versines to be recorded on 6 m chord length commencing from station no. 1.
2) Versine reading shall be taken for turnout side except for symmetrical split turnout where it shall be taken on mainline side.
3) In case of gap between T/R and S/R, that should be added to gauge measurement.

III) Crossing Assembly:

13) Condition of Crossing:

a) Sign of propagation of crack (if any) in crossing assembly				
b) Burring on top surface at nose.				
c) In case of Heat treated welded crossing, weld texture on top surface. If any flow or separation of weld portion				
d) Tightness of bolts at CI/Distance block at toe, heel and nose of crossing as applicable.				
e) condition of gapless joint.				

14) Wear of crossing (to be measured with straight edge):

For calculating actual wear, following values shall be deducted from the measured wear:
For wing rail wear
(a) for Built up/heat-treated welded crossing – 0 mm.
(b) for CMS crossing of 52 kg section – 2.0 mm
(c) for CMS / WCMS crossing of 60 kg section – 2.5 mm
For nose wear at ANC
(d) for Built up / heat-treated welded crossing – 6.0 mm
(e) for CMS crossing of 52 kg section – 8.0 mm.
(f) for CMS / WCMS crossing of 60 kg section – 8.5 mm
For nose wear at 100 mm behind ANC
(g) for Built up crossing – 0 mm
(h) for heat-treated welded crossing – 3.5 mm
(i) for CMS crossing of 52 kg section – 2.0 mm.
(j) for CMS crossing of 60 kg section – 2.5 mm.
(k) for WCMS crossings (1 in 12, 60 kg) – 6.0 mm
(l) for WCMS crossings (1 in 8.5, 60 kg) – 5.7 mm

LH Wing Rail		Nose		RH Wing Rail	
(at ANC)	(at 100 mm from ANC)	(at ANC)	(at 100 mm from ANC)	(at ANC)	(at 100 mm from ANC)

15) Gauge and Cross level at crossing:	Main Line		T/out	
	G	XL	G	XL
a) 1 m ahead of ANC				
b) 150 mm behind ANC				
c) 1 m behind ANC				

	LH	RH	Action taken	LH	RH	Action taken
16) Condition of check rail fitting i.e., bearing plates, keys, blocks, bolts and elastic fastenings.						

17) Clearance of check rails:

a) Opposite ANC						
b) At 1st block towards toe of crossing & 1st block towards heel of crossing						
c) At the flared end towards heel & at the flared end towards toe.						

	LH	RH	Action taken	LH	RH	Action taken
18) Clearance of wing Rail (Only for Built-up crossing):						

IV) Track behind Crossing on turnout side:

19) Track behind Crossing on Turnout side – Track Parameters (G, XL and Versines) to be measured up to next turnout/ derailing switch/ end of turn-in curve, as the case may be. In case no such track feature exists, measurement to be done up to 10 stations behind crossing. Stations to be marked at 3 m interval. Versines to be measured on 6 m chord. Station No. 0 to be marked at the centre of last long sleeper in case of PSC sleepers otherwise at heel of crossing. (ACS – 7)

St. No.	V	G	XL	St. No.	V	G	XL
0							
1							
2							
3							
4							
…							

20) Availability of 150 mm additional ballast shoulder width on outside of turn-in curve:				

V) General:

21) Any other special feature/defects:				
22) Signature of the inspection official with date:				

(Note – Locations where the gauge and cross levels are to be checked should be painted on the web of the rail)

Annexure - 4/3 (A) (*Para 429*)

Proforma for Intermediate Inspection

Station:	Point No.	
Location:	Rail Section:	
Type of Sleepers/Assembly:	Angel of Crossing:	
Nominal Gauge of T/out:	Left Hand or Right Hand:	
Laid on Straight or on Curve of Radius:	Similar/Contrary Flexure:	
Date of laying sleepers (mm/yyyy):	Type of Crossing:	
Detail of deep screening:		
Date (mm/yyyy):		
Manual/Mechanized:		
Date of Laying new/reconditioned crossing (mm/yyyy):		
Crossing unique number:		
Manufacturer:		
Date of laying new/reconditioned switch (mm/yyyy): LH/RH		
I. General – 1. Condition of ballast and drainage in turnout.		
II. Switch Assembly – 2. Condition of sleepers, slide chairs, plate screws, heel & distance blocks, other fittings of switch including tightness of bolts etc.:		
3. Condition of tongue rails: a) Whether chipped or cracked over 200 mm length within 1000 mm from ATS	LH	RH
b) Whether twisted or bent (causing gap of 5 mm or more at toe)		
c) Remarks over condition of tongue rail, whether it requires reconditioning or replacement		
4. Packing conditions under the switch assembly (preferably to be observed under traffic):		
5. Housing of stock and tongue rails.	LH:	RH:
6. Working of SDD (if provided):		
7. Gauge and cross level in switch and lead: G/XL		
a) At 450 mm ahead of toe of switch:		
b) At ATS between two stock rails:		
c) Gauge and cross level for Main line & Turnout side:		

	M/L		T/O	
Station	G	XL	G	XL
ATS/Heel – 0				
1				
2				
3				
4				

Note –
1. Stn. No. 0 to be marked at heel of switch for straight switch & at ATS for curved switches. Subsequent stations shall be marked at every 3m.
2. In case of gap between T/R and S/R, that should be added to gauge measurement.

<table>
<tr><td colspan="5" rowspan="2">8. Throw of Switch:</td><td colspan="3">LH</td><td colspan="3">RH</td></tr>
<tr><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td colspan="5">III. Crossing Assembly -</td><td colspan="6"></td></tr>
<tr><td colspan="5">9. Condition of Crossing:
a) Sign of propagation of crack (if any) in crossing assembly:</td><td colspan="6"></td></tr>
<tr><td colspan="5">b) In case of Heat-treated welded crossing, Weld texture on top surface, if any flow or separation of weld portion:</td><td colspan="6"></td></tr>
<tr><td colspan="5">c) Tightness of bolts at CI/Distance block at toe, heel and nose of crossing as applicable.</td><td colspan="6"></td></tr>
<tr><td colspan="5" rowspan="3">10. Wear of crossing (to be measured with straight edge):
For calculating actual wear, following values shall be deducted from the measured wear:
For wing rail wear
(a) for Built up/heat-treated welded crossing – 0 mm.
(b) for CMS crossing of 52 kg section – 2.0 mm
(c) for CMS / WCMS crossing of 60 kg section – 2.5 mm
For nose wear at ANC
(d) for Built up / heat-treated welded crossing – 6.0 mm
(e) for CMS crossing of 52 kg section – 8.0 mm.
(f) for CMS / WCMS crossing of 60 kg section – 8.5 mm
For nose wear at 100 mm behind ANC
(g) for Built up crossing – 0 mm
(h) for heat-treated welded crossing – 3.5 mm
(i) for CMS crossing of 52 kg section – 2.0 mm.
(j) for CMS crossing of 60 kg section – 2.5 mm.
(k) for WCMS crossings (1 in 12, 60 kg) – 6.0 mm
(l) for WCMS crossings (1 in 8.5, 60 kg) – 5.7 mm</td><td colspan="2">LH Wing Rail</td><td colspan="2">Nose</td><td colspan="2">RH Wing Rail</td></tr>
<tr><td>(at ANC)</td><td>(at 100 mm from ANC)</td><td>(at ANC)</td><td>(at 100 mm from ANC)</td><td>(at ANC)</td><td>(at 100 mm from ANC)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">11. Gauge and cross level at crossing</td><td colspan="6"></td></tr>
<tr><td rowspan="5"></td><td></td><td colspan="2">M/L</td><td colspan="2">T/O</td><td colspan="6"></td></tr>
<tr><td></td><td>G</td><td>XL</td><td>G</td><td>XL</td><td colspan="6"></td></tr>
<tr><td>a) 1 m ahead of ANC</td><td></td><td></td><td></td><td></td><td colspan="6"></td></tr>
<tr><td>b) 150 mm behind ANC</td><td></td><td></td><td></td><td></td><td colspan="6"></td></tr>
<tr><td>c) 1 m behind ANC</td><td></td><td></td><td></td><td></td><td colspan="6"></td></tr>
<tr><td colspan="5">12. Condition of checkrail fittings, e.g., bearing-plates, keys, blocks, bolts and elastic fastenings: (i.e., ERC, Liner, Rubber Pad)</td><td colspan="6"></td></tr>
<tr><td colspan="5">13. Clearance of check rails:
a) Opposite ANC:</td><td colspan="6"></td></tr>
<tr><td colspan="5">b) At 1st block towards toe of crossing and 1st block towards heel of crossing</td><td colspan="6"></td></tr>
<tr><td colspan="5">c) At the flared end towards heel and at the end towards toe.</td><td colspan="6"></td></tr>
<tr><td colspan="5">14. Clearance of wing rail (only for built up crossing):</td><td colspan="6"></td></tr>
<tr><td colspan="5">IV. General –</td><td colspan="6"></td></tr>
<tr><td colspan="5">15. Any other special feature/defects:</td><td colspan="6"></td></tr>
<tr><td colspan="5">16. Signature of the inspecting official with date:</td><td colspan="6"></td></tr>
</table>

Annexure - 4/4 (*Para 429*)

PROFORMA FOR INSECTION OF POINTS AND CROSSING
Diamond Crossings

Station Point No. Location Type of Rail Date of Laying Date of laying reconditioned crossing Type of Sleeper/Assembly Angle of Crossing Nominal guage of Turnout							
1 Sleeper Details:							
1.1	Condition of Sleeper						
1.2	Squaring						
1.3	Spacing						
2 Ballast Details:							
2.1	Condition of ballast						
2.2	Condition of drainage						
2.3	Ballast in shoulders and cribs						
2.4	Clean ballast cushion (mm)						
3	**Gauge and X-level between Crossings:** At 3 m interval in lead portion		Line - 1		Line - 2		
			Gauge	X-Level	Gauge	X-Level	
		Section 0					
		1					
		2					
		3					

		4								
		5								
4	**Condition of Crossing:**		Acute Xing 1		Acute Xing 2		Obtuse Xing 1		Obtuse Xing 2	
4.1	Sign of propagation of crack (if any)									
4.2	Burring top surface at nose									
5	**Type of Crossing:**									
6	**Wear of Crossing:**		Acute Xing 1			Acute Xing 2				
			Left wing Rail	On nose	Right wing Rail	Left wing Rail	On nose	Right wing Rail		
			Obtuse Xing 1				Obtuse Xing 2			
			Nose 1		Nose 2		Nose 1		Nose 2	
			On Nose	Wing Rail	On Nose	Wing Rail	On Nose	Wing Rail	On Nose	Wing Rail
7	**Clearance of wing rail opposite nose of crossing and upto 450 mm towards heel end:**		Acute Xing 1		Acute Xing 2		Obtuse Xing 1		Obtuse Xing 2	
			Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer
8	**Gauge and Cross Level:**		Acute Xing 1		Acute Xing 2		Obtuse Xing 1		Obtuse Xing 2	
			Line 1	Line 2	Line 1	Line 2	Line 1	Line 2	Line 1	Line 2
8.1	1 m ahead of ANC	Gauge								
		X-Level								
8.2	150 mm ahead of ANC	Gauge								
		X-Level								
8.3	150 mm behind ANC	Gauge								
		X-Level								

8.4	1 m behind ANC	Gauge								
		X-Level								
9	**Condition of Check rail and its fitting:**		Acute Xing 1		Acute Xing 2		Obtuse Xing 1		Obtuse 2	
9.1	Raised Check Rail									
9.2	Other bearing, plates, keys, blocks, bolts and classic fastening									
10	**Check Rail Clearance:**		Acute Xing 1		Acute Xing 2		Obtuse Xing 1		Obtuse 2	
10.1	Opposite ANC		Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer
10.2	500 mm ahead towards toe of crossing									
10.3	500 mm behind heel of crossing									
10.4	At the flared end towards heel									
10.5	At the flared end towards toe									
11	**Remarks:**									

Annexure - 4/4(A) (*Para 429*)

PROFORMA FOR INSPCTION OF POINTS AND CROSSINGS
Diamond Crossing: with Single Slip

Station Point No. Location Type of Rail Date of Laying Date of laying reconditioned crossings Date of laying reconditioned switches Type of Sleeper/assembly Angle of crossing Nominal gauge of Turnout	

1	**Sleeper Details:**						
1.1	Condition of sleeper						
1.2	Squaring						
1.3	Spacing						
2	**Ballast Details:**						
2.1	Condition of Ballast						
2.2	Condition of drainage						
2.3	Ballast in shoulders and cribs						
2.4	Clea ballast cushion (mm)						
3	**Condition of Switch Assembly:**		**Switch 1**	**Switch 2**			
3.1	Whether chipped or cracked over 200 mm length within 1000 mm from ATS	Inner					
		Outer					
3.2	Whether twisted or bent (causing gap of 5 mm or more at toe)	Inner					
		Outer					

3.3	Whether knife edge		Inner								
			Outer								
3.4	Seating of tongue rails on slide chairs		Inner								
			Outer								
3.5	Housing of stock and tongue rails		Inner								
			Outer								
3.6	Condition of fitting of switches										
3.7	Packing condition under switch assembly										
4	**Creep at toe of switch:**										
5	**Throw of Switch at ATS:**		Inner								
			Outer								
6	**Divergence at Heel Block:**		Inner								
			Outer								
7	**Straightness of straight (Measured on 10 m chord):**		Stock Rail								
			Tongue Rail								
8	**Wear in Tongue Rail and Stock Rail:**			**Switch 1**		**Switch 2**					
				Inner	**Outer**	**Inner**	**Outer**				
8.1	Tongue Rail	At point with 13 mm head width (as per annexure 2/6/1)	Vertical								
			Lateral								
8.2		At point where tongue rail and stock rail level is same	Vertical								
			Lateral								
8.3	Stock Rail	At point where tongue rail and stock rail level is same	Vertical								
			Lateral								
9	**Distance between gauge faces of stock rails at JOH:**			**Switch 1**		**Switch 2**					
10	**Distance between web to web of Tongue Rails:**										
10.1	Leading stretcher bar										
10.2	1st following stretcher bar										
10.3	2nd following stretcher bar										

11	**Gap between top edge of stretcher bar and bottom of rail foot:**									
11.1	Leading Stretcher bar	Inner								
		Outer								
11.2	1st following stretcher bar	Inner								
		Outer								
11.3	2nd following stretcher bar	Inner								
		Outer								
12	**Clearance at JOH:**									
12.1	On Open tongue rail side	Straight								
		Turnout								
12.2	On Closed tongue rail side	Straight								
		Turnout								
13	**Gauge and X-Level in Switch and Lead Portion:**		**Straight Side**				**Turnout Side**			
			Switch 1		**Switch 2**					
			Gauge	X-Level	Gauge	X-Level	Gauge	X-Level		
13.1	At 450 mm ahead of toe of switch									
13.2	At ATS between the two stock rails									
13.3	At 150 mm behind toe of switch									
13.4	At heel of switch									
13.5	At 3 m interval in lead portion	**Station**								
		0								
		1								
		2								
		3								
		…								

14	**Versine in Switch and Lead Portion:**		**Switch 1 and Switch 2**							
			Inner		Outer					
		(Heel/ATS) 0								
		1								
		2								
		3								
		4								
		5								
		…								
15	**Condition of Crossing:**		Acute Xing 1		Acute Xing 2		Obtuse Xing 1		Obtuse Xing 2	
15.1	Sign of Propagation of crack (if any)									
15.2	Burring on top surface at nose									
16	**Type of Crossing:**									
17	**Wear of Crossing:**		Acute Xing 1			Acute Xing 2				
			Left Wing Rail	On Nose	Right Wing Rail	Left Wing Rail	On Nose	Right Wing Rail		
			Obtuse Xing 1				Obtuse Xing 2			
			Nose 1		Nose 2		Nose 1		Nose 2	
			On Nose	Wing Rail	On Nose	Wing Rail	On Nose	Wing Rail	On Nose	Wing Rail
18	**Clearance of wing rail opposite Nose of Crossing and up to 450 mm towards heel end:**		Acute Xing 1		Acute Xing 2		Acute Xing 1		Acute Xing 2	
			Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer

19	**Gauge and Cross Level:**		Acute Xing 1		Acute Xing 2		Acute Xing 1		Acute Xing 2	
			Straight	Turnout	Straight	Turnout	Straight	Turnout	Straight	Turnout
19.1	1 m ahead of ANC	Gauge								
		X-Level								
19.2	150 mm ahead ANC	Gauge								
		X-Level								
19.3	150 mm behind ANC	Gauge								
		X-Level								
19.4	1 m behind ANC	Gauge								
		X-Level								
20	**Condition of Check rail and its fittings:**		Acute Xing 1		Acute Xing 2		Obtuse Xing 1		Obtuse Xing 2	
20.1	Raised Check Rail									
20.2	Other bearing, plates, keys, blocks, bolts and elastic fastenings									
21	**Check Rail Clearance:**		Acute Xing 1		Acute Xing 2		Obtuse Xing 1		Obtuse Xing 2	
			Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer
21.1	Opposite ANC									
21.2	500 mm ahead towards toe of crossing									
21.3	500mm behind heel of crossing									
21.4	At the flared end towards heel									
21.5	At the flared end towards toe									
22	**Remarks:**									

Annexure - 4/4 (B) (*Para 429*)

PROFORMA FOR INSPCTION OF POINTS AND CROSSINGS
Diamond Crossing: with Double Slip

Station Point No. Location Type of Rail Date of Laying Date of laying reconditioned crossings Date of laying reconditioned switches Type of Sleeper/assembly Angle of crossing Nominal gauge of Turnout						
1	**Sleeper Details:**					
1.1	Condition of sleeper					
1.2	Squaring					
1.3	Spacing					
2	**Ballast Details:**					
2.1	Condition of Ballast					
2.2	Condition of drainage					
2.3	Ballast in shoulders and cribs					
2.4	Clea ballast cushion (mm)					
3	**Condition of Switch Assembly:**		**Switch 1**	**Switch 2**	**Switch 3**	**Switch 4**
3.1	Whether chipped or cracked over 200 mm length within 1000 mm from ATS	Inner				
		Outer				
3.2	Whether twisted or bent (causing gap of 5 mm or more at toe)	Inner				
		Outer				

3.3	Whether knife edge		Inner								
			Outer								
3.4	Seating of tongue rails on slide chairs		Inner								
			Outer								
3.5	Housing of stock and tongue rails		Inner								
			Outer								
3.6	Condition of fitting of switches										
3.7	Packing condition under switch assembly										
4	**Creep at toe of switch:**										
5	**Throw of Switch at ATS:**		Inner								
			Outer								
6	**Divergence at Heel Block:**		Inner								
			Outer								
7	**Straightness of straight (Measured on 10 m chord):**		Stock Rail								
			Tongue Rail								
8	**Wear in Tongue Rail and Stock Rail:**			**Switch 1**		**Switch 2**		**Switch 3**		**Switch 4**	
				Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer
8.1	Tongue Rail	At point with 13 mm head width (as per annexure 2/6/1)	Vertical								
			Lateral								
8.2	Tongue Rail	At point where tongue rail and stock rail level is same	Vertical								
			Lateral								
8.3	Stock Rail	At point where tongue rail and stock rail level is same	Vertical								
			Lateral								
9	**Distance between gauge faces of stock rails at JOH:**			**Switch 1**		**Switch 2**		**Switch 3**		**Switch 4**	
10	**Distance between web to web of Tongue Rails:**										
10.1	Leading stretcher bar										
10.2	1st following stretcher bar										
10.3	2nd following stretcher bar										

11	**Gap between top edge of stretcher bar and bottom of rail foot:**									
11.1	Leading Stretcher bar	Inner								
		Outer								
11.2	1st following stretcher bar	Inner								
		Outer								
11.3	2nd following stretcher bar	Inner								
		Outer								
12										
12.1	On Open tongue rail side	Straight								
		Turnout								
12.2	On Closed tongue rail side	Straight								
		Turnout								
13	**Gauge and X-Level in Switch and Lead Portion:**		**Straight Side**				**Turnout Side**			
			Switch 1 & Switch 2		**Switch 3 & Switch 4**		**Switch 1 & Switch 2**		**Switch 3 & Switch 4**	
			Gauge	X-Level	Gauge	X-Level	Gauge	X-Level	Gauge	X-Level
13.1	At 450 mm ahead of toe of switch									
13.2	At ATS between the two stock rails									
13.3	At 150 mm behind toe of switch									
13.4	At heel of switch									
13.5	At 3 m interval in lead portion	**Station**								
		0								
		1								
		2								
		3								
		…								

14	**Versine in Switch and Lead Portion:**		**Switch 1 & Switch 3**				**Switch 2 & Switch 4**			
			Inner		Outer		Inner		Outer	
		(Heel/ATS) 0								
		1								
		2								
		3								
		4								
		5								
		…								
15	**Condition of Crossing:**		**Acute Xing 1**		**Acute Xing 2**		**Obtuse Xing 1**		**Obtuse Xing 2**	
15.1	Sign of Propagation of crack (if any)									
15.2	Burring on top surface at nose									
16	**Type of Crossing:**									
17	**Wear of Crossing:**		**Acute Xing 1**			**Acute Xing 2**				
			Left Wing Rail	On Nose	Right Wing Rail	Left Wing Rail	On Nose	Right Wing Rail		
			Obtuse Xing 1				**Obtuse Xing 2**			
			Nose 1		Nose 2		Nose 1		Nose 2	
			On Nose	Wing Rail	On Nose	Wing Rail	On Nose	Wing Rail	On Nose	Wing Rail
18	**Clearance of wing rail opposite Nose of Crossing and up to 450 mm towards heel end:**		**Acute Xing 1**		**Acute Xing 2**		**Acute Xing 1**		**Acute Xing 2**	
			Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer

19	**Gauge and Cross Level:**		**Acute Xing 1**		**Acute Xing 2**		**Obtuse Xing 1**		**Obtuse Xing 2**	
			Straight	Turnout	Straight	Turnout	Straight	Turnout	Straight	Turnout
19.1	1 m ahead of ANC	Gauge								
		X-Level								
19.2	150 mm ahead ANC	Gauge								
		X-Level								
19.3	150 mm behind ANC	Gauge								
		X-Level								
19.4	1 m behind ANC	Gauge								
		X-Level								
20	**Condition of Check rail and its fittings:**		**Acute Xing 1**		**Acute Xing 2**		**Obtuse Xing 1**		**Obtuse Xing 2**	
20.1	Raised Check Rail									
20.2	Other bearing, plates, keys, blocks, bolts and elastic fastenings									
21	**Check Rail Clearance:**		**Acute Xing 1**		**Acute Xing 2**		**Obtuse Xing 1**		**Obtuse Xing 2**	
			Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer
21.1	Opposite ANC									
21.2	500 mm ahead towards toe of crossing									
21.3	500mm behind heel of crossing									
21.4	At the flared end towards heel									
21.5	At the flared end towards toe									
22	**Remarks:**									

Annexure - 4/5 (*Para 429*)

PARTICULARS OF TONGUE RAILS SHOWING LOCATION AND HEAD THICKNESS AT LEVEL POINT OF STOCK AND TONGUE RAIL

(ACS – 6)

S No.	Description of switches	Drg. No. of tongue rails	Location of 13 mm head from ATS	Location of JOH from ATS	Location of level point of stock & tongue rail from ATS	Head thickness of tongue rail at level point
			mm	mm	mm	mm
1	6400 mm c/s on PSC BG 52 kg RT-4866	RT-4866/2	476.5	3023	1512	31.6
2	6400 mm c/s on PSC BG 60 kg RT-4966	RT-4966/1	476.5	3229	2348	48.25
3	10125 mm c/s on PSC, BG, 60 kg RT-4219	RT-4325/1	1682	5836	4244	43.4
4	10125 mm c/s on PSC BG 52 kg RT-4733	RT-4733/1	1682	5540	4029	40.34
5	7000 mm c/s on PSC, RDSO/T-5363, RDSO/T-5364 for 52 kg 1 in 8 ½ Diamond	RDSO/T-5364/1 to RDSO/T-5364/3	480	3095	1547.5	32
6	7000 mm c/s on PSC, RDSO/T-6493, RDSO/T-6494 for 60 kg 1 in 8 ½ Diamond	RDSO/T-6494/1 to RDSO/T-6494/3	585	3308	2406	50

(ACS – 6)

Pre-curving requirements and revised sleeper spacing of 1 in 8½, 1 in 12 & 1 in 16 Thick Web Switches for Contrary Flexure Turnouts

i) The tongue and stock rails of Thick Web Switches shall be given requisite amount of pre-curving at manufacturing premises only.

ii) Sleepers will become skew due to curvature, therefore, grinding of liners for fitting on some of the sleepers may be required.

iii) Pre-curving and sleeper spacing details have been specified for various groups of curvatures applicable for various curvature ranges. The details pertaining to relevant range shall be used for providing pre-curving and sleeper spacing.

a) 1 in 8½, BG 60kg Thick Web Switch in Contrary Flexure Turnout

Curvature Group	Applicable range of degree of curvature
Straight	up to 0.5º
1º	> 0.5º & up to 1.5º
2º	> 1.5º & up to 2.5º
3º	> 2.5º & up to 3.5º
4º	> 3.5º & up to 4.5º
5º	> 4.5º & up to 5.5º
6º	> 5.5º & up to 6.5º
7º	> 6.5º & up to 7.5º
8º	> 7.5º & up to 8.0º

b) 1 in 12, BG 60kg Thick Web Switch in Contrary Flexure Turnout

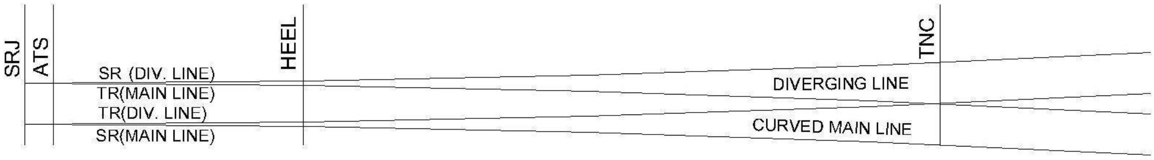
Curvature Group	Applicable range of degree of curvature
Straight	up to 0.5º
1º	> 0.5º & up to 1.5º
2º	> 1.5º & up to 2.5º
3º	> 2.5º & up to 3.5º
4º	> 3.5º & up to 4.5º
5º	> 4.5º & up to 5.0º

c) 1 in 16, BG 60kg Thick Web Switch in Contrary Flexure Turnout

Curvature Group	Applicable range of degree of curvature
Straight	up to 0.5º
1º	> 0.5º & up to 1.5º
2º	> 1.5º & up to 2.5º
3º	> 2.5º & up to 3.5º
4º	> 3.5º & up to 4.5º
5º	> 4.5º & up to 5.0º

Pre-curving of Tongue Rails (TR) & Stock Rails (SR) for 1 in 8½, BG 60kg Turnout with Zu-1-60/60E1A1 Thick-Web Switches for Contrary Flexure

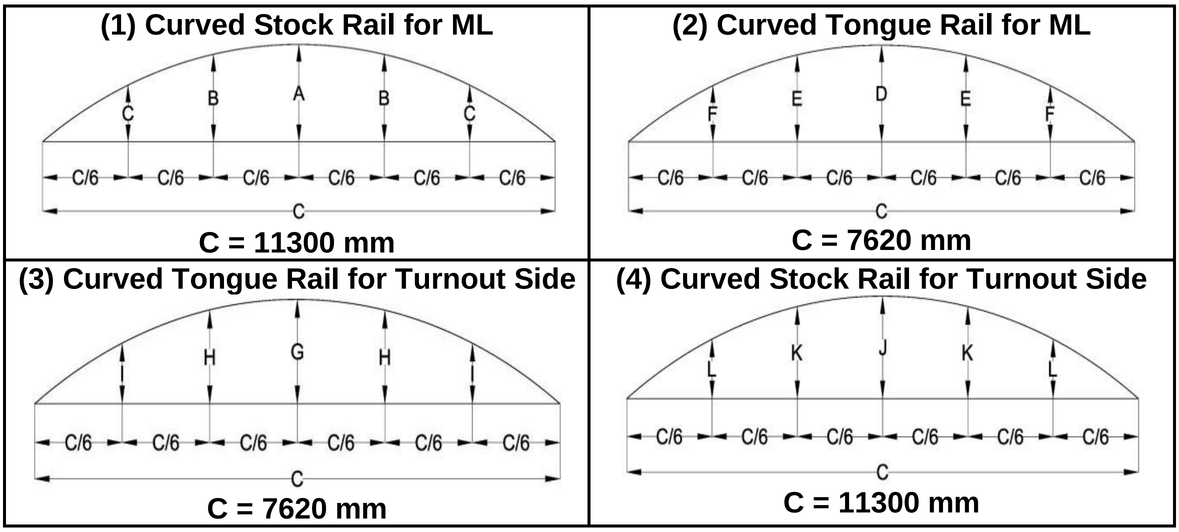
(ACS – 6)



Applicable range of degree of curvature	Versine in mm for Main Line Track						Versine in mm for Diverging Track					
	For Stock Rail			For Tongue Rail			For Tongue Rail			For Stock Rail		
	A	B	C	D	E	F	G	H	I	J	K	L
Up to 0.5º	0	0	0	0	0	0	-31	-28	-17	-69	-62	-38
> 0.5º & up to 1.5º	9	8	5	4	4	2	-27	-24	-15	-60	-53	-33
> 1.5º & up to 2.5º	18	16	10	8	7	5	-23	-20	-13	-51	-45	-28
> 2.5º & up to 3.5º	27	24	15	12	11	7	-19	-17	-10	-42	-37	-23
> 3.5º & up to 4.5º	36	32	20	17	15	9	-15	-13	-8	-32	-29	-18
> 4.5º & up to 5.5º	46	41	25	21	19	12	-11	-9	-6	-23	-21	-13
> 5.5º & up to 6.5º	55	49	30	25	22	14	-6	-6	-4	-14	-12	-8
> 6.5º & up to 7.5º	64	57	35	29	26	16	-2	-2	-1	-5	-4	-3
> 7.5º & up to 8.0º	73	65	41	33	30	19	2	2	1	4	4	2

Note: *Negative versines of tongue and stock rails of diverging track indicates that curvature of tongue and stock rails of diverging track are in the reverse direction to the curvature of tongue and stock rails of main line track.*

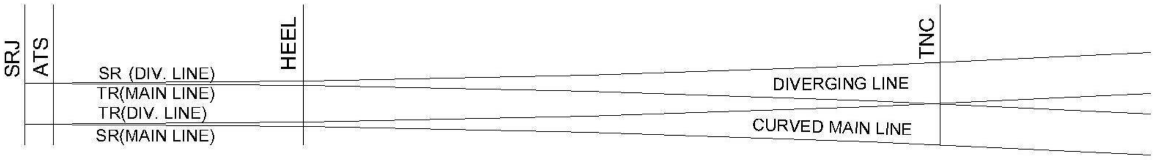
Contrary Flexure Turnout



(ACS – 6)

Pre-curving of Tongue Rails (TR) & Stock Rails (SR) for 1 in 12, BG 60kg Turnout with Zu-1-60/60E1A1 Thick-Web Switches for Contrary Flexure

(ACS – 6)

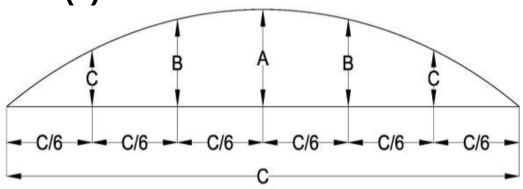


Applicable range of degree of curvature	Versine in mm for Main Line Track						Versine in mm for Diverging Track					
	For Stock Rail			For Tongue Rail			For Tongue Rail			For Stock Rail		
	A	B	C	D	E	F	G	H	I	J	K	L
Upto 0.5º	0	0	0	0	0	0	-44	-39	-25	-40	-36	-22
> 0.5º & up to 1.5º	10	9	6	11	10	6	-33	-29	-18	-30	-27	-17
> 1.5º & up to 2.5º	20	18	11	22	20	12	-22	-19	-12	-20	-18	-11
> 2.5º & up to 3.5º	30	27	17	33	30	19	-11	-10	-6	-10	-9	-5
> 3.5º & up to 4.5º	40	36	22	45	40	25	0	0	0	0	0	0
> 4.5º & up to 5.0º	50	45	28	56	50	31	12	10	6	10	9	6

Note: Negative versines of tongue and stock rails of diverging track indicates that curvature of tongue and stock rails of diverging track are in the reverse direction to the curvature of tongue and stock rails of main line track.

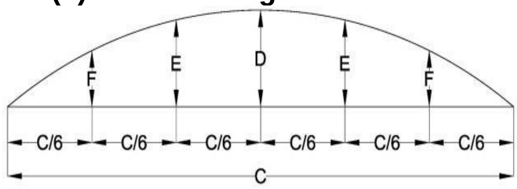
Contrary Flexure Turnout

(1) Curved Stock Rail for ML



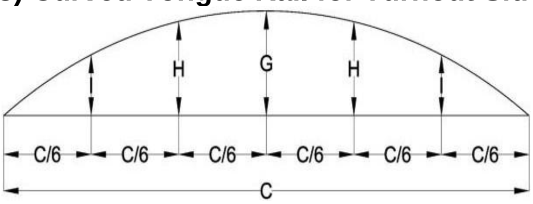
C = 11856 mm

(2) Curved Tongue Rail for ML



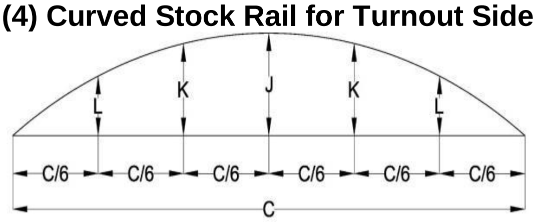
C = 12480 mm

(3) Curved Tongue Rail for Turnout Side



C = 12480 mm

(4) Curved Stock Rail for Turnout Side

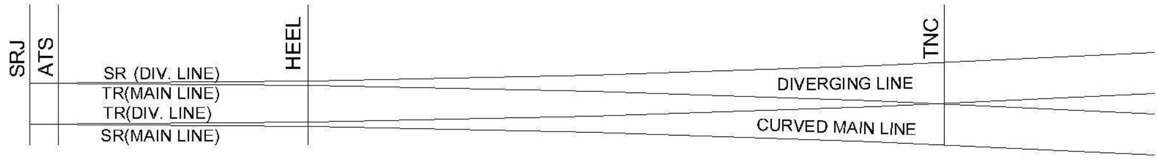


C = 11856 mm

(ACS – 6)

Pre-curving of Tongue Rails (TR) & Stock Rails (SR) for 1 in 16, BG 60kg Turnout with Zu-1-60/60E1A1 Thick-Web Switches for Contrary Flexure

(ACS – 6)

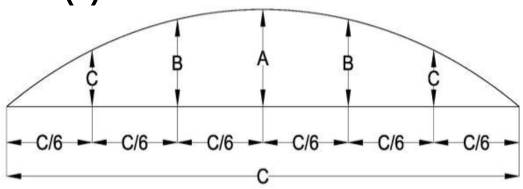


Applicable range of degree of curvature	Versine in mm for Main Line Track						Versine in mm for Diverging Track					
	For Stock Rail			For Tongue Rail			For Tongue Rail			For Stock Rail		
	A	B	C	D	E	F	G	H	I	J	K	L
up to 0.5º	0	0	0	0	0	0	-27	-24	-15	-22	-20	-12
> 0.5º & up to 1.5º	10	9	6	12	11	7	-15	-13	-8	-12	-11	-7
> 1.5º & up to 2.5º	20	18	11	24	21	13	-3	-2	-2	-2	-2	-1
> 2.5º & up to 3.5º	30	27	17	36	32	20	9	8	5	8	7	4
> 3.5º & up to 4.5º	40	36	22	48	43	27	21	19	12	18	16	10
> 4.5º & up to 5.0º	50	45	28	60	53	33	33	29	18	28	25	15

Note: Negative versines of tongue and stock rails of diverging track indicates that curvature of tongue and stock rails of diverging track are in the reverse direction to the curvature of tongue and stock rails of main line track.

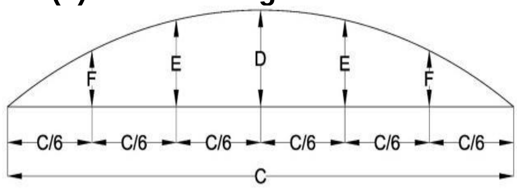
Contrary Flexure Turnout

(1) Curved Stock Rail for ML



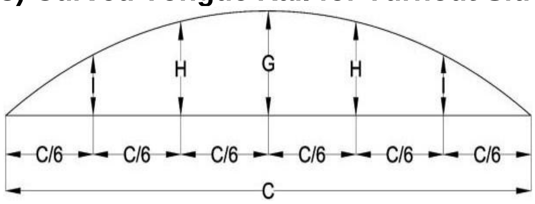
C = 11856 mm

(2) Curved Tongue Rail for ML



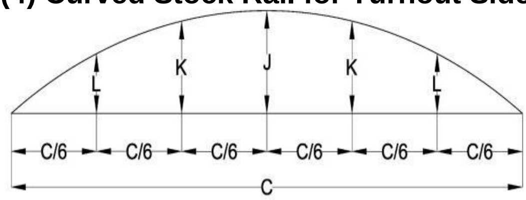
C = 12935 mm

(3) Curved Tongue Rail for Turnout Side



C = 12935 mm

(4) Curved Stock Rail for Turnout Side



C = 11856 mm

(ACS – 6)

Sleeper Spacing for 1 in 8½, BG, 60kg TWS (Contrary Flexure Turnout) (ACS – 6)																				
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°		Curvature of ML 6°		Curvature of ML 7°		Curvature of ML 8°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
SRJ		0		0		0		0		0		0		0		0		0		0
	268		268		268		268		268		268		268		268		268		268	
1		268		268		268		268		268		268		268		268		268		268
	600		600		600		600		600		600		600		600		600		600	
2		868		868		868		868		868		868		868		868		868		868
	600		600		600		600		600		600		600		600		600		600	
3		1468		1468		1468		1468		1468		1468		1468		1468		1468		1468
	745		745		745		745		745		745		745		745		745		745	
4		2213		2213		2213		2213		2213		2213		2213		2213		2213		2213
	560		560		560		560		560		560		560		560		560		560	
5		2773		2773		2773		2773		2773		2773		2773		2773		2773		2773
	660		660		660		660		660		660		660		660		660		660	
6		3433		3433		3433		3433		3433		3433		3433		3433		3433		3433
	600		600		600		600		600		600		600		600		600		600	
7		4033		4033		4033		4033		4033		4033		4033		4033		4033		4033
	600		600		600		600		600		600		600		600		600		600	
8		4633		4633		4633		4633		4633		4633		4633		4633		4633		4633
	600		600		600		600		600		600		600		600		600		600	
9		5233		5233		5233		5233		5233		5233		5233		5233		5233		5233
	600		600		600		600		600		600		600		600		600		600	
10		5833		5833		5833		5833		5833		5833		5833		5833		5833		5833
	600		600		600		600		600		600		600		600		600		600	
11		6433		6433		6433		6433		6433		6433		6433		6433		6433		6433
	600		600		600		600		600		600		600		600		600		600	
12		7033		7033		7033		7033		7033		7033		7033		7033		7033		7033
	600		600		600		600		600		600		600		600		600		600	
13		7633		7633		7633		7633		7633		7633		7633		7633		7633		7633
	564		600		592		584		576		569		561		553		545		537	
14		8197		8233		8225		8217		8209		8202		8194		8186		8178		8170
	597		600		599		599		598		598		597		597		596		595	
15		8794		8833		8824		8816		8807		8800		8791		8783		8774		8765
	598		600		599		599		598		598		597		597		596		595	

Sleeper Spacing for 1 in 8½, BG, 60kg TWS (Contrary Flexure Turnout) (ACS – 6)

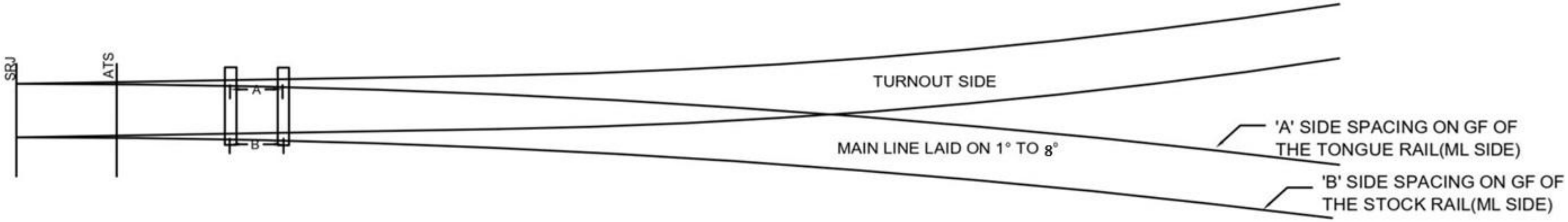
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°		Curvature of ML 6°		Curvature of ML 7°		Curvature of ML 8°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
16		9392		9433		9423		9415		9405		9398		9388		9380		9370		9360
	598		600		599		599		598		598		597		597		596		595	
17		9990		10033		10022		10014		10003		9996		9985		9977		9966		9955
	598		600		599		599		598		598		597		597		596		595	
18		10588		10633		10621		10613		10601		10594		10582		10574		10562		10550
	597		600		599		599		598		598		597		597		596		595	
19		11185		11233		11220		11212		11199		11192		11179		11171		11158		11145
	598		600		599		599		598		598		597		597		596		595	
20		11783		11833		11819		11811		11797		11790		11776		11768		11754		11740
	598		600		599		599		598		598		597		597		596		595	
21		12381		12433		12418		12410		12395		12388		12373		12365		12350		12335
	598		600		599		599		598		598		597		597		596		595	
22		12979		13033		13017		13009		12993		12986		12970		12962		12946		12930
	597		600		599		599		598		598		597		597		596		595	
23		13576		13633		13616		13608		13591		13584		13567		13559		13542		13525
	598		600		599		599		598		598		597		597		596		595	
24		14174		14233		14215		14207		14189		14182		14164		14156		14138		14120
	598		600		599		599		598		598		597		597		596		595	
25		14772		14833		14814		14806		14787		14780		14761		14753		14734		14715
	598		600		599		599		598		598		597		597		596		595	
26		15370		15433		15413		15405		15385		15378		15358		15350		15330		15310
	597		600		599		599		598		598		597		597		596		595	
27		15967		16033		16012		16004		15983		15976		15955		15947		15926		15905
	598		600		599		599		598		598		597		597		596		595	
28		16565		16633		16611		16603		16581		16574		16552		16544		16522		16500
	598		600		599		599		598		598		597		597		596		595	
29		17163		17233		17210		17202		17179		17172		17149		17141		17118		17095
	598		600		599		599		598		598		597		597		596		595	
30		17761		17833		17809		17801		17777		17770		17746		17738		17714		17690
	597		600		600		599		598		598		597		596		596		596	
31		18358		18433		18409		18400		18375		18368		18343		18334		18310		18286
	598		600		600		599		598		598		597		596		596		596	

Sleeper Spacing for 1 in 8½, BG, 60kg TWS (Contrary Flexure Turnout) (ACS – 6)

Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°		Curvature of ML 6°		Curvature of ML 7°		Curvature of ML 8°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
32		18956		19033		19009		18999		18973		18966		18940		18930		18906		18882
	598		600		600		599		598		598		597		596		596		596	
33		19554		19633		19609		19598		19571		19564		19537		19526		19502		19478
	598		600		600		599		598		597		597		596		596		596	
34		20152		20233		20209		20197		20169		20161		20134		20122		20098		20074
	597		600		600		599		599		597		597		596		596		596	
35		20749		20833		20809		20796		20768		20758		20731		20718		20694		20670
	598		600		600		599		599		597		597		596		596		596	
36		21347		21433		21409		21395		21367		21355		21328		21314		21290		21266
	598		600		600		599		599		597		597		596		596		596	
37		21945		22033		22009		21994		21966		21952		21925		21910		21886		21862
	598		600		600		599		599		597		597		596		596		596	
38		22543		22633		22609		22593		22565		22549		22522		22506		22482		22458
	597		600		600		598		599		597		597		596		596		596	
39		23140		23233		23209		23191		23164		23146		23119		23102		23078		23054
	598		600		600		598		599		597		598		596		596		596	
40		23738		23833		23809		23789		23763		23743		23717		23698		23674		23650
	598		600		600		598		599		597		598		596		596		596	
41		24336		24433		24409		24387		24362		24340		24315		24294		24270		24246
	598		600		600		598		599		597		598		596		596		596	
42		24934		25033		25009		24985		24961		24937		24913		24890		24866		24842
	550		550		550		550		550		550		550		550		550		550	
43		25484		25583		25559		25535		25511		25487		25463		25440		25416		25392
	550		550		550		550		550		550		550		550		550		550	
44		26034		26133		26109		26085		26061		26037		26013		25990		25966		25942
	550		550		550		550		550		550		550		550		550		550	
45		26584		26683		26659		26635		26611		26587		26563		26540		26516		26492
	550		550		550		550		550		550		550		550		550		550	
46		27134		27233		27209		27185		27161		27137		27113		27090		27066		27042
	550		550		550		550		550		550		550		550		550		550	
47		27684		27783		27759		27735		27711		27687		27663		27640		27616		27592
	550		550		550		550		550		550		550		550		550		550	

Sleeper Spacing for 1 in 8½, BG, 60kg TWS (Contrary Flexure Turnout) (ACS – 6)

Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°		Curvature of ML 6°		Curvature of ML 7°		Curvature of ML 8°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
48		28234		28333		28309		28285		28261		28237		28213		28190		28166		28142
	550		550		550		550		550		550		550		550		550		550	
49		28784		28883		28859		28835		28811		28787		28763		28740		28716		28692
	550		550		549		549		548		548		547		547		546		546	
50		29334		29433		29408		29384		29359		29335		29310		29287		29262		29238
	550		550		549		549		548		548		547		547		546		546	
51		29884		29983		29957		29933		29907		29883		29857		29834		29808		29784
	550		550		549		549		548		548		547		547		546		546	
52		30434		30533		30506		30482		30455		30431		30404		30381		30354		30330
	550		550		550		549		549		548		548		547		546		546	
53		30984		31083		31056		31031		31004		30979		30952		30928		30900		30876
	550		550		550		549		549		548		548		546		547		545	
54		31534		31633		31606		31580		31553		31527		31500		31474		31447		31421



(ACS – 6)

Sleeper Spacing for 1 in 12, BG, 60kg TWS (Contrary Flexure Turnout) (ACS – 6)

Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
SRJ		0		0		0		0		0		0		0
	150		150		150		150		150		150		150	
1		150		150		150		150		150		150		150
	457		457		457		457		457		457		457	
2		607		607		607		607		607		607		607
	505		505		505		505		505		505		505	
3		1112		1112		1112		1112		1112		1112		1112
	745		745		745		745		745		745		745	
4		1857		1857		1857		1857		1857		1857		1857
	492		492		492		492		492		492		492	
5		2349		2349		2349		2349		2349		2349		2349
	550		550		550		550		550		550		550	
6		2899		2899		2899		2899		2899		2899		2899
	550		550		550		550		550		550		550	
7		3449		3449		3449		3449		3449		3449		3449
	550		550		550		550		550		550		550	
8		3999		3999		3999		3999		3999		3999		3999
	550		550		550		550		550		550		550	
9		4549		4549		4549		4549		4549		4549		4549
	550		550		550		550		550		550		550	
10		5099		5099		5099		5099		5099		5099		5099
	550		550		550		550		550		550		550	
11		5649		5649		5649		5649		5649		5649		5649
	550		550		550		550		550		550		550	
12		6199		6199		6199		6199		6199		6199		6199
	550		550		550		550		550		550		550	
13		6749		6749		6749		6749		6749		6749		6749
	550		550		550		550		550		550		550	
14		7299		7299		7299		7299		7299		7299		7299
	550		550		550		550		550		550		550	
15		7849		7849		7849		7849		7849		7849		7849
	550		550		550		550		550		550		550	

Sleeper Spacing for 1 in 12, BG, 60kg TWS (Contrary Flexure Turnout)														
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
16		8399		8399		8399		8399		8399		8399		8399
	550		550		550		550		550		550		550	
17		8949		8949		8949		8949		8949		8949		8949
	550		550		550		550		550		550		550	
18		9499		9499		9499		9499		9499		9499		9499
	550		550		550		550		550		550		550	
19		10049		10049		10049		10049		10049		10049		10049
	550		550		550		550		550		550		550	
20		10599		10599		10599		10599		10599		10599		10599
	526		550		539		529		518		507		497	
21		11125		11149		11138		11128		11117		11106		11096
	549		550		549		549		548		548		547	
22		11674		11699		11687		11677		11665		11654		11643
	549		550		549		549		548		548		547	
23		12223		12249		12236		12226		12213		12202		12190
	549		550		549		549		548		548		547	
24		12772		12799		12785		12775		12761		12750		12737
	549		550		549		549		548		548		547	
25		13321		13349		13334		13324		13309		13298		13284
	549		550		549		549		548		548		547	
26		13870		13899		13883		13873		13857		13846		13831
	549		550		549		549		548		548		547	
27		14419		14449		14432		14422		14405		14394		14378
	549		550		549		549		548		548		547	
28		14968		15549		14981		14971		14953		14942		14925
	549		550		549		549		548		548		547	
29		15517		16099		15530		15520		15501		15490		15472
	549		550		549		549		548		548		547	
30		16066		16649		16079		16069		16049		16038		16019
	549		550		549		549		548		548		547	
31		16615		17199		16628		16618		16597		16586		16566
	549		550		549		549		548		548		547	

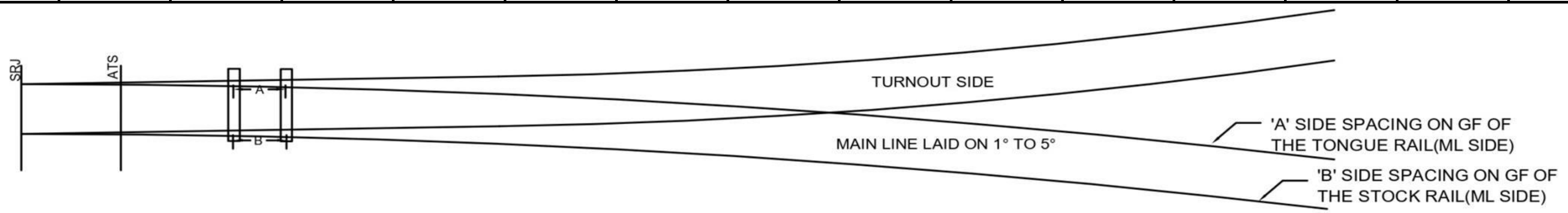
Sleeper Spacing for 1 in 12, BG, 60kg TWS (Contrary Flexure Turnout)														
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
32		17164		17199		17177		17167		17145		17134		17113
	549		550		549		549		548		548		547	
33		17713		17749		17726		17716		17693		17682		17660
	549		550		549		549		548		548		547	
34		18262		18299		18275		18265		18241		18230		18207
	549		550		549		549		548		548		547	
35		18811		18849		18824		18814		18789		18778		18754
	549		550		549		549		548		548		547	
36		19360		19399		19373		19363		19337		19326		19301
	549		550		549		549		548		548		547	
37		19908		19949		19922		19912		19885		19874		19848
	549		550		549		549		548		548		547	
38		20457		20499		20471		20461		20433		20422		20395
	549		550		549		549		548		548		547	
39		21006		21049		21020		21010		20981		20970		20942
	549		550		549		549		548		548		547	
40		21555		21599		21569		21559		21529		21518		21489
	549		550		549		549		548		548		547	
41		22104		22149		22118		22108		22077		22066		22036
	549		550		549		549		548		548		547	
42		22653		22699		22667		22657		22625		22614		22583
	549		550		549		549		548		548		547	
43		23202		23249		23216		23206		23173		23162		23130
	549		550		549		549		548		548		547	
44		23751		23799		23765		23755		23721		23710		23677
	549		550		550		549		548		548		547	
45		24300		24349		24315		24304		24269		24258		24224
	549		550		550		549		548		548		547	
46		24849		24899		24865		24853		24817		24806		24771
	549		550		550		549		548		548		547	
47		25398		25449		25415		25402		25365		25354		25318
	549		550		550		549		549		548		547	

Sleeper Spacing for 1 in 12, BG, 60kg TWS (Contrary Flexure Turnout)														
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
48		25947		25999		25965		25951		25914		25902		25865
	549		550		550		549		549		548		547	
49		26496		26549		26515		26500		26463		26540		26412
	549		550		550		549		549		548		548	
50		27045		27099		27065		27049		27012		26998		26960
	549		550		550		549		549		548		548	
51		27594		27649		27615		27598		27561		27546		27508
	549		550		550		549		549		548		548	
52		28143		28199		28165		28147		28110		28094		28056
	549		550		550		549		549		548		548	
53		28692		28749		28715		28696		28659		28642		28604
	549		550		550		549		549		548		548	
54		29241		29299		29265		29245		29208		29190		29152
	549		550		550		549		549		548		548	
55		29790		29849		29815		29794		29757		29738		29700
	549		550		550		549		549		548		548	
56		30339		30399		30365		30343		30306		30286		30248
	549		550		550		549		549		548		548	
57		30888		30949		30915		30892		30855		30834		30796
	549		550		550		549		549		548		548	
58		31437		31499		31465		31441		31404		31382		31344
	549		550		550		549		549		548		548	
59		31986		32049		32015		31990		31953		31930		31892
	549		550		550		549		549		548		548	
60		32535		32599		32565		32539		32502		32478		32440
	549		550		550		549		549		548		548	
61		33084		33149		33115		33088		33051		33026		32988
	549		550		550		549		549		547		548	
62		33633		33699		33665		33637		33600		33573		33536
	549		550		550		548		549		547		548	
63		34182		34249		34215		34185		34149		34120		34084
	549		550		550		548		549		547		548	

Sleeper Spacing for 1 in 12, BG, 60kg TWS (Contrary Flexure Turnout)

Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
64		34731		34799		34765		34733		34698		34667		34632
	549		550		550		548		549		547		548	
65		35280		35349		35315		35281		35247		35214		35180
	550		550		550		550		550		550		550	
66		35830		35899		35865		35831		35797		35764		35730
	550		550		550		550		550		550		550	
67		36380		36449		36415		36381		36347		36314		36280
	550		550		550		550		550		550		550	
68		36930		36999		36965		36931		36897		36864		36830
	550		550		550		550		550		550		550	
69		37480		37549		37515		37481		37447		37414		37380
	550		550		550		550		550		550		550	
70		38030		38099		38065		38031		37997		37964		37930
	550		550		550		550		550		550		550	
71		38580		38649		38615		38581		38547		38514		38480
	550		550		550		550		550		550		550	
72		39130		39199		39165		39131		39097		39064		39030
	550		550		550		550		550		550		550	
73		39680		39749		39715		39681		39647		39614		39580
	550		550		550		550		550		550		550	
74		40230		40299		40265		40231		40197		40164		40130
	550		550		549		549		548		548		547	
75		40780		40849		40814		40780		40745		40712		40677
	550		550		549		549		548		548		547	
76		41330		41399		41363		41329		41293		41260		41224
	550		550		549		549		548		548		547	
77		41880		41949		41912		41878		41841		41808		41771
	550		550		549		549		548		548		547	
78		42430		42499		42461		42427		42389		42356		42318
	550		550		549		549		548		548		547	
79		42980		43049		43010		42976		42937		42904		42865
	550		550		550		549		549		548		547	

Sleeper Spacing for 1 in 12, BG, 60kg TWS (Contrary Flexure Turnout)														
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
80		43530		43599		43560		43525		43486		43452		43412
	550		550		550		549		549		548		548	
81		44080		44149		44110		44074		44035		44000		43960
	550		550		550		549		549		548		548	
82		44630		44699		44660		44623		44584		44548		44508
	550		550		550		549		549		547		548	
83		45180		45249		45210		45172		45133		45095		45056



(ACS – 6)

Sleeper Spacing for 1 in 16, BG, 60kg TWS (Contrary Flexure Turnout)

Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
SRJ		0		0		0		0		0		0		0
	244		244		244		244		244		244		244	
1		244		244		244		244		244		244		244
	568		568		568		568		568		568		568	
2		812		812		812		812		812		812		812
	745		745		745		745		745		745		745	
3		1557		1557		1557		1557		1557		1557		1557
	522		522		522		522		522		522		522	
4		2079		2079		2079		2079		2079		2079		2079
	600		600		600		600		600		600		600	
5		2679		2679		2679		2679		2679		2679		2679
	600		600		600		600		600		600		600	
6		3279		3279		3279		3279		3279		3279		3279
	600		600		600		600		600		600		600	
7		3879		3879		3879		3879		3879		3879		3879
	600		600		600		600		600		600		600	
8		4479		4479		4479		4479		4479		4479		4479
	600		600		600		600		600		600		600	
9		5079		5079		5079		5079		5079		5079		5079
	600		600		600		600		600		600		600	
10		5679		5679		5679		5679		5679		5679		5679
	600		600		600		600		600		600		600	
11		6279		6279		6279		6279		6279		6279		6279
	600		600		600		600		600		600		600	
12		6879		6879		6879		6879		6879		6879		6879
	600		600		600		600		600		600		600	
13		7479		7479		7479		7479		7479		7479		7479
	600		600		600		600		600		600		600	
14		8079		8079		8079		8079		8079		8079		8079
	600		600		600		600		600		600		600	
15		8679		8679		8679		8679		8679		8679		8679
	600		600		600		600		600		600		600	

Sleeper Spacing for 1 in 16, BG, 60kg TWS (Contrary Flexure Turnout)

Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
16		9279		9279		9279		9279		9279		9279		9279
	600		600		600		600		600		600		600	
17		9879		9879		9879		9879		9879		9879		9879
	600		600		600		600		600		600		600	
18		10479		10479		10479		10479		10479		10479		10479
	600		600		600		600		600		600		600	
19		11079		11079		11079		11079		11079		11079		11079
	600		600		600		600		600		600		600	
20		11679		11679		11679		11679		11679		11679		11679
	583		600		588		576		565		553		541	
21		12262		12279		12267		12255		12244		12232		12220
	599		600		599		599		598		598		597	
22		12861		12879		12866		12854		12842		12830		12817
	600		600		599		599		598		598		597	
23		13461		13479		13465		13453		13440		13428		13414
	599		600		599		599		598		598		597	
24		14060		14079		14064		14052		14038		14026		14011
	599		600		599		599		598		598		597	
25		14659		14679		14663		14651		14636		14624		14608
	600		600		599		599		598		598		597	
26		15259		15279		15262		15250		15234		15222		15205
	599		600		599		599		598		598		597	
27		15858		15879		15861		15849		15832		15820		15802
	599		600		599		599		598		598		597	
28		16457		16479		16460		16448		16430		16418		16399
	600		600		599		599		598		598		597	
29		17057		17079		17059		17047		17028		17016		16996
	599		600		599		599		598		598		597	
30		17656		17679		17658		17646		17626		17614		17593
	600		600		599		599		598		598		597	
31		18256		18279		18257		18245		18224		18212		18190
	599		600		599		599		598		598		597	

Sleeper Spacing for 1 in 16, BG, 60kg TWS (Contrary Flexure Turnout)														
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
32		18855		18879		18856		18844		18822		18810		18787
	599		600		599		599		598		598		597	
33		19454		19479		19455		19443		19420		19408		19384
	600		600		599		599		598		598		597	
34		20054		20079		20054		20042		20018		20006		19981
	599		600		599		599		598		598		597	
35		20653		20679		20653		20641		20616		20604		20578
	599		600		599		599		598		598		597	
36		21252		21279		21252		21240		21214		21202		21175
	600		600		599		599		598		598		597	
37		21852		21879		21851		21839		21812		21800		21772
	599		600		599		599		598		598		597	
38		22451		22479		22450		22438		22410		22398		22369
	599		600		599		599		598		598		597	
39		23050		23079		23049		23037		23008		22996		22966
	600		600		599		599		598		598		597	
40		23650		23679		23648		23636		23606		23594		23563
	599		600		599		599		598		598		597	
41		24249		24279		24247		24235		24204		24192		24160
	600		600		599		599		598		598		597	
42		24849		24879		24846		24834		24802		24790		24757
	599		600		599		599		598		598		597	
43		25448		25479		25445		25433		25400		25388		25354
	599		600		599		599		598		598		597	
44		26047		26079		26044		26032		25998		25986		25951
	600		600		599		599		598		598		597	
45		26647		26679		26643		26631		26596		26584		26548
	599		600		599		599		598		598		597	
46		27246		27279		27242		27230		27194		27182		27145
	599		600		599		599		598		598		597	
47		27845		27879		27841		27829		27792		27780		27742
	600		600		599		599		598		598		597	

Sleeper Spacing for 1 in 16, BG, 60kg TWS (Contrary Flexure Turnout)														
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
48		28445		28479		28440		28428		28390		28378		28339
	599		600		599		599		598		598		597	
49		29044		29079		29039		29027		28988		28976		28936
	599		600		599		599		598		598		597	
50		29643		29679		29638		29626		29586		29574		29533
	600		600		599		599		598		598		597	
51		30243		30279		30237		30225		30184		30172		30130
	599		600		599		599		598		598		597	
52		30842		30879		30836		30824		30782		30770		30727
	599		600		599		599		598		598		597	
53		31441		31479		31435		31423		31380		31368		31324
	600		600		600		599		598		598		597	
54		32041		32079		32035		32022		31978		31966		31921
	599		600		600		599		598		598		597	
55		32640		32679		32635		32621		32576		32564		32518
	600		600		600		599		598		598		597	
56		33240		33279		33235		33220		33174		33162		33115
	599		600		600		599		598		598		597	
57		33839		33879		33835		33819		33772		33760		33712
	599		600		600		599		598		598		597	
58		34438		34479		34435		34418		34370		34358		34309
	600		600		600		599		598		598		597	
59		35038		35079		35035		35017		34968		34956		34906
	599		600		600		599		598		598		597	
60		35637		35679		35635		35616		35566		35554		35503
	599		600		600		599		598		597		597	
61		36236		36279		36235		36215		36164		36151		36100
	600		600		600		599		598		597		597	
62		36836		36879		36835		36814		36762		36748		36697
	599		600		600		599		599		597		597	
63		37435		37479		37435		37413		37361		37345		37294
	599		600		600		599		599		597		597	

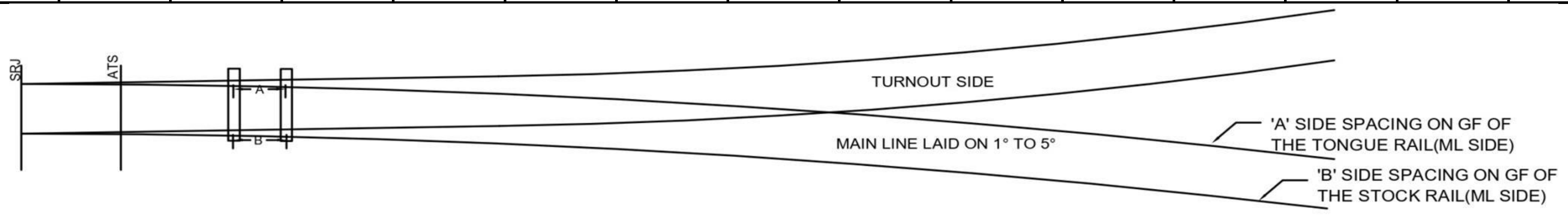
Sleeper Spacing for 1 in 16, BG, 60kg TWS (Contrary Flexure Turnout)

Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
64		38034		38079		38035		38012		37960		37942		37891
	600		600		600		599		599		597		597	
65		38634		38679		38635		38611		38559		38539		38488
	599		600		600		599		599		597		597	
66		39233		39279		39235		39210		39158		39136		39085
	600		600		600		599		599		597		597	
67		39833		39879		39835		39809		39757		39733		39682
	599		600		600		599		599		597		597	
68		40432		40479		40435		40408		40356		40330		40279
	599		600		600		599		599		597		597	
69		41031		41079		41035		41007		40955		40927		40876
	600		600		600		598		599		597		597	
70		41631		41679		41635		41605		415554		41524		41473
	599		600		600		598		599		597		598	
71		42230		42279		42235		42203		42153		42121		42071
	599		600		600		598		599		597		598	
72		42829		42879		42835		42801		42752		42718		42669
	600		600		600		598		599		597		598	
73		43429		43479		43435		43399		43351		43315		43267
	599		600		600		598		599		597		598	
74		44028		44079		44035		43997		43950		43912		43865
	599		600		600		598		599		597		598	
75		44627		44679		44635		44595		44549		44509		44463
	600		600		600		598		599		597		598	
76		45227		45279		45235		45193		45148		45106		45061
	600		600		600		598		599		597		598	
77		45827		45879		45835		45791		45747		45703		45659
	600		600		600		600		600		600		600	
78		46427		46479		46435		46391		46347		46303		46259
	600		600		600		600		600		600		600	
79		47027		47079		47035		46991		46947		46903		46859
	600		600		600		600		600		600		600	

Sleeper Spacing for 1 in 16, BG, 60kg TWS (Contrary Flexure Turnout)														
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
80		47627		47679		47635		47591		47547		47503		47459
	600		600		600		600		600		600		600	
81		48227		48279		48235		48191		48147		48103		48059
	600		600		600		600		600		600		600	
82		48827		48879		48835		48791		48747		48703		48659
	600		600		600		600		600		600		600	
83		49427		49479		49435		49391		49347		49303		49259
	600		600		600		600		600		600		600	
84		50027		50079		50035		49991		49947		49903		49859
	600		600		600		600		600		600		600	
85		50627		50679		50635		50591		50547		50503		50459
	600		600		600		600		600		600		600	
86		51227		51279		51235		51191		51147		51103		51059
	600		600		600		600		600		600		600	
87		51827		51879		51835		51791		51747		51703		51659
	600		600		599		599		598		598		597	
88		52427		52479		52434		52390		52345		52301		52256
	600		600		599		599		598		598		597	
89		53027		53079		53033		52989		52943		52899		52853
	600		600		599		599		598		598		597	
90		53627		53679		53632		53588		53541		53497		53450
	600		600		599		599		598		598		597	
91		54227		54297		54231		54187		54139		54095		54047
	600		600		599		599		598		598		597	
92		54827		54879		54830		54786		54737		54693		54644
	600		600		599		599		598		598		597	
93		55427		55479		55429		55385		55335		55291		55241
	600		600		599		599		598		598		597	
94		56027		56079		56028		55984		55933		55889		55838
	600		600		599		599		598		598		597	
95		56627		56679		56627		56583		56531		56487		56435
	600		600		600		599		598		598		597	

Sleeper Spacing for 1 in 12, BG, 60kg TWS (Contrary Flexure Turnout)

Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline - Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 4°		Curvature of ML 5°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
96		57227		57279		57227		57182		57129		57085		57032
	600		600		600		599		598		598		597	
97		57827		57879		57827		57781		57727		57683		57629
	600		600		600		599		599		597		597	
98		58427		58479		58427		58380		58326		58280		58226
	600		600		600		599		599		597		597	
99		59027		59079		59027		58979		58925		58877		58823
	600		600		600		598		599		597		598	
100		59627		59679		59627		59577		59524		59474		59421
	600		600		600		598		599		597		598	
101		60227		60279		60227		60175		60123		60071		60019



Pre-curving requirements and revised sleeper spacing of 1 in 12 & 1 in 16 Thick Web Switches for Similar Flexure Turnouts

i) The tongue and stock rails of Thick Web Switches shall be given requisite amount of pre-curving at manufacturing premises only.

ii) Sleepers will become skew due to curvature, therefore, grinding of liners for fitting on some of the sleepers may be required.

iii) Pre-curving and sleeper spacing details have been specified for various groups of curvatures applicable for various curvature ranges. The details pertaining to relevant range shall be used for providing pre-curving and sleeper spacing.

a) 1 in 12, BG 60kg Thick Web Switch in Similar Flexure Turnout

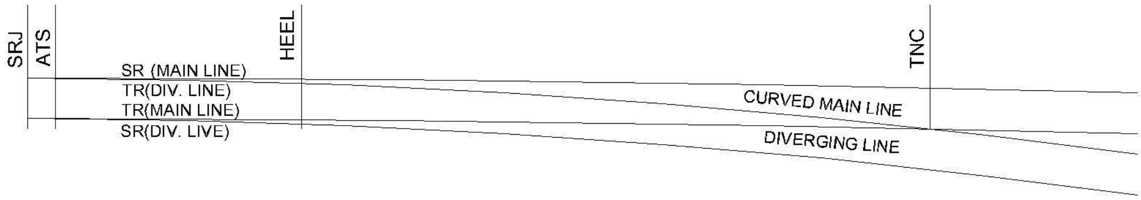
Curvature Group	Applicable range of degree of curvature
Straight	up to 0.5º
1º	> 0.5º & up to 1.5º
2º	> 1.5º & up to 2.0º

b) 1 in 16, BG 60kg Thick Web Switch in Similar Flexure Turnout

Curvature Group	Applicable range of degree of curvature
Straight	up to 0.5º
1º	> 0.5º & up to 1.5º
2º	> 1.5º & up to 2.5º
3º	> 2.5º & up to 3.5º
3.75º	> 3.5º & up to 3.75º

Pre-curving of Tongue Rails (TR) & Stock Rails (SR) for 1 in 12, BG 60kg Turnout with Zu-1-60/60E1A1 Thick-Web Switches for Similar Flexure

(ACS – 6)

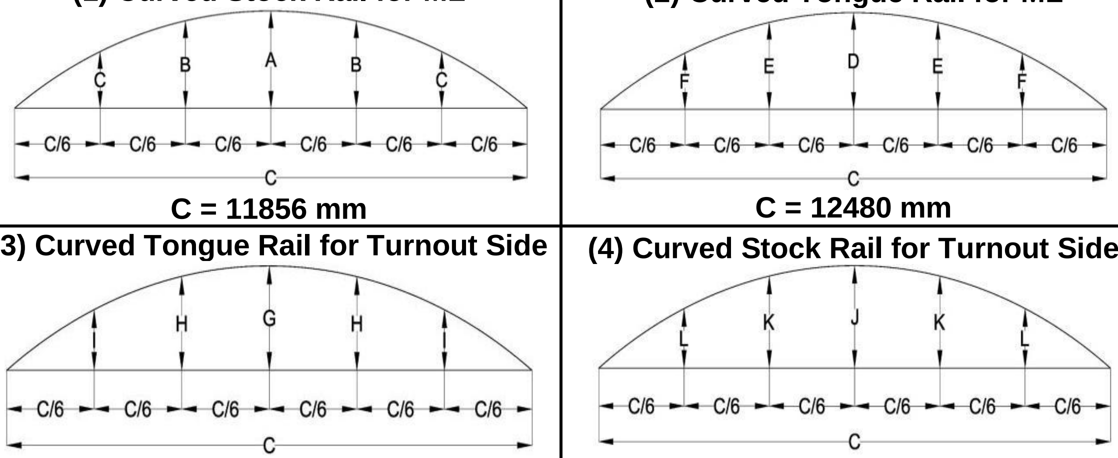


Applicable range of degree of curvature	Versine in mm for Main Line Track						Versine in mm for Diverging Track					
	For Stock Rail			For Tongue Rail			For Tongue Rail			For Stock Rail		
	A	B	C	D	E	F	G	H	I	J	K	L
Upto 0.5º	0	0	0	0	0	0	44	39	25	40	36	22
> 0.5º & up to 1.5º	10	9	6	11	10	6	55	49	31	50	45	28
> 1.5º & up to 2.0º	20	18	11	22	20	12	66	59	37	60	54	33

Similar Flexure Turnout

(1) Curved Stock Rail for ML

(2) Curved Tongue Rail for ML



C = 11856 mm

C = 12480 mm

(3) Curved Tongue Rail for Turnout Side

(4) Curved Stock Rail for Turnout Side

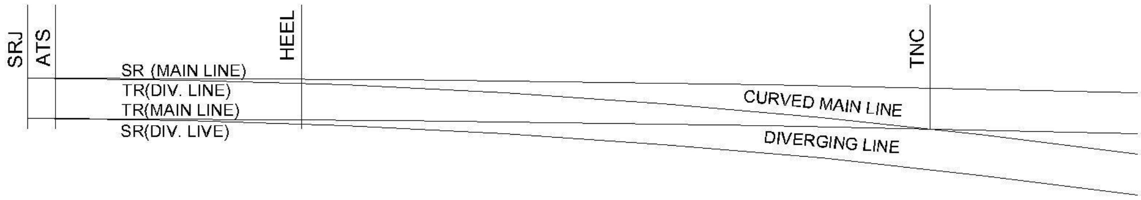
C = 12480 mm

C = 11856 mm

(ACS – 6)

Pre-curving of Tongue Rails (TR) & Stock Rails (SR) for 1 in 16, BG 60kg Turnout with Zu-1-60/60E1A1 Thick-Web Switches for Similar Flexure

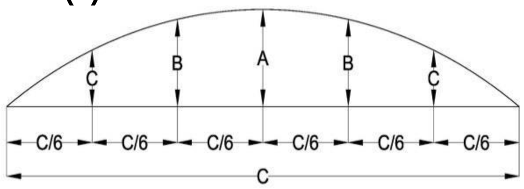
(ACS – 6)



Applicable range of degree of curvature	Versine in mm for Main Line Track						Versine in mm for Diverging Track					
	For Stock Rail			For Tongue Rail			For Tongue Rail			For Stock Rail		
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Upto 0.5º	0	0	0	0	0	0	27	24	15	22	20	12
> 0.5º & up to 1.5º	10	9	6	12	11	7	39	34	21	33	29	18
> 1.5º & up to 2.5º	20	18	11	24	21	13	51	45	28	43	38	24
> 2.5º & up to 3.5º	30	27	17	36	32	20	63	56	35	53	47	29
> 3.5º & up to 3.75º	38	33	21	45	40	25	71	64	40	60	54	34

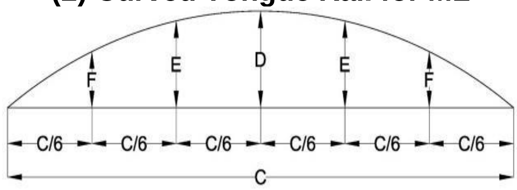
Similar Flexure Turnout

(1) Curved Stock Rail for ML



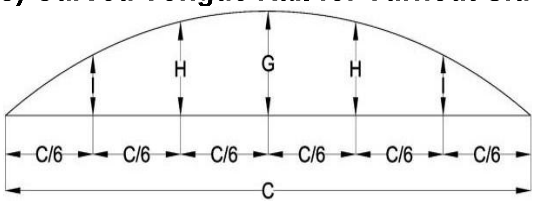
C = 11856 mm

(2) Curved Tongue Rail for ML



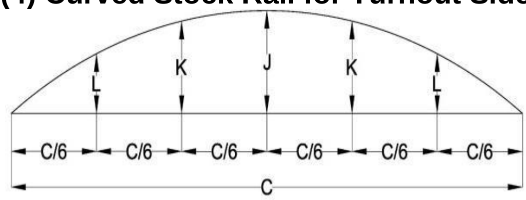
C = 12935 mm

(3) Curved Tongue Rail for Turnout Side



C = 12935 mm

(4) Curved Stock Rail for Turnout Side



C = 11856 mm

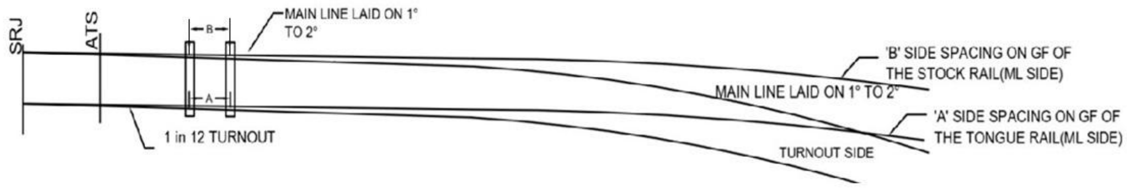
(ACS – 6)

Sleeper Spacing for 1 in 12, BG, 60kg, TWS (Similar Flexure Turnout) (ACS – 6)								
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
SRJ		0		0		0		0
	150		150		150		150	
1		150		150		150		150
	457		457		457		457	
2		607		607		607		607
	505		505		505		505	
3		1112		1112		1112		1112
	745		745		745		745	
4		1857		1857		1857		1857
	492		492		492		492	
5		2349		2349		2349		2349
	550		550		550		550	
6		2899		2899		2899		2899
	550		550		550		550	
7		3449		3449		3449		3449
	550		550		550		550	
8		3999		3999		3999		3999
	550		550		550		550	
9		4549		4549		4549		4549
	550		550		550		550	
10		5099		5099		5099		5099
	550		550		550		550	
11		5649		5649		5649		5649
	550		550		550		550	
12		6199		6199		6199		6199
	550		550		550		550	
13		6749		6749		6749		6749
	550		550		550		550	
14		7299		7299		7299		7299
	550		550		550		550	
15		7849		7849		7849		7849
	550		550		550		550	
16		8399		8399		8399		8399
	550		550		550		550	
17		8949		8949		8949		8949
	550		550		550		550	
18		9499		9499		9499		9499
	550		550		550		550	
19		10049		10049		10049		10049
	550		550		550		550	
20		10599		10599		10599		10599
	526		550		561		571	
21		11125		11149		11160		11170
	549		550		551		551	
22		11674		11699		11711		11721
	549		550		551		551	

Sleeper Spacing for 1 in 12, BG, 60kg, TWS (Similar Flexure Turnout)								
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (A)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
23		12223		12249		12262		12272
	549		550		551		551	
24		12772		12799		12813		12823
	549		550		551		551	
25		13321		13349		13364		13374
	549		550		551		551	
26		13870		13899		13915		13925
	549		550		551		551	
27		14419		14449		14466		14476
	549		550		551		551	
28		14968		14999		15017		15027
	549		550		551		551	
29		15517		15549		15568		15578
	549		550		551		551	
30		16066		16099		16119		16129
	549		550		551		551	
31		16615		16649		16670		16680
	549		550		551		551	
32		17164		17199		17221		17231
	549		550		551		551	
33		17713		17749		17772		17782
	549		550		551		551	
34		18262		18299		18323		18333
	549		550		551		551	
35		18811		18849		18874		18884
	549		550		551		551	
36		19360		19399		19425		19435
	548		550		551		551	
37		19908		19949		19976		19986
	549		550		551		551	
38		20457		20499		20527		20537
	549		550		551		551	
39		21006		21049		21078		21088
	549		550		551		551	
40		21555		21599		21629		21639
	549		550		551		551	
41		22104		22149		22180		22190
	549		550		551		551	
42		22653		22699		22731		22741
	549		550		551		551	
43		23202		23249		23282		23292
	549		550		551		551	
44		23751		23799		23833		23843
	549		550		550		551	
45		24300		24349		24383		24394
	549		550		550		551	
46		24849		24899		24933		24945
	549		550		550		551	

Sleeper Spacing for 1 in 12, BG, 60kg, TWS (Similar Flexure Turnout)								
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (A)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
47		25398		25449		25483		25496
	549		550		550		551	
48		25947		25999		26033		26047
	549		550		550		551	
49		26496		26549		26583		26598
	549		550		550		551	
50		27045		27099		27133		27149
	549		550		550		551	
51		27594		27649		27683		27700
	549		550		550		551	
52		28143		28199		28233		28251
	549		550		550		551	
53		28692		28749		28783		28802
	549		550		550		551	
54		29241		29299		29333		29353
	549		550		550		551	
55		29790		29849		29883		29904
	549		550		550		551	
56		30339		30399		30433		30455
	549		550		550		551	
57		30888		30949		30983		31006
	549		550		550		551	
58		31437		31499		31533		31557
	549		550		550		551	
59		31986		32049		32083		32108
	549		550		550		551	
60		32535		32599		32633		32659
	549		550		550		551	
61		33084		33149		33183		33210
	549		550		550		551	
62		33633		33699		33733		33761
	549		550		550		552	
63		34182		34249		34283		34313
	549		550		550		552	
64		34731		34799		34833		34865
	549		550		550		552	
65		35280		35349		35383		35417
	550		550		550		550	
66		35830		35899		35933		35967
	550		550		550		550	
67		36380		36449		36483		36517
	550		550		550		550	
68		36930		36999		37033		37067
	550		550		550		550	
69		37480		37549		37583		37617
	550		550		550		550	
70		38030		38099		38133		38167
	550		550		550		550	

Sleeper Spacing for 1 in 12, BG, 60kg, TWS (Similar Flexure Turnout)								
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (A)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
71		38580		38649		38683		38717
	550		550		550		550	
72		39130		39199		39233		39267
	550		550		550		550	
73		39680		39749		39783		39817
	550		550		550		550	
74		40230		40299		40333		40367
	550		550		551		551	
75		40780		40849		40884		40918
	550		550		551		551	
76		41330		41399		41435		41469
	550		550		551		551	
77		41880		41949		41986		42020
	550		550		551		551	
78		42430		42499		42537		42571
	550		550		551		551	
79		42980		43049		43088		43122
	550		550		550		551	
80		43530		43599		43638		43673
	550		550		550		551	
81		44080		44149		44188		44224
	550		550		550		551	
82		44630		44699		44738		44775
	550		550		550		551	
83		45180		45249		45288		45326



(ACS – 6)

Sleeper Spacing for 1 in 16, BG, 60kg, TWS (Similar Flexure Turnout)												
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 3.75°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
SRJ		0		0		0		0		0		0
	244		244		244		244		244		244	
1		244		244		244		244		244		244
	568		568		568		568		568		568	
2		812		812		812		812		812		812
	745		745		745		745		745		745	
3		1557		1557		1557		1557		1557		1557
	522		522		522		522		522		522	
4		2079		2079		2079		2079		2079		2079
	600		600		600		600		600		600	
5		2679		2679		2679		2679		2679		2679
	600		600		600		600		600		600	
6		3279		3279		3279		3279		3279		3279
	600		600		600		600		600		600	
7		3879		3879		3879		3879		3879		3879
	600		600		600		600		600		600	
8		4479		4479		4479		4479		4479		4479
	600		600		600		600		600		600	
9		5079		5079		5079		5079		5079		5079
	600		600		600		600		600		600	
10		5679		5679		5679		5679		5679		5679
	600		600		600		600		600		600	
11		6279		6279		6279		6279		6279		6279
	600		600		600		600		600		600	
12		6879		6879		6879		6879		6879		6879
	600		600		600		600		600		600	
13		7479		7479		7479		7479		7479		7479
	600		600		600		600		600		600	
14		8079		8079		8079		8079		8079		8079
	600		600		600		600		600		600	
15		8679		8679		8679		8679		8679		8679
	600		600		600		600		600		600	
16		9279		9279		9279		9279		9279		9279
	600		600		600		600		600		600	
17		9879		9879		9879		9879		9879		9879
	600		600		600		600		600		600	
18		10479		10479		10479		10479		10479		10479
	600		600		600		600		600		600	
19		11079		11079		11079		11079		11079		11079
	600		600		600		600		600		600	
20		11679		11679		11679		11679		11679		11679
	583		600		612		624		635		644	
21		12262		12279		12291		12303		12314		12323
	599		600		601		601		602		602	
22		12861		12879		12892		12904		12916		12925
	600		600		601		601		602		602	

Sleeper Spacing for 1 in 16, BG, 60kg, TWS (Similar Flexure Turnout)												
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 3.75°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
23		13461		13479		13493		13505		13518		13527
	599		600		601		601		602		602	
24		14060		14079		14094		14106		14120		14129
	599		600		601		601		602		602	
25		14659		14679		14695		14707		14722		14731
	600		600		601		601		602		602	
26		15259		15279		15296		15308		15324		15333
	599		600		601		601		602		602	
27		15858		15879		15897		15909		15926		15935
	599		600		601		601		602		602	
28		16457		16479		16498		16510		16528		16537
	600		600		601		601		602		602	
29		17057		17079		17099		17111		17130		17139
	599		600		601		601		602		602	
30		17656		17679		17700		17712		17732		17741
	600		600		601		601		602		602	
31		18256		18279		18301		18313		18334		18343
	599		600		601		601		602		602	
32		18855		18879		18902		18914		18936		18945
	599		600		601		601		602		602	
33		19454		19479		19503		19515		19538		19547
	600		600		601		601		602		602	
34		20054		20079		20104		20116		20140		20149
	599		600		601		601		602		602	
35		20653		20679		20705		20717		20742		20751
	599		600		601		601		602		602	
36		21252		21279		21306		21318		21344		21353
	600		600		601		601		602		602	
37		21852		21879		21907		21919		21946		21955
	599		600		601		601		602		602	
38		22451		22479		22508		22520		22548		22557
	599		600		601		601		602		602	
39		23050		23079		23109		23121		23150		23159
	600		600		601		601		602		602	
40		23650		23679		23710		23722		23752		23761
	599		600		601		601		602		602	
41		24249		24279		24311		24323		24354		24363
	600		600		601		601		602		602	
42		24849		24879		24912		24924		24956		24965
	599		600		601		601		602		602	
43		25448		25479		25513		25525		25558		25567
	599		600		601		601		602		602	
44		26047		26079		26114		26126		26160		26169
	600		600		601		601		602		602	
45		26647		26679		26715		26727		26762		26771
	599		600		601		601		602		602	

Sleeper Spacing for 1 in 16, BG, 60kg, TWS (Similar Flexure Turnout)												
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 3.75°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
46		27246		27279		27316		27328		27364		27373
	599		600		601		601		602		602	
47		27845		27879		27917		27929		27966		27975
	600		600		601		601		602		602	
48		28445		28479		28518		28530		28568		28577
	599		600		601		601		602		602	
49		29044		29079		29119		29131		29170		29179
	599		600		601		601		602		602	
50		29643		29679		29720		29732		29772		29781
	600		600		601		601		602		602	
51		30243		30279		30321		30333		30374		30383
	599		600		601		601		602		602	
52		30842		30879		30922		30934		30976		30985
	599		600		601		601		602		602	
53		31441		31479		31523		31535		31578		31587
	600		600		600		601		602		602	
54		32041		32079		32123		32136		32180		32189
	599		600		600		601		602		602	
55		32640		32679		32723		32737		32782		32791
	600		600		600		601		602		602	
56		33240		33279		33323		33338		33384		33393
	599		600		600		601		602		602	
57		33839		33879		33923		33939		33986		33995
	599		600		600		601		602		602	
58		34438		34479		34523		34540		34588		34597
	600		600		600		601		602		602	
59		35038		35079		35123		35141		35190		35199
	599		600		600		601		602		602	
60		35637		35679		35723		35742		35792		35801
	599		600		600		601		602		602	
61		36236		36279		36323		36343		36394		36403
	600		600		600		601		602		602	
62		36836		36879		36923		36944		36996		37005
	599		600		600		601		601		602	
63		37435		37479		37523		37545		37597		37607
	599		600		600		601		601		602	
64		38034		38079		38123		38146		38198		38209
	600		600		600		601		601		602	
65		38634		38679		38723		38747		38799		38811
	599		600		600		601		601		602	
66		39233		39279		39323		39348		39400		39413
	600		600		600		601		601		602	
67		39833		39879		39923		39949		40001		40015
	599		600		600		601		601		602	
68		40432		40479		40523		40550		40602		40617
	599		600		600		601		601		603	

Sleeper Spacing for 1 in 16, BG, 60kg, TWS (Similar Flexure Turnout)												
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 3.75°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
69		41031		41079		41123		41151		41203		41220
	600		600		600		602		601		603	
70		41631		41679		41723		41753		41804		41823
	599		600		600		602		601		603	
71		42230		42279		42323		42355		42405		42426
	599		600		600		602		601		603	
72		42829		42879		42923		42957		43006		43029
	600		600		600		602		601		603	
73		43429		43479		43523		43559		43607		43632
	599		600		600		602		601		603	
74		44028		44079		44123		44161		44208		44235
	599		600		600		602		601		603	
75		44627		44679		44723		44763		44809		44838
	600		600		600		602		601		603	
76		45227		45279		45323		45365		45410		45441
	600		600		600		602		601		603	
77		45827		45879		45923		45967		46011		46044
	600		600		600		600		600		600	
78		46427		46479		46523		46567		46611		46644
	600		600		600		600		600		600	
79		47027		47079		47123		47167		47211		47244
	600		600		600		600		600		600	
80		47627		47679		47723		47767		47811		47844
	600		600		600		600		600		600	
81		48227		48279		48323		48367		48411		48444
	600		600		600		600		600		600	
82		48827		48879		48923		48967		49011		49044
	600		600		600		600		600		600	
83		49427		49479		49523		49567		49611		49644
	600		600		600		600		600		600	
84		50027		50079		50123		50167		50211		50244
	600		600		600		600		600		600	
85		50627		50679		50723		50767		50811		50844
	600		600		600		600		600		600	
86		51227		51279		51323		51367		51411		51444
	600		600		600		600		600		600	
87		51827		51879		51923		51967		52011		52044
	600		600		601		601		602		602	
88		52427		52479		52524		52568		52613		52646
	600		600		601		601		602		602	
89		53027		53079		53125		53169		53215		53248
	600		600		601		601		602		602	
90		53627		53679		53726		53770		53817		53850
	600		600		601		601		602		602	
91		54227		54279		54327		54371		54419		54452
	600		600		601		601		602		602	

Sleeper Spacing for 1 in 16, BG, 60kg, TWS (Similar Flexure Turnout)												
Location/ Sleeper No.	C/C spacing of sleepers to be measured along gauge face of tongue rail of mainline (A)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)		C/C spacing of sleepers to be measured along gauge face of stock rail of mainline (B)	
	All Locations		Mainline – Straight		Curvature of ML 1°		Curvature of ML 2°		Curvature of ML 3°		Curvature of ML 3.75°	
	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing	Spacing	Cumulative Spacing
92		54827		54879		54928		54972		55021		55054
	600		600		601		601		602		602	
93		55427		55479		55529		55573		55623		55656
	600		600		601		601		602		602	
94		56027		56079		56130		56174		56225		56258
	600		600		601		601		602		602	
95		56627		56679		56731		56775		56827		56860
	600		600		600		601		602		602	
96		57227		57279		57331		57376		57429		57462
	600		600		600		601		602		602	
97		57827		57879		57931		57977		58031		58064
	600		600		600		601		601		602	
98		58427		58479		58531		58578		58632		58666
	600		600		600		601		601		602	
99		59027		59079		59131		59179		59233		59268
	600		600		600		602		601		603	
100		59627		59679		59731		59781		59834		59871
	600		600		600		602		601		603	
101		60227		60279		60331		60383		60435		60474

CHAPTER – 5

TRACK MONITORING & TOLERANCES

PART – A

Track Monitoring

501 General - Inspections by individuals on foot or by trolley, locomotive, and rear vehicle enable the Permanent Way staff to carry out assessment of the quality of track based on their expertise and experience. For objective assessment of track quality, the following mechanized means are being used on Indian Railways.

(1) Track Recording Car

(2) Oscillation Monitoring System

(ACS – 3)

502 Track Recording Cars: - These enable collection of discrete values of various track geometry Parameters on selected sampling interval under loaded condition. The TRCs work on *inertial principle of measurements* for various track geometry parameters except Gauge.

(1) **Inertial Principle of Measurements:-**

TRC measures lateral and vertical accelerations with the help of accelerometers placed at coach floor / bogie frame. The acceleration values obtained are integrated twice to get loci of the location of accelerometers. The relative displacements between rail and accelerometer locations are obtained from displacement transducers (LVDT)/LASER based contactless sensors. The loci of accelerometers are combined with relative displacement between accelerometers and rail obtained from sensors to derive the vertical and lateral profile of the rail. These measurements are further corrected for roll and yaw motion of coach using gyroscopes.

(2) **Gauge Measurement:-**

For measurement of Gauge Parameter, the following types of Gauge sensors are in use on Indian Railways:

(a) Contact gauge sensor (used up to maximum recording speed of 100 Kmph); and

(b) Contactless laser based gauge sensor (used up to maximum recording speed of 160 Kmph);

503 Quick Calibration, Recording and Speed:-

(1) Before start of any run (day light hours only), it should be ensured that quick calibration of the system has been done satisfactorily.

(2) The track recording car specials must have a through run over the section between two major stations and run through main lines only at all stations.

(3) The track parameter recording is independent of speed above a minimum speed of 20 Kmph (needed for inertial platform); however, the Track Recording Cars should be run at the maximum speed of Section/TRC for objective assessment of ride quality in terms of acceleration peaks and Ride Index. Any recording done below speed of 20 Kmph is taken as *"Non-recorded".*

504 Arrangements for Running Track Recording Car:-

(1) On receipt of monthly program for running of TRCs on various zonal railways issued by RDSO, Zonal Railways shall arrange for suitable power, crew, consumables and path for an uninterrupted run of the Track Recording Car as per RDSO program.

(2) ADENs & SSEs headquartered at originating / halting stations shall coordinate for proper placement, watering, charging, and other assistance for the TRC special.

505 Officials to Accompany the TRC run:-

Sectional Sr. DEN/DEN, ADEN and SSE/P.Way (In-charge) shall accompany TRC run in their sections.

Sectional Sr. DEN/DEN shall ensure proper liaison in the control office for suitable path and monitoring of the TRC special.

The soft copy of TRC recording shall be provided by RDSO officials and the same shall be uploaded in TMS.

506 Frequency of Track Recording:-

The frequency of Track geometry monitoring by TRC is as under:

SN	Speed Slab	Frequency
i)	Routes with speeds above 130 Kmph	Once in 2 months
ii)	Routes with speeds above 110 Kmph & up to 130 Kmph	Once in 4 months
iii)	Routes with speeds up to 110 Kmph	Once in 6 months

507 Track Geometry Parameters Recorded by TRC: - The following track geometry parameters are measured by the Track Recording Cars:

(1) Unevenness of left & right rail (on two selected chords)

(2) Alignment of left & right rail (on two selected chords)

(3) Twist (calculated on two selected bases)

(4) Variation of gauge over nominal gauge, which is 1676 mm for IR.

(5) Vertical and lateral accelerations on coach floor above bogie pivot, in test vehicles (Locomotive)

(6) Curve details (only in contactless laser based TRCs)

(7) Speed of recording

508 Chords for Measurements/Report:-

Both types of TRCs have the ability to measure and calculate track geometry parameters on two user selectable chords/bases in the range of 2 to 20 metres. The shorter one is termed as short chord/base and the other one as long chord/base (denoted by suffix 1 & 2 respectively). The length of short and long chord/base for track monitoring are as under:

SN	Parameter	Short Chord / Base (m)	Long Chord/ Base (m)
1	Unevenness	9.0 *(UN-1)*	18.0 *(UN-2)*
2	Alignment	9.0 *(AL-1)*	15.0 *(AL-2)*
3	Twist	3.0 *(TW-1)*	15.0 *(TW-2)*

509 Reporting of TRC Results:-

While recording the track parameters, on-line reports are generated by TRC for each block of 200 metre and for the entire kilometre:

(1) **Details of every block of 200 m:-**

(a) Standard Deviation values of Unevenness of left & right rail on short and long chord

(b) Standard Deviation value of Alignment of left & right rail on short and long chord

(c) Average of Variation of gauge over nominal gauge (1676 mm)

(d) Maintenance Instructions corresponding to Gauge (MI-G) based on Condition Based Maintenance Limit (CBML) and Urgent Maintenance Limit (UML) values for average/mean gauge

(e) Average speed

(f) Vertical and Lateral Ride Index on coach floor above bogie pivot (accelerometer location) and in test vehicle (Locomotive) in Laser Contact less TRCs

(g) Parameter Index for Unevenness (UNI-1 & UNI-2) and Alignment (ALI-1 & ALI-2) on short and long chords.

(h) Track Quality Index (TQI) on both short and long chord i.e., TQI-S and TQI-L

(i) Composite Track Quality Index for Sections having Speed > 100 Kmph (TQI-C)

(j) Maintenance Instructions corresponding to SD (MI-SD) based on PML and CBML for Unevenness and Alignment (ACS – 4)

(2) **Results reported for whole kilometre:**

(a) Total number of peaks above Condition Based Maintenance Limits (CBML) on long chord and short chord for Alignment and Unevenness.

(b) Total number of peaks above Condition Based Maintenance Limits (CBML) and Urgent Maintenance Limit (UML) on short base for Twist.

(c) Total number of peaks above Condition Based Maintenance Limits (CBML) and Urgent Maintenance Limit (UML) for Gauge.

(d) Total number of peaks above Urgent Maintenance Limit (UML) for vertical and lateral acceleration.

(e) Parameter Indices for Unevenness (UNI-1 & UNI-2) and Alignment (ALI-1 & ALI-2) on short and long chord.

(f) Track Quality Index (TQI) on both short and long chord i.e. TQI-S and TQI-L.

(g) Composite Track Quality Index for sections having speed > 100 Kmph (TQI-C).

(h) Average speed.

(i) Vertical and Lateral Ride Index on coach floor above bogie pivot (at accelerometer location).

(j) 10 highest peak values of alignment and unevenness Parameters with location on long and short chord out of the maximum peak values measured for each 50 m block of a kilometer.

(k) 10 highest peak values of Twist Parameter with location on short base out of the maximum peak values measured for each 50 m block of a kilometer.

(l) 10 highest peak values of variation of Gauge (over nominal gauge of 1676 mm) parameter with location out of the maximum peak values measured for each 50 m block of a kilometer.

(m) 10 highest peak values of vertical and lateral accelerations with location out of the maximum peak values measured for each 50 m block of a kilometer.

(n) 10 maximum peak values of Twist on short base exceeding Urgent Maintenance Limits (UML) with location.

(o) 10 maximum peak values of Gauge (over nominal gauge of 1676 mm) exceeding Urgent Maintenance Limits (UML) with location.

(p) 10 maximum peak values of vertical and lateral accelerations exceeding Urgent Maintenance Limits (UML) with location. (ACS – 4)

(3) SMS alerts would be generated for cases of exceedances of UML during TRC recordings. These alerts would be sent through TMS to concern JE/P.Way, SSE/P.Way, ADEN and sectional DEN/Sr.DEN along with Sr.DEN/Coordination.

510 Action to be Taken After Track Recording by TRC:-

(1) Spots/blocks requiring attention as per Parameter limits, and acceleration peak limits set as UML should be noted by the ADEN and SSE/P.Way accompanying the car for giving requisite action/attentions as per ***Para 521***.

(2) Track recording results should be uploaded in TMS by SSE/In-charge of TRC after end of days recording and analyzed in the Divisional Office.

(a) A comparison of the records of each section shall be made with the previous run.

(b) Analysis shall be done for identifying the blocks/locations needing Planned, Need Based and Urgent attention for onward transmission to concerned maintenance units.

(c) Analysis of data to generate various reports/charts using TRC offline software or through TMS to take up the maintenance and precautionary action as detailed in ***Para 523*.** Alerts with respect to UML will also be generated by TMS after uploading of data in TMS.

(d) Maintenance units shall take action for maintenance as detailed in ***Para 523***.

511 Parameter Indices:-

For characterization of the Track Quality, the Parameter wise Indices viz. Unevenness index (UNI-1 and UNI-2) and Alignment Index (ALI-1 and ALI-2) on short and long chord for each block of 200 m are computed as under:

(1) **Alignment Index:**

(a) On Short Chord (ALI_1):

$$ALI_1 = 100 \times e^{-\left[\frac{(SD_{M-AAL-1} - (SD_{NTL-AL-1}))}{((1.3 \times SD_{CBML-UN-1} - (SD_{NTL-UN-1})))}\right]}$$

(b) On Long Chord (ALI_2):

$$ALI_2 = 100 \times e^{-\left[\frac{(SD_{M-AAL-2} - (SD_{NTL-AL-2}))}{((1.3 \times SD_{CBML-UN-2} - (SD_{NTL-UN-2})))}\right]}$$

(2) **Unevenness Index:**

(a) On Short Chord (UNI_1):

$$UNI_1 = 100 \times e^{-\left[\frac{(SD_{M-AUN-1} - (SD_{NTL-UN-1}))}{((1.3 \times SD_{CBML-UN-1} - (SD_{NTL-UN-1})))}\right]}$$

(b) On Long Chord (UNI_2):

$$UNI_2 = 100 \times e^{-\left[\frac{(SD_{M-AUN-2} - (SD_{NTL-UN-2}))}{((1.3 \times SD_{CBML-UN-2} - (SD_{NTL-UN-2})))}\right]}$$

Where,

ALI_1	Alignment Index on short chord i.e. on 9.0 metre chord
ALI_2	Alignment Index on long chord i.e. on 15.0 metre chord
UNI_1	Unevenness Index on short chord i.e. on 9.0 metre chord
UNI_2	Unevenness Index on long chord i.e. on 18.0 metre chord
$SD_{M-AAL-1}$	Average of measured SD value of alignment of left and right rail on short chord
$SD_{NTL-AL-1}$	SD value of New Track Limit of alignment on short chord
$SD_{CBML-AL-1}$	SD value of Condition Based Maintenance Limit of alignment on short chord
$SD_{M-AAL-2}$	Average of measured SD value of alignment of left and right rail on long chord
$SD_{NTL-AL-2}$	SD value of New Track Limit of alignment on long chord
$SD_{CBML-AL-2}$	SD Value of Condition Based Maintenance Limit of alignment on long chord
$SD_{M-AUN-1}$	Average of measured SD value of unevenness of left and right rail on short chord
$SD_{NTL-UN-1}$	SD value of New Track Limit of unevenness of short chord
$SD_{CBML-UN-1}$	SD value of Condition Based Maintenance Limit of unevenness on short chord
$SD_{M-AUN-2}$	Average of measured SD value of uneveness of left and right rail on long chord
$SD_{NTL-UN-2}$	SD value of New Track Limit of unevenness on long chord
$SD_{CBML-UN-2}$	SD value of Condition Based Maintenance Limit of unevenness on long chord

(ACS – 4)

512 Track Quality Index (TQI):-

(1) TQI is prescribed for overall assessment of track quality for IR routes categorized in four different speed bands. The TQI could be worked out by expressions given in (a) and (b) below using indices for short chord (for all speeds) as well as long chord (for speeds more than 100 Kmph) respectively. Additionally, a composite TQI can also be calculated by expressions given in (c) below.

(a) On **Short Chord**

$$TQI_S = \left(\frac{UNI_1 + ALI_1}{2}\right)$$

(b) On **Long Chord** (For Speed >100 Kmph only)

$$TQI_L = \left(\frac{UNI_2 + ALI_2}{2}\right)$$

(c) **Composite Track Quality Index** (For Speed >100 Kmph only)

$$TQI_C = \left(\frac{UNI_1 + ALI_1 + UNI_2 + ALI_2}{4}\right)$$

(2) The TQI values based on the above expressions are only an indicator; the actual maintenance of track shall be planned on the basis of SD values and peak values of different track parameters in comparison to respective benchmark values.

513 Oscillation Monitoring System:-

This equipment measures the track performance by measurement of vehicles response in terms of vertical and lateral accelerations. The real time output of the equipment is in the form of value of peaks exceeding the limiting value, their locations, and Ride index. These values are available for both vertical and lateral accelerations.

(1) The OMS equipment used for oscillation monitoring uses a portable accelerometer and transducers converting the oscillations into electrical signals, which can be recorded electronically and processed. The OMS equipment used should preferably be GPS enabled.

(2) (i) The OMS equipment shall be kept in the rearmost coach of the fastest train in the section or in a dedicated coach, which shall be attached, as last vehicle, to the fastest train in the section.

(ii) The OMS equipment shall be kept on the coach floor (as close to the bogie pivot as possible) on the free end of the coach.

(3) The stored data should be uploaded in TMS for analysis and maintenance planning.

514 Frequency of OMS Recording:-

OMS recording shall be carried out once in a month on all routes, irrespective of the sectional speed.

(ACS – 5)

515 Recording of Defects:-

To assess the track quality, vertical and lateral acceleration peaks of 0.15g or above are to be considered.

(ACS – 3)

516 Classification of Track Quality:-

For judging the track quality, the following criteria could be used (average total number of peaks per km) to classify a continuous section for track quality (SSE/P Way's jurisdiction/Subdivision/division):

Track Quality / Section Speed	Very Good	Good	Average
Speed Above 110 Kmph	Less than 1.0	1-2	Greater than 2
Others	Less than 1.5	1.5-3.0	Greater than 3

517 (Deleted) (ACS – 3)

518 (Deleted) (ACS – 3)

PART – B

Track Tolerances

519 General - The track deteriorates structurally and geometrical Parameters de-grade with the passage of traffic resulting in decline in ride quality. The rate of deterioration of the track depends on the quality of track at that point in time. Various limits for track geometrical Parameters are laid down to assess the ride quality of track and to plan necessary maintenance interventions during the service life.

520 New Track Tolerances:- (*Back to* ***Para 716***)

(1) Utmost care should be taken during linking of track to ensure good quality of work. As a good practice, the laying standards of track geometry for track laid with new material are as under: (To be measured three months after speed is raised to normal).

(2) For measurements recorded by TRC.

(a) SD Values for Unevenness and Alignment:

Sl. No.	Parameter	Speed upto 100 Kmph	Speed above 100 Kmph and up to 160 Kmph
1.	UN-1	2.0 mm	1.4 mm
2.	UN-2	-	1.9 mm
3.	AL-1	1.4 mm	1.1 mm
4.	AL-2	-	1.3 mm

(b) Peak Values for Unevenness and Alignment:

Sl. No.	Parameter	Speed upto 100 Kmph	Speed above 100 Kmph and upto 160 Kmph
1.	UN-1	6.0 mm	4.0 mm
2.	UN-2	-	6.0 mm
3.	AL-1	4.0 mm	3.0 mm
4.	AL-2	-	4.0 mm

(3) For measurements recorded in floating conditions: (*Back to* ***Para 429, 715, 716***)

(a) **Gauge:**

For new track and through renewal of track, following tolerances would be applicable-

(i) For straight including curves of radius up to 350 m and more: **-5 mm to +3 mm**

(ii) For curves of radius less than 350 m: **Up to +10 mm**

(b) **Other parameters:**

S. No	Parameter	Description of Measurement	Value
1	**Gauge**	Sleeper to sleeper variation	2 mm
2	**Expansion gap**	Over average gap worked out by recording 20 successive gaps	± 2 mm
3	**Joints**	Low joints not permitted High joints not more than Squareness of joints on straight	+ 2 mm ±10 mm
4	**Spacing of sleepers**	With respect to theoretical spacing	± 20 mm
5	**Cross level**	To be recorded on every 4th sleeper	± 3 mm
6	**Alignment**	On straight on 10 m Chord	± 2 mm
7		*Variation over theoretical versines: (On 20 m Chord).* On curves of Radius more than 600 m	5 mm
8		*Variation over theoretical versines: (On 20 m Chord).* On curves of Radius less than 600 m	10 mm
9	**Longitudinal level**	Variation with reference to approved longitudinal sections.	50 mm

521 Planning of Maintenance – (*Back to **Para 510***)

For planning/taking up maintenance of track in respect of Alignment, Unevenness, Gauge and Twist Parameters based on TRC results, track shall be categorized under following three categories:

(1) Track requiring planned maintenance

(2) Track requiring Condition Based Maintenance

(3) Track requiring urgent maintenance

(a) **Planned Maintenance Limit (PML) –**

(i) These tolerances provide a guidance to plan through maintenance of track in a complete block section. These Limits, if exceeded, require that track geometry condition be analysed and considered for planned maintenance operations.

(ii) The Planned Maintenance Limits (PML) for Unevenness and Alignment are based on Standard Deviation (SD) values, as these Parameters affect Ride quality.

(iii) Peak based limits are not stipulated for unevenness and alignment for planned maintenance as the planned maintenance is to be carried out by track machines for which the planning will be based on standard deviation values only.

(b) **Condition Based Maintenance Limit (CBML) –**

(i) These limits are defined for applying timely correction before the defects size grows to the level of Urgent Maintenance Limit (UML); requiring traffic slow down. Allowable time for attention to defects exceeding the CBML would depend upon the magnitude of the defects and various factors affecting track geometry deterioration such as sectional speed, axle load, traffic volume etc.

(ii) The Condition Based Maintenance Limits (CBML) are based on Standard Deviation and peak values for Unevenness and Alignment. For Gauge and Twist, these limits are based on peak values.

(c) **Urgent Maintenance Limits (UML) –**

(i) These limits are so specified that upon their exceedances, the permitted speed should be reduced; which can be restored only after attending the track.

(ii) These are laid in terms of acceleration limits on comfort consideration and peak values for Gauge and Twist. (ACS – 4)

522 Maintenance Limits for Different Speed Bands: Based on TRC and OMS results, various limits of PML CBML and UML for Unevenness, Alignment, Gauge and Twist Parameters for different speed bands are stipulated as under:

(1) **For Speeds up to 100 Kmph:**

SN	Parameter	Planned Maintenance Limit (PML)	Condition Based Maintenance Limit (CBML)	Urgent Maintenance Limit (UML)
1	**Unevenness**			Vertical and lateral acceleration peak of **0.30 g**
1.1	UN-1	SD-5.0 mm	SD-6.8 mm Peak-20 mm	
1.2	UN-2	-	-	
2	**Alignment**			
2.1	AL-1	SD-3.3 mm	SD-4.9 mm Peak-15 mm	
2.2	AL-2	-	-	

3	**Gauge**			
3.1	**Mean gauge over 200 m section over nominal gauge**			
(a)	Straight	-	-8 mm to +10 mm	-10 mm to + 12 mm
(b)	Curve with radius 440 m or more	-	-5 mm to +14 mm	-7 mm to +17 mm
(c)	Curve with radius less than 440 m (Permissible speed as per relevant Para of IRPWM)	-	-5 mm to +18 mm	-7 mm to +20 mm
3.2	**Isolated defects – Nominal track gauge to peak value**			
(a)	Straight	-	-10 mm to +12 mm	-12 mm to + 15 mm
(b)	Curve with radius 440 m or more	-	-7 mm to +17 mm	-11 mm to +20 mm
(c)	Curve with radius less than 440 m (Permissible speed as per relevant Para of IRPWM)	-	-6 mm to +22 mm	-8 mm to +25 mm
4	**Twist (TW-1)**		5 mm/m	7 mm/m

Note: *In case of curve, the limits for alignment prescribed are above average versine.*

(2) **For Speeds above 100 Kmph and up to 110 Kmph:**

SN	Parameter	Planned Maintenance Limit (PML)	Condition Based Maintenance Limit (CBML)	Urgent Maintenance Limit (UML)
1	**Unevenness**			Vertical and lateral acceleration peak of **0.30 g**
1.1	UN-1	SD-3.8 mm	SD-5.5 mm Peak-17 mm	
1.2	UN-2	SD-5.4 mm	SD-7.5 mm Peak-23 mm	
2	**Alignment**			
2.1	AL-1	SD-2.5 mm	SD-3.9 mm Peak-12 mm	
2.2	AL-2	SD-4.1 mm	SD-6.7 mm Peak-20 mm	
3	**Gauge**			
3.1	**Mean gauge over 200 m section over nominal gauge**			
(a)	Straight	-	-8 mm to +10 mm	-10 mm to + 12 mm
(b)	Curve with radius 440 m or more	-	-5 mm to +14 mm	-7 mm to +17 mm
(c)	Curve with radius less than 440 m (Permissible speed as per relevant Para of IRPWM)	-	-5 mm to +18 mm	-7 mm to +20 mm
3.2	**Isolated defects – Nominal track gauge to peak value**			
(a)	Straight	-	-10 mm to +12 mm	-12 mm to + 15 mm
(b)	Curve with radius 440 m or more	-	-7 mm to +17 mm	-11 mm to +20 mm
(c)	Curve with radius less than 440 m (Permissible speed as per relevant Para of IRPWM)	-	-6 mm to +22 mm	-8 mm to +25 mm
4	**Twist (TW-1)**		4 mm/m	7 mm/m

Note: *In case of curve, the limits for alignment prescribed are above average versine.*

(3) **For Speeds above 110 Kmph and up to 130 Kmph:**

SN	Parameter	Planned Maintenance Limit (PML)	Condition Based Maintenance Limit (CBML)	Urgent Maintenance Limit (UML)
1	**Unevenness**			Vertical and lateral acceleration peak of **0.25 g**
1.1	UN-1	SD-3.3 mm	SD-4.9 mm Peak-15 mm	
1.2	UN-2	SD-5.1 mm	SD-7.4 mm Peak-22 mm	
2	**Alignment**			
2.1	AL-1	SD-2.5 mm	SD-3.6 mm Peak-11 mm	
2.2	AL-2	SD-3.5 mm	SD-5.3 mm Peak-16 mm	
3	**Gauge**			
3.1	**Mean gauge over 200 m section over nominal gauge**			
(a)	Straight	-	-8 mm to +10 mm	-10 mm to + 12 mm
(b)	Curve with radius 440 m or more	-	-5 mm to +14 mm	-7 mm to +17 mm
(c)	Curve with radius less than 440 m (Permissible speed as per relevant Para of IRPWM)	-	-5 mm to +18 mm	-7 mm to +20 mm
3.2	**Isolated defects – Nominal track gauge to peak value**			
(a)	Straight	-	-10 mm to +12 mm	-12 mm to + 15 mm
(b)	Curve with radius 440 m or more	-	-7 mm to +17 mm	-11 mm to +20 mm
(c)	Curve with radius less than 440 m (Permissible speed as per relevant Para of IRPWM)	-	-6 mm to +22 mm	-8 mm to +25 mm
4	**Twist (TW-1)**		4 mm/m	6 mm/m

Note: *In case of curve, the limits for alignment prescribed are above average versine.*

(4) **For Speeds above 130 Kmph and up to 160 Kmph:**

SN	Parameter	Planned Maintenance Limit (PML)	Condition Based Maintenance Limit (CBML)	Urgent Maintenance Limit (UML)
1	**Unevenness**			Vertical and lateral acceleration peak of **0.20 g**
1.1	UN-1	SD-2.9 mm	SD-4.4 mm Peak-13 mm	
1.2	UN-2	SD-4.4 mm	SD-6.6 mm Peak-20 mm	
2	**Alignment**			
2.1	AL-1	SD-1.9 mm	SD-3.6 mm Peak-11 mm	
2.2	AL-2	SD-2.5 mm	SD-4.9 mm Peak-15 mm	
3	**Gauge**			
3.1	**Mean gauge over 200 m section over nominal gauge**			
(a)	Straight	-	-6 mm to +10 mm	-8 mm to + 12 mm
(b)	Curve with radius 440 m or more	-	-5 mm to +13 mm	-7 mm to +15 mm
(c)	Curve with radius less than 440 m (Permissible speed as per relevant Para of IRPWM)	-	-5 mm to +18 mm	-7 mm to +20 mm

3.2	**Isolated defects – Nominal track gauge to peak value**			
(a)	Straight	-	-8 mm to +12 mm	-10 mm to + 15 mm
(b)	Curve with radius 440 m or more	-	-6 mm to +16 mm	-9 mm to +20 mm
(c)	Curve with radius less than 440 m (Permissible speed as per relevant Para of IRPWM)	-	-6 mm to +22 mm	-8 mm to +25 mm
4	**Twist (TW-1)**		3.5 mm/m	5 mm/m

Note: *In case of curve, the limits for alignment prescribed are above average versine.*

(ACS – 4)

523 Action to be Taken Based on TRC Results: (*Back to **Para 510**, **602**, **604***)

(1) **Action to be taken on exceedance of UML:**

Spots/blocks exceeding track Parameter limits, and acceleration peak limits set as UML should be noted by the ADEN and SSE accompanying the TRC and suitable speed restrictions have to be immediately imposed, which shall be relaxed only after suitable attention/maintenance of track at concerned location. Similar action should be taken on exceedance of UML during OMS run also.

(2) **Action to be taken on exceedance of CBML:**

(i) The blocks requiring condition based maintenance on the basis of laid down SD based CBML and isolated spots on the basis of laid down Peak based CBML shall be identified using offline software or through TMS. All such blocks and isolated spots should be attended within a reasonable time of TRC run so that good ride quality is maintained and the track geometry does not exceed the UML. The reasonable time would be different for different sections depending upon the magnitude of defects, cause of the defect, traffic density of the section, maximum permissible speed of the section etc. The officials responsible for maintenance at various levels have to plan the deployment of maintenance resources keeping in view the relative priority and availability of maintenance resources.

(ii) Gap between two successive CBML locations in block sections/yards should also be tamped while attending these CBML locations if this gap is less than/equal to 200 m. (1 TRC block).

(iii) While attending an CBML block in the yard in which any portion of the turnout falls, the entire turnout should be tamped.

(3) **Planning of through tamping based on PML:**

(i) The blocks requiring planned maintenance on the basis of laid down SD based PML shall be identified for block sections and for yards separately using off line software or through TMS.

The block section for any main line should be treated from block (TRC block of 200 m) of last SEJ of preceding station to block of first SEJ of current station. Both the blocks containing above SEJ would be excluded from the block section on any particular line (UP & DOWN separately).

Similarly, the yard would be treated from a block of 200 m containing 1st SEJ to block of last SEJ on any particular line (UP & DOWN separately) of the concerned station/yard.

In case of CWR through yards, the yard should be taken as 50 metres beyond farthest SRJ/ Back of crossing of turnout from centre of station yard on either side on any particular line (UP and DN separately).

(ii) The block section should be planned for through tamping if the percentage of blocks exceeding PML is more than 40%.

(iii) Yards should be planned for through tamping if the percentage of blocks exceeding PML is more than 50%.

Tamping of turnouts and straight of all other passenger loop lines should be planned on condition basis by ADEN while machines are deployed in yard for need based or planned attention of main line of yards.

(4) **Maintenance action when track recording is not done**

(i) For sections in which TRC has not run for more than one year and the last tamping has been done more than two years before, the condition based maintenance and urgent maintenance should continue to be carried out based on OMS recording and other inspections.

(ii) Sectional Sr.DEN/DEN should periodically (at suitable intervals not greater than six months) review the need for maintenance of track of each such block sections/ yards based on OMS recording, other inspections and other maintenance considerations.

(iii) Through tamping of such block sections / yards, if considered necessary based on OMS recording and other considerations, should be proposed for inclusion in planning of Through Tamping by Sr.DEN / DEN of section through Sr.DEN / Coordination of Division for approval of CTE. (ACS – 4)

524 Realignment Criteria for Curves:- (*Back to **Para 418***)

The running over a curve depends not only on the difference between the actual versine and the designed versine but also on the station to station variation of the actual versine values, which determine the rate of change of lateral acceleration, on which depends the riding comfort.

Sl. No.	Speed on curve	Limits of Station to Station Variation of Versine (mm)
1	160 Kmph and up to 110 Kmph	**10 mm** (15 mm for speed of 110 Kmph); or 20% of average Versine on circular portion, whichever is more.
2	Below 110 Kmph and up to 50 Kmph	**20 mm**; or 20% of average Versine on circular portion, whichever is more.
3	Below 50 Kmph	**40 mm**; or 20% of average Versine on circular portion, whichever is more.

In case exceedances of the above Limit is observed during inspection, local adjustment may be resorted to in cases where the variation of versine between adjacent stations is only at a few locations, at the earliest possible. If more than 20% stations are having versine variations above the limits prescribed, complete realignment of curve should be planned within a month.

525 Track Parameters in Floating Conditions:- (*Back to **Para 429, Ann. 6/9***)

The Gauge and Twist values for manual measurement in floating conditions are as under:

(1) **Gauge:**

While it is desirable to maintain correct gauge, variation in gauge may be there due to age and condition of the rail, sleepers, and fastenings. The limits of gauge as per measurement in floating condition, for the guidance of the engineering officials regarding condition of track from passenger comfort perspective shall be as given below, provided that generally a uniform gauge can be maintained over long lengths.

a)	On straight Track	-6 mm to +6 mm
b)	On curves with radius 440 m or more	-6 mm to +15 mm
c)	On curves with radius less than 440 m	Up to + 20 mm

In case of exceedances of these limits, the results of last TRC/OMS shall be analyzed for planning suitable maintenance action.

(2) **Twist:**

It is desirable to maintain the track geometry for a comfortable ride at sectional speed. The limits of twists as per measurement in floating condition, for guidance of the engineering officials regarding condition of track from passenger comfort perspective shall be as under; (to be calculated on a base of 3.0 m)

(i) On straight and curve track, other than transition - 3.5 mm/m

(ii) On transition of curve- 2.1 mm/m (Local defects above Designed value)

In case of exceedances of above limits, the results of last TRC/OMS shall be analyzed for planning suitable maintenance action.

526 Track Parameters for Low Speeds:-

For guidance of field officials, following track Parameters are stipulated in floating conditions, for maintenance of tracks where speeds are low such as worksite, yard line, etc.

Speed (in Kmph)	Peak value of UN (on 3.6 m chord) in mm	Peak value of twist (on 3.0 m chord) in mm	Permissible gauge range
Up to 45	22	18	-10 to +27 mm
Up to 30	24	21	-10 to +27 mm
Up to 15	33	25	-12 to +27 mm

527 Stability of Trains Against Derailment: The stability of trains against derailment depends upon several factors such as track geometry, vehicle characteristics and state of their maintenance and speed of the particular vehicle at relevant point of time etc. Rail wheel interaction is, thus, a complex phenomenon and, therefore, safety tolerance for track alone cannot be prescribed in Isolation. Accordingly, safety tolerances for maintenance of track have not been prescribed on Indian Railways. Each derailment case, therefore, needs careful examination of all available evidence, in respect of track, rolling stock, speed and other factors considered relevant, to arrive at the cause. The provisions and tolerances mentioned herein before and elsewhere in this Manual are with a view to maintain track geometry for good riding comfort considered and deviation from these maintenance Parameters should not be considered alone for cause of accident without examining all evidences mentioned above.

Annexure - 5/1 ***(Para 517)***

(Deleted)

(ACS – 3)

CHAPTER – 6

MAINTENANCE OF PERMANENT WAY

PART – A

Regular Track Maintenance

601 **Track Maintenance:-**The track should be maintained with the objective of restoring it to best possible condition consistent with its maintainability by Mechanized system of maintenance as per **Para 604**. However, till complete mechanization, few activities like picking up of slacks may be done manually.

602 **Annual Programme of Track Maintenance: -**The annual machine deployment programme shall be issued by CTE for track renewal, rail grinding, deep screening and shoulder screening machines based on yearly requirement of track maintenance. For other machines, the deployment programme shall be decided by Sr. DEN / Co which will be periodically reviewed based on TRC results and **Para 523**. Field engineers will also make annual (two half-yearly, first: April to September and second: October to March) programme of regular track maintenance and works incidental thereto which shall be consistent with annual machine deployment programme. The annual programme of regular track maintenance and works incidental thereto may be followed for guidance as below:

Annual Programme for Regular Track Maintenance

(a) Post monsoon attention	Immediately after cessation of monsoon, attention to run down lengths, condition based maintenance or works incidental to requirement of urgent maintenance as projected by OMS/TRC recording or identified during footplate inspections should be taken up in the entire gang beat to restore section to good shape. Thereafter, the following schedule of work may be followed: *(i)* Picking of slack: 1-2 days in a week *(ii)* On remaining days Systematic planned/condition based maintenance, from one end of the section to the other as necessitated by TRC results, including through gauging, Sleeper spacing/squaring, casual renewals of rails/sleepers, attention to bridge approaches, level crossings and points & crossings, SEJs, Glued Joints, lubrication of rail joints, weld collar painting, destressing of track, cold weather patrolling, etc.
(b) Pre-monsoon attention	Normally 2 to 3 days in a week should be devoted to clearing of side and catch water drains, earthwork repairs to cess, clearing waterways and picking up slacks. In the rest of the days normal systematic planned/condition based maintenance as necessitated by results of TRC/OMS etc., will be carried out, which include through gauging, Sleeper spacing/squaring, casual renewals of rails and sleepers, Shallow screening of specified lengths, destressing of track, hot weather patrolling etc.
(c) Attention during monsoon	Attention to track as required, consisting primarily of picking up slacks or condition based maintenance and attention to side and catch water drains and waterways. During abnormally heavy rains, patrolling of the line by gangs should be carried out in addition to regular monsoon patrolling.

(ACS – 4)

603 **Rolling Block Programme and Maintenance Planning:-**

(1) Planned Maintenance (repair & replacement) and execution of infrastructure work shall normally be executed as per Rolling block programme as stipulated in Rule 15.02 clause(c) of Indian Railways (Open Lines) General (Third Amendment) Rules, 2023 issued by Railway Board.

(2) Maintenance Planning – Every SSE/P.Way (In-charge) should prepare a perspective maintenance plan of his section in advance based on various track recording results and exception reports from TMS. This should also take account of trolley and footplate inspections and inspection of higher officials so that optimum utilization of various resources, track machines, traffic blocks, and labour etc. is possible. Every SSE/P.Way (In-charge) should also ensure that arrangements are made for adequate materials, tools, labour, man power and necessary caution orders/blocks, as may be necessary. The monthly and weekly maintenance planning shall be based broadly on annual plan to include:

(a) Plain track maintenance,

(b) Maintenance of yards including point and crossings,

(c) Maintenance and realignment of curves,

(d) Level crossings,

(e) Adjustment of creep (SWR, Fish Plated track)

(f) Deep screening,

(g) Casual renewal,

(h) Renewal of over-aged assets such as points and crossings, SEJs, Glued Joints, welds etc.

(i) Welding of joints,

(j) Destressing of long welded rails etc.

604 Mechanised Track Maintenance System:- (*Back to **Para 601***)

The 3 tier system of track maintenance shall be adopted on sections nominated for Mechanized track maintenance. This shall consist of the following 3 tiers of track maintenance –

- On-track Machines Unit (OMU)
- Mobile Maintenance Gang (MMG)
- Sectional Gangs.

1) *On-track Machines Unit (OMU):* On track machines for track maintenance include Tie – tamping machines for plain track and points and crossings, shoulder ballast cleaning machines, ballast cleaning machines, ballast regulating machines, dynamic track stabilizers and UTV.

These machines shall be used as per the various instructions contained in Indian Railways Track Machines Manual and **Para** 523. These machines shall be deployed to carry out the following jobs:

a) Systematic tamping of plain track as well as Points & Crossings;

b) Intermediate tamping of plain track as well as Points & crossings;

c) Shoulder ballast cleaning;

d) Ballast profiling/redistribution;

e) Track stabilization;

f) Periodical deep screening;

g) Picking up and transportation of material.

2) *Mobile Maintenance Gang:*

a) There will be one Mobile Maintenance Gang (MMG) under each SSE/P.Way (In overall charge) with a jurisdiction of about 70-80 km in single line section and 30 to 50 km in double or multi line section. It will be headed by a sectional JE/SSE P.Way/ (MMG) and shall be based on a Rail Borne Maintenance Vehicle (RBMV) for mobility. Till RBMV are arranged for all In-charge SSE/P.Way. The activities listed hereunder except (b) (viii) shall be done by sectional gangs.

b) The functions of MMG shall be as under:

(i) Repair to rail/weld fracture including in-situ AT welding.

(ii) Attention to SEJs.

(iii) Scattered replacement of switches and crossing components, glued joints, SEJs, etc.

(iv) Rail cutting/drilling and chamfering.

(v) Spot renewals of rails and sleepers.

(vi) Spot attention by tamping of few sleepers with off-track tampers or any other approved equipment.

(vii) Loading and unloading of material required for spot attention.

(viii) Driving of RBMV.

(ix) Any other functions assigned.

c) The MMG shall possess the equipment and other accessories as given in **Annexure - 6/1**, which shall be used according to the working instructions and manufacturer's operating instructions.

3) *Sectional Gangs:* The sectional gangs shall perform the following functions:

a) Systematic through packing of track where tamping machines have not been deployed or small stretches of track needing spot attention for which machines cannot be deployed due to whatever reasons.

b) Overhauling of track.

c) In addition to above following works are/may also be assigned –

(i) Patrolling of track –

- Keyman's daily patrol
- Hot/cold weather patrolling
- Monsoon Patrolling

(ii) Watching vulnerable locations

(iii) Need-based attention to bridges, turnouts, SEJs and level crossings and their approaches.

(iv) Greasing of ERCs, lubrication of joints, casual changing of rubber pads and other fittings

(v) Minor cess repairs

(vi) Cleaning of drains

(vii) Attention to loops

(viii) Creep and gap adjustment not involving use of machines

(ix) Pre & post tamping attention

(x) Examination of rails, sleepers and fastenings including measurement of toe load of ERCs.

(xi) Inspection of and attention to insulated joints, switch expansion joints etc.

(xii) Weld collar painting, cess cleaning, cutting of tree branches/shrubs for improving visibility.

(xiii) Any other functions assigned.

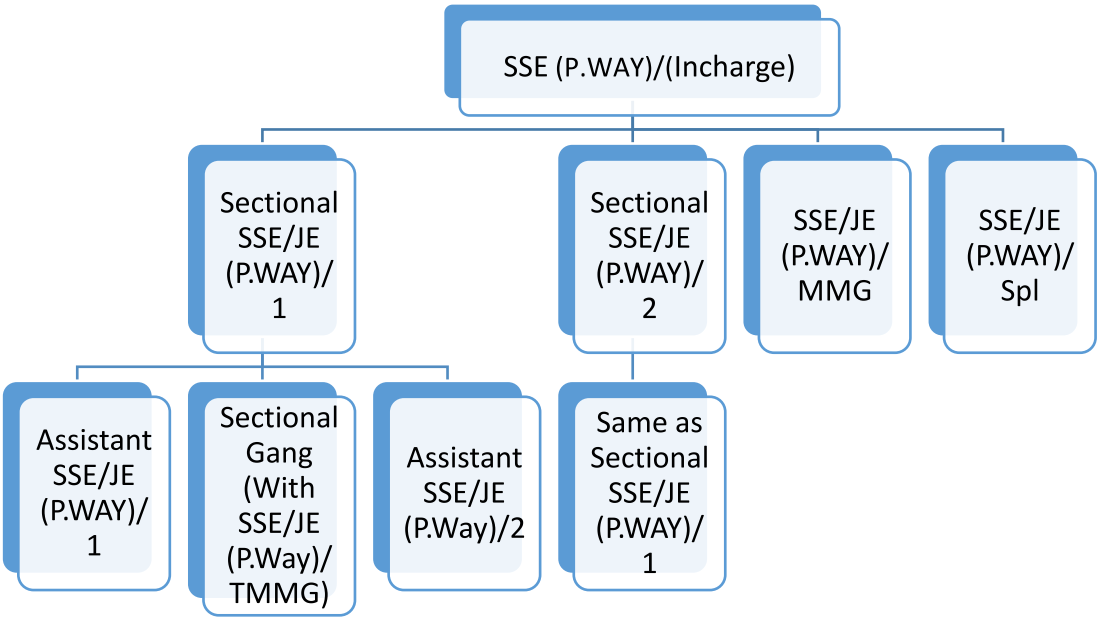
604(A) Modified Three Tier System of Track Maintenance

Principal Chief Engineer of the Railway may decide to implement Modified Three Tier System of Track Maintenance on existing lines, new lines and all gauge conversion projects, where traffic density is light and less than 10 GMT. Principal Chief Engineer may also decide to implement this system on sections having more than 10 GMT on case to case basis.

The Modified Three Tier System of Track Maintenance, shall consist of following three tiers:

- On-track Machines Unit (OMU)
- Mobile Maintenance Gang (MMG)
- Sectional Gangs

The organisation structure under SSE/P.Way (In Charge) will be as given below:



The Structure and functions to be performed by the three tiers shall be as detailed below:

1) **On–track Machines Unit (OMU)** – This tier will be same as in para 604 (1). However, each DEN/Sr. DEN in whose section Modified Three Tier System of Track Maintenance is implemented shall have minimum one Utility Vehicle (UTV) nominated exclusively for such sections. For MPT, Para 606(1) will be applicable. (ACS – 2)

2) **Mobile Maintenance Gang (MMG)** – This tier will be same as per para 604 (2) and will have same jurisdiction and same function. It will also have same set of equipment's for MMG as mentioned in Annexure–6/1.

   Additional infrastructure and responsibility for this unit are:

a. SSE/P.Way (In–charge) shall also be provided with one truck for transportation of materials.
b. In addition to RBMV, one pickup van shall also be provided with each MMG for giving them alternative mode of mobility for attending locations approachable by road.
c. MMG shall be provided with adequate skilled and unskilled manpower for operation and maintenance of RBMV and its equipment's. For this, it will be supplemented with manpower through Zonal and Special P.Way Contracts.
d. SSE/P.Way (In–charge) shall inspect his section on foot, once in six months.
e. He shall be assisted by one SSE/JE (P.Way)/Spl for executing special works in the section.

3) **Sectional Gangs:**

a. Sectional SSE/JE (P.Way) will have a jurisdiction of 35-40 Km in single line section and 17 to 20 Km in double/multiple line section and shall comprise of:

- Assistant SSE/JE (P.Way)
- Keyman
- Sectional Gang

b. Sectional SSE/JE (P.Way) will inspect his section on foot, once in three months.

c. Assistant SSE/JE (P.Way), whose beat shall be about 17 to 20 Km in single line and 8 to 10 Km in double/multiple line covering the beat of 2 to 3 Keyman will perform following duty:

- Inspect his beat once in a fortnight on foot.
- Supervise the maintenance and special works going on in his beat like keyman and other patrolling activity, machine working, works especially requiring the presence of JE (P.Way) including the working of contractors etc.
- He will also supervise TMMG when the same is deployed in his section as per requirement.

d. The track shall be inspected daily by Keymen with a jurisdiction of about 6–8 Km each in single line and 3–4 Km in double/multiple line.

e. On foot inspection schedule of SSE/JE/P.Way (In–charge) and SSE/JE/P.Way (Sectional), as mentioned in Table 1–B (Para 106 and 109) and for SSE/JE (P.Way) (Other than in–charge or Sectional) in Table–1C (para 110) of IRPWM–2020 shall not be applicable in sections under Modified Three Tier System of Track Maintenance.

f. Sectional gang will maintain the entire jurisdiction of Sectional SSE/JE (P.Way). It will be supplemented with manpower through Zonal and/or Special P.Way Contracts. The sectional gang will comprise of:

- Mobile Track Maintenance and Monitoring Gang (TMMG) with a multi-utility road vehicle that transports the track maintainers, equipment and materials and will have the same jurisdiction as that of sectional SSE/JE (P.Way). It will be headed by one SSE/JE (P.Way)/TMMG.
- Manpower for patrolling of track.
- Stationary watchmen.
- Boulder gangs.
- Gatemen for manning level crossing gates in the section including rest giver.

g. The TMMG will generally be responsible for:

- Looking after overall safety of track in their beat.
- Carrying out works of casual renewal.
- Spot maintenance.
- Attention to fittings.
- Assisting the Mobile Maintenance Gang (MMG).
- Assisting the working of On–track machines.
- Protection of work sites.
- Other miscellaneous repair/maintenance activities etc. assigned by Sectional JE/SSE (P.Way)

h. Each SSE (P.Way) (In–charge) shall be provided with a Zonal P.Way contract and activity specific Special P.Way Contracts for the maintenance works not covered under the works to be carried out by sectional gangs. The Zonal Contract will supplement the departmental manpower and will cover the entire jurisdiction of the SSE (P.Way) (In–charge). The special P.Way contracts shall be awarded for specific maintenance works with predetermined quantities and locations.

605 Systematic Tamping of Plain Track and Points & Crossings:-

(1) *General:* Systematic tamping of plain track as well as points & crossings should be planned on long continuous lengths, based on results of TRC/OMS etc.

(2) *Deployment of tamping machines* – Deployment of tamping machines for plain track and points & crossing shall be based on results of TRC/OMS, the past history of deterioration of track, traffic GMT, type of formation, condition of track and its components.

(3) *Pre-requisites to introduction of mechanical maintenance* –

(a) A minimum depth of 150 mm of clean ballast cushion below the bottom of the sleepers is recommended for the proper functioning of the tie tampers. Adequate ballast should be available in the shoulders and cribs.

(b) For this purpose, planning and execution of deep screening of ballast, where required, as well as running out of ballast should be done well in advance.

(c) Time allowance for working the machines should be provided in the working timetable. The block time should be interpolated in the master chart for passenger and goods trains that is prepared with every change in timetable.

(d) It is as much the responsibility of the Operating Department as that of the Engineering Department to ensure provision of adequate time for economical working of machines.

(4) *Pre-tamping attention* – To achieve good results the JE/SSE/P.Way should carry out the following preparatory work before taking up the tamping:

(a) Ballasting where there is shortage of ballast.

(b) Heaping up of ballast in the tamping zone, to ensure effective packing.

(c) Making up of low cess.

(d) Cleaning of pumping joints and providing additional clean ballast, where necessary.

(e) Attention to hogged joints before tamping.

(f) Tightening of all fittings and fastenings like fish bolts and elastic fastenings and replacement of worn out fittings.

(g) Renewing broken and damaged sleepers.

(h) Squaring of sleepers and spacing adjustment; re-gauging to be done as necessary.

(i) Adjusting creep and expansion gap in rails.

(j) Examination of rails for cracks, sleepers and fastenings etc.

(k) Survey for realignment of curves, which are badly out of alignment.

(l) Clearing of ballast on sleepers to make them visible to the operator.

(m) All obstructions such as signal rods, cables, pipes, level crossing check rails, joggled fish plates etc., likely to be damaged by the tampers should be preferably removed. In unavoidable case, these should be clearly marked and made known to the tamping operator before he starts work. Tight overhead clearance should also be brought to his notice; the beginning and end of transitions should be marked. Slew, Super elevation and lift value, if any should be marked on every second/third sleeper so that it can guide the operator for levelling up correctly.

(5) *Attention during tamping* – The following points should be observed by the machine operator and JE/SSE/P.Way:

(a) The tamping depth i.e. gap between the top edge of the tamping blade and the bottom edge of the sleeper in closed position of the tamping tool should be adjusted to 15 mm to 20 mm. Care should be taken to ensure that tamping tools are inserted centrally between the sleepers into the ballast to avoid any damage to the sleepers.

(b) The tamping (squeezing) Pressure (110 – 120 Kg/Sq. Cm for plain track and 125-135 Kg/Sq.cm for P&C) and squeezing time (0.8 second to 1.2 second) should be adjusted according to the track structure, as per the recommendations of the manufacturer.

(c) Generally, one insertion is adequate. Two insertions may be necessary if the lift is above 30 mm.

(d) The shoulders should be compacted along with tamping, where separate provision for shoulder compaction is available.

(e) A run-off ramp of 1 in 1000 should be given before closing the day's work.

(6) *Post tamping attention* – The JE/SSE/P.Way shall pay attention to following points:

(a) Immediately after the tamping work, the track should be checked for quality of work done, in respect of cross levels and alignment and action taken as considered necessary.

(b) As some of the fastenings might become loose, tightening of fittings should be done immediately after tamping.

(c) Any broken fitting/sleeper should be replaced.

(d) The ballast should be dressed neatly and proper filling and consolidation of ballast between the sleepers should be done.

606 Picking Up Slacks:-

(1) Slacks usually occur on stretches of yielding formation, on high banks and cuttings, on approaches of bridges, LC approaches, SEJs, P&C zones, Glued Joints, on badly aligned curves, axle counter locations and other electrical and S&T installations where ballast is poor in quality or quantity or where drainage is defective. Need for attention to slacks is determined by inspections and results of track recording car and OMS. The locations needing urgent maintenance as detected by TRC/OMS shall be targeted first for restoring normal condition quickly and thereafter the locations identified for condition based maintenance as determined by track recording car or other inspections shall be attended. For spot attention/slack picking, multi- purpose tampers and off-track hand held tampers/any other approved equipment shall be used as a regular measure. **Each ADEN shall have one Multipurpose Tamper (MPT) for this purpose progressively.**

(ACS – 2)

(ACS – 3)

(ACS – 4)

(2) For off-track tampers, the working instructions, issued by Railway Board/RDSO should be followed. As an interim measure, where off-track tampers are not available,

packing may be done with the help of crowbar/beater, duly taking care that concrete sleepers are not damaged.

(3) The quantum of work turned out by a gang during the day will depend on the extent of slacks. In all cases, sighting is done, the defects assessed and marks made with chalk on sleepers to be attended. The marked sleepers should then be dealt with as in through packing as given in **Para** 607, care being taken to see that the packing of adjacent sleepers does not get disturbed. In case a large percentage of sleepers needs attention in a rail length, the entire rail length should be attended to. The marking of defects shall be as indicated below –

Sl. No.	Defects	Symbol	Place of indication
1	Cross levels	C-2	On the sleeper inside gauge face.
2	Loose packing	H or P	On the sleeper outside the gauge face
3	Gauge	G±	On the sleeper inside the gauge face
4	Unevenness	→ ←	On the rail web on gauge face side
5	Alignment	↓ →	On the foot of rail inside the gauge face

(4) In the case of a low joint, the fishplates should be slightly loosened and the joint tapped, so that the rail ends are, rendered free and are capable of being lifted. After the joint is thoroughly packed the fishplates should be tightened again. When joints are picked up, at least three sleepers on either side of the joints should be packed.

(5) If the length of track marked for Condition Based Maintenance is more in a Kilometer, then this should be attended by on track Machine (ACS – 4)

607 Through Packing by Conventional Manual Method:- (*Back to* *Para* *345, 609*)

Normally manual through packing is not to be done in concrete sleeper track. However, in locations of slacks where multipurpose tampers are not available, following steps in sequence shall be followed. The length of track opened out on any one day shall not be more than that can be efficiently tackled before the end of the day.

(a) Opening of the road.

(b) Examination of rails, sleepers and fastenings.

(c) Squaring of sleepers.

(d) Slewing of track to correct alignment.

(e) Gauging.

(f) Packing of sleepers.

(g) Repacking of joint sleepers.

(h) Boxing of ballast section and tidying.

The details of various steps listed above is given in **Annexure - 6/9**. The provisions of Part D of Chapter 3 should be followed, wherever through packing is being done in LWR/CWR track. Appropriate small track machines should be deployed instead of conventional tools for carrying out various operations, wherever feasible.

608 Observance of Sleepers under Passage of Traffic – During the passage of the trains within working hours, the Mate and Track Maintainers at the work site should stand on the cess each about one rail-length apart on either side of the portion of track they are attending to, and observe the movement of sleepers under load.

Immediately after the passing of train, loose sleepers should be marked, packed uniformly and the packing tested. In respect of other trains, the mate and the trackmen should observe the sleepers near where they are working and take similar action. Firm and uniform packing is the primary need for good track maintenance.

609 Systematic Overhauling – The length of the section to be overhauled shall be such that complete overhauling of track will be accomplished within a specific period (normally 3 to 5 years). The overhauling should be done using SBCM for cleaning of shoulder ballast. The crib ballast should also be shifted to shoulders for screening by the machine, which should again be put back in crib portion. In case it is not feasible to screen the crib ballast by machine, the same should be screened manually. Adequate care should be taken in removing the crib ballast in LWR/CWR track.

All the loop lines should be shallow screened/overhauled once in 7 years or more frequently as required, along with systematic tamping/packing.

(1) *Sequence of operations* – Overhauling consists of the following operations in sequence:

(a) Shallow screening and making up of ballast.

(b) All items attended to, while doing through packing as detailed in **Para 607**.

(c) Making up the cess.

(2) *Shallow screening and making up of ballast* –

(a) For good drainage periodical screening of ballast is essential.

(b) In case of manual overhauling, the crib ballast in the shoulders should be opened out to a depth of 75 to 100 mm below the bottom of sleepers, sloping from the centre towards sleeper end. The ballast in the shoulders opposite to the crib as well as between the sleepers is removed to the full depth. A slope is given at the bottom sloping away from the sleeper end. The ballast is then screened and put back. Care should be taken to see that the packing under the sleepers is not disturbed and the muck removed is not allowed to raise the cess above the correct level.

(c) Two contiguous spaces between sleepers should not be worked at the same time.

(d) Screening should be progressed in alternate panels of one rail length. In no circumstances should several rail lengths of track be stripped of ballast simultaneously.

(e) Where drains across the track exist, they should be cleaned and filled with boulders or ballast to prevent packing from working out and forming slacks.

(f) After screening, full ballast section should be provided, extra ballast being run out in advance for the purpose. Work should be commenced after making sure that the ballast will not be seriously deficient. Deficiency, if any, should be shown in the central portion of sleeper and this also should be made up soon.

(3) Through packing of track – The detailed operations are described in **Para 607.** Through packing may be done preferably by using machines and in unavoidable situations by conventional beater packing.

(4) Making up of Cess – Cess when high should be cut along with overhauling and when low should be made up. A template should be used for this purpose.

(5) Overhauling should be completed before the end of March.

(6) *Overhauling of SWR/LWR/CWR track* – In such cases the relevant provisions detailed in **Para 324 & 345** should be followed.

609(A) **Maintenance of Pathways** – Pathways provided to connect platforms or at any other identified locations like elephant crossings etc. shall be opened and overhauled with each cycle of machine or manual packing, or at a higher frequency as warranted by condition, and in no case shall the opening be delayed beyond two years. In all cases, rails and fastenings in contact with the pathway shall be provided with galvanized fittings. Alternatively, non-galvanized fittings should be thoroughly cleaned with wire brush and a coat of coal tar/anti-corrosive paint applied. Flange way clearances, cross level, gauge and alignment should be checked and corrected as necessary, and the track packed thoroughly before reopening the pathway for users.

(ACS – 10)

PART – B

Handling and Maintenance of Rails, Sleepers, Fastenings & Other Misc. Items

610 Handling and Stacking of Rails –

(1) Any carelessness in loading, unloading, handling and laying of rails is liable to cause damage, which will not only contribute towards bad running but also result in irreparable damage to, or incipient failures of rails.

(a) During loading and unloading, ramps of un-serviceable rails should be made and the rails slid over them, intermediate supports being given to prevent excessive sagging. Preferably, crane may be used for loading/unloading of single rails.

(b) For handling rails, slings or tongs should be used.

(c) When hauled into position, prior to linking or otherwise, rails should be so spread as to rest evenly along their entire length or on supports closely spaced and should lie on the foot.

(2) During any operation requiring marking of rails such as yard surveys, curve adjustments, and realigning operations etc., the marking on rail shall be done by paint mark only and chisel or punch marking is not permitted.

(3) The gas cutting of rails; and making of holes using gas is prohibited.

(4) While stacking rails, care shall be taken that :

(a) The ground is level and well drained.

(b) Free rails are supported at least at four points, evenly along their length; Welded rail panels shall be so spread on cess as to rest evenly along their entire length on supports spaced at 4 metre centre to centre to prevent formation of kinks.

(c) Each stack of the rail should be of the same section and class.

(5) Detailed guidelines on stacking of rails as contained in *RDSO's Guidelines for Handling and Stacking of Rails (No. CT-35)* may be referred to.

611 Inspection of Rails in Service –

(1) *General* - The detection of rail flaws is done by visual examination of the rail and by Ultra Sonic Flaw Detection (USFD) of rails.

(2) *Visual examination of rails* – Rail ends should be examined for cracks during the lubrication of rail joints by cleaning the surface of the rail by wire brush and using a magnifying glass. A small mirror is of assistance in examining the underside of rails. Such examination on important girder bridges and their approaches should be done twice a year under the supervision of JE/SSE/P.Way.

(3) *USFD testing of service rails* – No rail, untested by USFD, shall be laid in the track whether for new lines or layouts or renewals or for repair works or even temporarily such as service rails for PQRS work.

(4) The JE/SSE/P.Way carrying out the ultrasonic testing of rails shall be trained by RDSO. Detailed instructions for ultrasonic testing of rails and welds are contained in the “Manual for Ultrasonic Testing of Rails and Welds”.

612 Causes of Rail Deterioration – The principal factors causing rail deterioration are detailed below: (*Back to* ***Para 310 (2) (b)****)*

(1) *Corrosion and rusting* – Corrosion is caused not so much by the dampness as by acid gases dissolved in the film of moisture, which frequently coats the rails. Corrosion is generally noticed on the web and foot of the rail. Corrosion is generally heavy in the following locations:

(a) Platform lines where trains make prolonged halts.

(b) Sidings where saline or corrosive goods are dealt with.

(c) Near water hydrants due to insufficient drainage.

(d) Tunnels and deep cuttings.

(e) Areas near the seacoast.

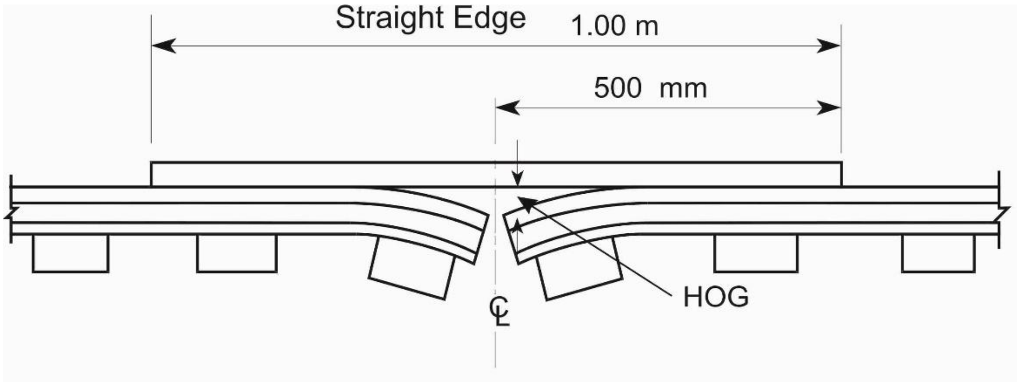
(f) Industrial belts.

(2) *Wear on rail table* – The wear of top table increases with higher traffic density as in suburban section, though not proportionately.

(3) *Flattening of rail table* – This mostly occurs on the inner rail of a curve because of higher contact stresses due to heavy axle loads, large un-sprung mass or under equilibrium speed on canted track, which causes slipping of wheel sets. Flattening of rail table is an indication of overloading on inner rail; and this tendency can be reduced, if appropriate cant is provided.

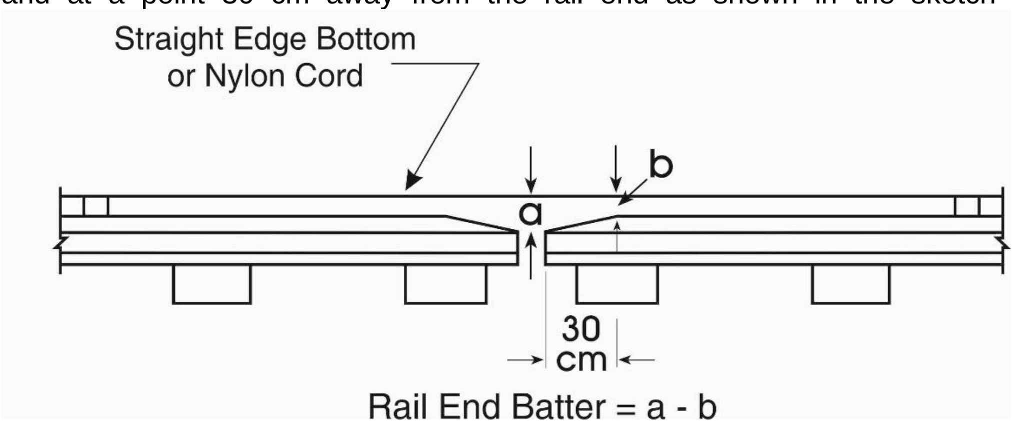
(4) *Wear on gauge face* – The outer rail of a curve has to withstand heavy pressure from the wheels, which results in the running edge becoming worn or 'side-cut'. Wear on gauge face is especially pronounced in case of suburban sections where rolling stock are provided with laterally un-sprung traction motors.

(5) *Hogging of rail end* – A hogged rail is one with its end or ends bent in vertical direction. A hogged rail end in the track is ascertained by un-fishing the joints, removing the fastenings and then measuring the extent of hog at the rail end by placing a 1 metre long straight edge over the rail table, centrally over the joint as shown in the sketch below:



Hogging of Rail – Method of Measurement

(6) *Battering of rail ends* – Rail end batter occurs where the joint gaps are excessive. It is caused by the impact of wheels on end of a rail particularly if the fishplates do not fit snugly. Rail end batter is measured as the difference in heights of the rail at its end and at a point 30 cm away from the rail end as shown in the sketch below:



(7) *Wheel burns* – Wheel slipping occurs usually on adverse gradients or while starting on rising grades when considerable heat is generated and top of the rail is torn off in patches, causing depressions known as wheel burns, from which cracks may develop. This also occurs when train brakes are applied suddenly and wheels lock and slide, or due to under-powering of trains. Wheel burns cause the wheels to hammer the rails and lead to difficulties in keeping the sleepers packed firmly and fastenings tight. Such rail should be kept under observation and changed, in case repair by welding is not feasible.

(8) *Corrugation* – In certain locations, rail table develops ridges and hollows called corrugation and when vehicles pass over these rails, a roaring sound ensues. Such rails are called "roaring rails". In such locations, excessive vibrations are caused, due to which fastenings and packing tend to get loose and track needs frequent attention.

(9) *Rail flaw* – During service life of rail, various other rail flaws like head checks, spalling, shelling, squats etc. may develop which may have to be attended.

613 Rail Maintenance to Reduce Rail Deterioration –

(1) Efficient maintenance of rails results in increased service life of rails. The following precautions/maintenance practices, if observed, will effectively reduce rail deterioration.

(2) Prevention of corrosion –

(a) Identification and measurement –

(i) Areas prone to corrosion of rails shall be identified by the Principal Chief Engineer of the Railway on the basis of reports sent by DENs.

(ii) In corrosion prone areas identified in accordance with above Para, measurement of depth of corrosion both vertically and laterally (reduction in bottom flange width of rail), shall be done using straight edge and feeler gauge or any other suitable device at a fixed periodicity of once in a year on every 100 sleepers by removing elastic rail clips and liners and such measurements shall be recorded in TMS by JE/SSE/P.Way as per **Annexure - 6/5**.

(iii) For new line/gauge conversion projects, corrosion prone areas shall be identified by CAO(C) in consultation with Principal Chief Engineer.

(b) Anti-corrosive painting –

(i) In case of the new rails to be laid during track renewal/doublings/other construction projects in identified corrosion prone areas, anti-corrosive bituminous coating as per procedure mentioned in (iii) below should be provided before laying in track. This should preferably be done in flash butt welding plants.

For severe corrosion prone areas, wherever possible, Zinc Metallisation in lieu of bituminous painting in centralized plant/flash butt welding plant can also be done. The Zinc Metallisation shall be done as per procedure laid down in *Technical Specification for Zinc Aluminium Metallisation of Rails (IRS: T-51).*

(ii) In case of rails that are already laid in track in identified corrosion prone areas, anticorrosive bituminous coating to rails should be given in the track itself as per procedure mentioned in (iii) below.

(iii) Surface preparation of rails shall be done, with the help of hand operated or power operated tools i.e. scrappers, wire brushes, sand paper, pumice stones etc. Wire brushing shall invariably be done at the end so as to obtain uniform rubbed surface.

The surface prepared shall be checked visually for uniformity of surface. Special care should be taken in surface preparation at weld collars and liner contact areas. Surface preparation should not be done when ambient temperature is below 10° C or above 50° C, in rainy season, during night, in winter before 8AM, in summer between 11AM to 3PM and in extremely windy/misty/dusty conditions. Chemical should not be used for surface preparation. Painting should be done in two coats of thickness of 100 microns each by anti-corrosive bituminous black paint conforming to IS: 9862 after an interval of 8 hours between two coats. All the liners and elastic rail clips shall also be painted with anti-corrosive black bituminous paint after duly cleaning the surface.

(iv) In identified corrosion prone areas, bituminous painting of rails shall be done once in a year on inside of gauge face including web and flange and once in three years on non-gauge face side of rail including web and flange. In other areas, wherever signs of corrosion are seen in isolated patches, prompt action for anti-corrosive painting shall be taken.

(c) *Greasing and sealing of liner contact area* – In identified corrosion prone areas, the rail liner seat should be greased using graphite grease *IS-408-1981 Gr. O* specification after proper cleaning. The grease is also applied all around the liner on the rail foot to prevent the ingress of toilet droppings in the gap between the liner and the rail foot. Greasing and sealing of liners contact area shall be done once in year for gauge face as well as non-gauge face side of rail.

(ACS – 3)

(d) *Shifting of liner locations* – Shifting of liner location on rail foot at regular intervals is desirable to ensure that the effect of corrosion is not allowed to build up at liner locations and render rails vulnerable to fractures due to increased depth of liner bite pits.Longitudinal shifting of liner location from the sleeper seat can be done when corrosion is less than 1.5mm. The extent to which shifting of liner bite location will be done during de-stressing shall be decided by the SSE/P.Way (In-charge).

After new rails are laid in an identified corrosion prone area, regular watch on the effect of corrosion shall be kept by taking measurement of depth of pits. Corrective measure should be taken by shifting of the liner biting locations/interchanging of rails at the time of de-stressing of rails in LWR/CWR track and pulling back rails in SWR/fish-plated track as per frequency and guidelines approved by the Chief Track Engineer based on local conditions.

(e) Rail flange/web should be kept free of the muck.

(f) Periodical cleaning of rubbish should be done in goods shed siding lines.

(g) Train watering arrangements should be avoided on the run through main lines as far as possible. Proper drainage should be ensured in yard/station lines including washing lines, washable aprons, Ballastless Track, train watering lines etc.

(3) Reducing side wear on rails - (Gauge face of outer rails):

(a) On sharp curves where the tendency of wear on the outer rail is noticeable, lubricators should be installed as per **Para 424** or hand lubrication of gauge face should be done, care being taken not to apply the lubricant on the top of the table. In case of hand lubrication, the DEN may decide frequency of lubrication duly considering local conditions and traffic on the line.

(b) Spot renewals should not be carried out with new rails, if the heads of the existing rails are worn badly. These should be spot renewed with matching sections of serviceable rails.

(4) Repairs to wheel burns, corrugations, rail flaws – This could be carried out at site by replacing the affected length or by grinding/milling of rail.

(5) Grinding of Rails – Rail Grinding is an important maintenance activity, which helps in improving the asset reliability, safety and service life by reducing the damage to the rail, wheel and other track components. Rail grinding machine can be used for

removal of wheel burns, corrugation and other rail flaws. Rail lubrication should be used as per the provisions of Para 424.

(6) Deployment priority of Rail Grinding Machine – The deployment of Rail Grinding Machines is to be done as per priority order given below:

1. Priority 1 – All 25 T loading routes.
2. Priority 2 – All CC + 8 loading routes having more than 10 GMT.
3. Priority 3 – All CC + 6 loading routes having more than 10 GMT.

614 Rail Closures on other than LWR Track –

(1) Permanent rail closure in running lines should not be less than 11 metre in length. However, on sections having maximum speed upto 100 Kmph, minimum length of permanent rail closure can be 5.5 metre.

Temporary closure, not less than 4 m, can be used with speed restriction of 30 Kmph.

(2) For locations such as –

(a) Tunnel

(b) Major and important bridges

(c) Deep cuttings

(d) High embankments

(e) Junctions of different types of rails and/or sleepers

(f) Points and crossings

(g) Including 500 metre length on both side approaches of all the above,

Permanent closure in running lines should not be less than 11 metre in length. Closure rails existing in track, which are less than 11 metre, should be welded at least at one joint on either side to make the minimum rail length of 11 metre between two adjoining fish plated joints. Until such time this welding is done and the length of at least 11 metre is achieved, speed restriction of 30 Kmph shall be imposed.

(3) Closures should not be located near each other, or opposite to each other. They should be separated by at least 39 m on the same rail (left or right rail) and 11m on opposite rails.

(4) Use of closures should be limited and reduced to the minimum possible.

615 Attention to Defective Rails and Welds Detected by USFD – On getting information about a defective rail or weld JE/SSE/P.Way shall take action in accordance with the **Para 6.4 and 8.14** of “Manual for Ultrasonic Testing of Rails and Welds” for provision of joggle fish plate and/or removal of defective rails or welds.

616 Casual Renewal of Rails – Casual rail renewal shall be done for replacement of defective rail, fractured rail, wheel burnt rail or old worn out rail. On detection of such defective rail, the affected rail length should be cut during block and the same should be replaced with serviceable rail duly observing all the precautions for SWR/LWR/CWR as the case may be.

For repairs and casual renewals, location-wise Imprest of tested rails of various lengths (13 m, 9 m, 6 m etc.) shall be prescribed for each JE/SSE/P.Way by Sr.DEN/DEN.

617 Rail Failures –

(1) *Action to be taken in case of rail failures* – When a rail fails in track, action as detailed below is to be taken:

a) Entry in the JE/SSE/P.Way section register as detailed in *Sub Para (2)* below.

b) Preparation of a detailed report of the failure in cases where applicable as laid down in *Sub-Para (3)* below.

c) Detailed metallurgical investigation in cases, where applicable, as per *Sub-Para (3) & (4)* below

(2) *Record of rail failures* – All the cases of rail failures have to be entered in TMS by the JE/SSE/P.Way as laid down in **Annexure - 6/6**. For this purpose, all failures whether in running lines, points and crossing rails etc. and irrespective of type and age of the rails, have to be entered in the section register. This record is intended to serve as a basic record, which should be available in the office of the JE/SSE/P.Way and will serve to furnish data, if required subsequently for any statistical analysis or for framing out proposals for track renewal works. Care should therefore be taken by the JE/SSE/P.Way for filling up all the details. The DEN and ADEN concerned shall frequently peruse the TMS records of rail/weld failures.

(3) *Reports of rail failures* – In addition to the records maintained, as detailed in *Sub Para (2)* above, a report has to be prepared as per **Annexure - 6/6** in all cases of rail failures occurring in track with the exception of the cases noted below:

- Rail failures occurring in non-running lines.
- Non-standard and obsolete rails.
- Accidental damages to the rails such as wheel burn and scabbing, buckling, kinks, derailments, abnormal slipping of loco wheels, excessive wear, loss of section by corrosion, battering, elongation of holes etc.

a) JE/SSE/P.Way will prepare a 'Rail failure' Report as per proforma (**Annexure - 6/6**), enter into TMS and forward to the ADEN, who will transmit with his remarks to the DEN, for onward transmission to the Chief Track Engineer and Executive Director (M&C)/RDSO/Lucknow.

b) In case of failures requiring metallurgical investigation, a copy of report should be sent to the Chemist and Metallurgist of the Zonal Railway along with the samples as detailed in the *Sub-Para (4 to 6)* below.

c) Sketches and photographs illustrating the fractures should also be submitted with the failure reports on each case duly indicating the running/gauge face of the rail.

d) It is particularly essential to record the type of failure in the failure reports against item No. 5.3 as per RDSO monograph "*Rail Failures - Description, Classification and Reporting*". The Executive Director (M&C) will arrange to carry out analysis of rail failures from the reports received from the JE/SSE/P.Way and the Chemist and metallurgical investigation and publish reports with suggestions for reducing failures.

e) In most cases, it is possible to determine the cause of the failure by visual examination/ultrasonic detection report without the need for metallurgical investigation however, in cases mentioned in *Sub-Para (4)* below, it is obligatory to take up full metallurgical examination by the Chemist and Metallurgist of the railway concerned with a view to ascertain the exact cause of failure.

f) In such cases the rail failure report should be made out in the prescribed proforma inserting the most probable code of failure against item No. 5.3 of rail fracture report proforma as given in **Annexure - 6/7**, and indicating whether the sample has been sent to the chemist and metallurgist for metallurgical investigation.

g) In cases, detected visually or by ultrasonic flaw detectors, the rail pieces of 1m length (500mm + 500mm) containing the flaw shall be sent for metallurgical test only from those rails which are removed from track based on the criteria for removal of rails and falling in the category listed in *Sub-Para (4)* below.

h) The test pieces for metallurgical examination are to be sent only for rail failures which occur within first 25% of service life subject to maximum of 10 years of rolling and for which detailed reports are to be prepared.

i) In case of repetitive failures of rails of same rolling mark, irrespective of the type of fracture/flaw, short rail piece of approximately 1m long (500mm + 500mm) containing the fracture/flaw detected visually or by ultrasonic flaw detector should be sent to the Chemist and Metallurgist together with a rail failure report for metallurgical investigation.

j) Chief track engineer of zonal railway shall forward the cases of repetitive failure of rails of same rolling mark on account of chemical & metallurgical reasons to Executive Director/M&C/RDSO along with investigation reports from Chemist and Metallurgist. The rail pieces of approximately 1m long (500mm + 500mm) containing the fracture should be sent to Executive Director/M&C/RDSO together with a rail failure report for metallurgical investigation where rail/weld failure is prima facie cause of train accident.

k) To sum up, test pieces to the Chemist and Metallurgist or RDSO, would be sent in either of the following condition

   i. The rail failure is within first 25% of service life subject to maximum of 10 years of rolling of rail, irrespective of the type of fracture/flaw.

   ii. The rails have been removed from track as a result of visual or ultrasonic detection and rail failure falls in categories listed in *Sub Para (4)* below.

   iii. The rail where rail/ weld failure is prima facie cause of train accident should be sent to RDSO.

   iv. The rails with repetitive failure of same rolling mark irrespective of type of failure.

l) In cases of failures of imported rails occurring within guarantee period, stipulation of Sub Para (5) shall be followed.

(4) Type of rail failures for which metallurgical investigation is required -

100/200 - Transverse breakage with apparent origin (sudden breakage)

1212/2212 - Head, surface, shallow surface defect (line).

1321/2321 - Web horizontal crack at top fillet radius.

1322/2322 - Web horizontal crack at bottom fillet radius.

1323/2323 - Web horizontal crack not at fillet radius.

238 - Web diagonal cracks not at a hole.

253 - Foot, vertical, longitudinal crack in foot half-moon break

1511/2511 - Foot transverse break at rail seat.

1512/2512 - Foot transverse break not at rail seat.

111/211 - Internal flaw in head, transverse breakage.

112/212 - Internal flaw in head, horizontal crack.

113/213 - Internal flaw in head, vertical longitudinal split

133/23 - Web, vertical longitudinal splitting

139/239 - Web, lap.

153/253 - Foot, vertical longitudinal split.

(5) *Failure of imported rails within the guarantee period* - In all cases of failure of imported rail occurring within the guarantee period, irrespective of the type of fracture/flaw rail piece approximately 1m long (500mm + 500mm) containing the fracture/ flaw detected visually or by ultrasonic flaw detector should be sent to the Chemist and Metallurgist

together with a rail failure report for metallurgical investigation.

(6) *Procedure for sending samples for metallurgical investigation* - In case of fractured rail, both the pieces of approximately 500 mm long each i.e. total 1m long containing fractured faces/flaw should be sent to the Chemist and Metallurgist for investigation. To avoid damage in transit, the fractured faces shall be protected with mineral jelly and suitably covered with hessian cloth. Cracked rails may also be suitably protected at the crack location to avoid damage in transit. Pieces having internal defects may be dispatched as such.

The Chemist and Metallurgist of the Railway will carry out metallurgical investigation, as required, and forward one copy of the report each to the Chief Track Engineer of the Railway and the Executive Director (M&C)/RDSO and the report shall be, attached to rail/weld fracture report previously uploaded, in the TMS by DEN/Sr. DEN.

In case of failures of imported rails within the guarantee period, attributable to manufacturing defects as revealed by metallurgical investigation, the Chief Track Engineer should immediately lodge a provisional claim with the manufacturer pending Executive Director (M&C)'s confirmation of the findings submitted by the Chemist and Metallurgist of the Railway.

The Executive Director (M&C)/RDSO will scrutinize the report submitted by the Chemist and Metallurgist and if he agrees with the findings as submitted, inform the Chief Track Engineer accordingly.

Where the Executive Director (M&C)/RDSO feels the need for carrying out further investigation before giving his verdict, he will call for the sample from the Chemist and Metallurgist of the Railway and carry out confirmatory tests, as necessary and intimate the findings to the Chief Track Engineer. On the basis of Executive Director (M&C)'s advice, the Chief Track Engineer will then finalize the claim with the manufacturer.

In case of failures of rails other than imported, the Executive Director (M&C)/RDSO will call for samples from the Chemist and Metallurgist, for confirmatory test, where necessary. Based on the trend indicated by the numerical analysis of the rail failures for the period under review, the Executive Director (M&C) will bring to the notice of the indigenous manufacturers and Inspecting Agency, any predominance of failures attributable to manufacturing defects, to enable corrective action being taken.

618 Action to be Taken in Case of Rail Fractures/Weld Failures – It is of Paramount importance that whenever a fracture of a rail/welded joint is noticed, immediate action is taken to restore the track, if necessary, with restricted speed, with the least possible delay.

(1) The Mate/Keyman/Trackman, as soon as he notices the rail fracture/weld failure should first protect the track. He should also send information to the JE/SSE/P.Way and the Station Master of the nearest station.

(2) If the fracture is with a gap of less than 30 mm, the fractured rail ends should be joined with fish plates and clamps.

(3) When the fracture gap is more than 30 mm, a closure of appropriate length should be used, and fish plated with clamps.

(4) In cases where a small portion or piece of rail has come off or in the case of multiple fractures, the rail has to be changed before allowing traffic.

(5) In the case of weld failure, joggled fishplates and clamps should be used.

(6) After carrying out the emergency repairs the trains may be passed by a Gang Mate/Keyman at speed prescribed in **Annexure - 3/8**, until the permanent way official replaces the rail. Trackman deputed as patrolman (railway employee) may also pass only the first train which is stopped by him in the course of protection of track after detecting rail/weld failure and after carrying out the emergency repairs, if he feels confident of passing the train.

619 Lubrication of Rail Joints –

(1) The purpose of lubricating rail joints is not only to facilitate expansion of rails but also to retard wear on the fishing planes of the rail and the fishplate. Reduced wear on the fishing planes is one of the preventives of the low joints.

(2) A stiff paste of plumbago (Graphite) and kerosene oil, made in the proportion of 3 kg of plumbago to 2 kg of kerosene oil may be used as lubricant. Black oil or reclaimed oil may be used for fish bolts and nuts. Alternatives to the above may be used, with the specific approval of Chief Engineer.

(3) All rail joints should normally be lubricated once a year on a programmed basis during the cold weather months after the monsoon, from October to February. Lubrication should not be carried out in extremes of weather both hot and cold. On non-running lines, this period may be extended to 2 years with the approval of the Chief Engineer.

(4) Creep in excess of 150 mm should be adjusted before the work of lubrication of rail joints is undertaken.

(5) The lubrication of rail joints should normally be carried out by gangs working under the direct supervision of at least JE/P.Way. The work should be carried out under caution orders arranged to be issued daily by the JE/SSE(P.Way) and under protection of engineering signals or under traffic block, as per **Para 806** The procedure to be followed will be as below –

a) The nuts are unscrewed and the fish bolts and fishplates are removed.

b) The fishing surfaces of the fishplates and rail are then cleaned with a wire brush.

c) The rail ends are inspected for cracks and the fishing surfaces of rails and fishplates are checked for wear. A magnifying glass and a mirror should be used for detecting cracks in rail ends and fishplates.

d) The fishing surfaces of the rails and fishplates are then lubricated.

e) The fish bolts are then put back in reverse position and tightened using a standard fish bolt spanner, the inner two bolts being tightened first.

f) While tightening overstraining of bolts shall be avoided.

g) Spare fishplates and bolts should be available for replacement of cracked ones.

(6) The Chief Engineer may issue subsidiary instructions as necessary.

(7) The lengths over which the rail joints are lubricated together with dates shall be recorded in the TMS. In the month of April, SSE/P.Way (In-charge) should submit the certificate of lubrication of rail joints giving reasons for any exception to the ADEN. Copies of these certificates should be forwarded with the ADEN's comments to the DEN for scrutiny and record.

(8) During all works such as relaying, rail renewals and renewals of turnouts, etc. rail joints should be lubricated. All such joints those have been lubricated by the gang should be checked and retightened by Keyman during his routine patrolling.

(9) Insulated joint fishplates should not be greased.

620 Maintenance of Rail Joints –

(1) Special care is needed for maintenance of fish-plated joints to get better rail life as well as improved running.

(2) The hammering of the fishplates is forbidden. For removing a fishplate, which has seized to the rails, the fishplate may be tamped gently by a hammer, by interposing a wooden piece.

(3) Over tightening of fish bolts shall be avoided. Mechanical/light weight battery operated

torque wrenches with predetermined torque should be used. Alternatively, Fish bolt spanner of standard length shall be used. When tightening bolts, the two central bolts should be tightened first.

(4) *The efficient maintenance of joint depends on* –

(a) Efficiency of elastic fastenings.

(b) The efficiency of packing and correct spacing of sleepers.

(c) The provision and maintenance of correct expansion gaps.

(d) The proper lubrication and fishing of the joints.

(e) The correct maintenance of gauge and cross level.

(f) Efficient drainage.

(5) *Defects in rail joints* – Some of the major defects, noticed at the rail joints and the preventive measures suggested to rectify or minimise the deficiencies /defects noticed are detailed below:

(a) Slack sleepers – During packing ballast below sleepers, it should be ensured that the sleepers do not get tilted.

(b) Loose fish plates – Fish bolts must be kept tight but not so tight as to prevent expansion or contraction of rails.

(c) Wear of fish plates and rails at fishing surfaces – When wear takes place on the fishing planes of rails and fish-plates, the joint dips down. The wear is generally more at the centre of the top of the fishplates and less at the ends. Corrective action should be taken by providing tapered shims or by replacing the rail end.

(d) Battering of rail ends – Battering can be avoided by packing the joint sleepers firmly and by maintaining correct expansion gaps. Battering of rail ends can be repaired by end cropping.

(e) Hogged rail joints – Cropping of rail ends can eliminate hogging. The use of repressed fish plates also helps in improving the hogged joints. De-hogging machines can be used for this purpose.

(f) Broken fish plates – Broken or cracked fishplates must be replaced.

(g) Cracked or broken rail ends – The fish bolt and bond holes at rail ends weaken the rails, which might result in rail end fractures. Chamfering of boltholes and bond holes should be done.

The fracture normally starts as a fine crack from the fish bolt or bond holes. During lubrication of rail joints, opportunity should be taken to observe the rail ends carefully for presence of fine cracks.

If cracks are noticed, rails should be replaced. Ultrasonic testing of rails helps in detecting the cracks, which are difficult to detect by visual examination.

(h) Pumping of joints – Immediately after the monsoon, the ballast at such joints should be removed and replaced. Cross drains should be provided between first and second shoulder sleepers.

(6) *Other important points regarding joint maintenance* –

(a) Gap survey should be undertaken periodically and gap adjusted, as detailed in **Para 320.**

(b) Ordinary fish-plated track could be converted into three-rail panel, wherever all other conditions for SWR are satisfied, to minimize number of fish-plated joints.

(7) *Chamfering of bolt holes in rails* –

(a) General –

(i) Chamfering of boltholes work hardens the periphery of holes and thereby delays the formation of star cracks. Each drilled hole, including holes done for providing structural/continuity bonds by Electrical/S&T departments, shall be chamfered.

(ii) Existing boltholes, if elongated, should be removed; new holes drilled and chamfered.

(iii) Chamfering of bolt holes should be done with approved chamfering kit. Procedure for chamfering of boltholes shall be as per the manufacturer's manual accompanying the equipment.

(b) Bolt holes in new rails received directly from steel plant should be chamfered before rails are laid in track.

(c) Chamfering of boltholes in the welded rail panels should be done before despatch in the Flash Butt Welding Plants.

(d) When rails in track are end-cropped, new boltholes should be chamfered at site.

621 Fish Plate Failures –

(1) A fish-plate is said to have failed if it fractures or cracks for reasons other than service wear and tear, accidents, or excessive wheel grazing noticed on it, and it becomes necessary to remove it from track.

(2) Renewal of worn fishplates should be considered when condition so warrants.

622 Inspection and Maintenance of Insulated Rail joints/Glued Joints – (*Back to **Para 223***)

(1) General - There are two types of insulated rail joints provided for track circuiting:

(a) Fish plated insulated joints **–** Insulating components of this type are provided and maintained by S&T department. Rail ends shall be provided as square and smooth, battered ends should be rectified and gap between rails, if large, should be adjusted. The fish plated joint shall be kept tight and ballast well packed in the vicinity of joints to prevent undue movement of rail ends. JE/SSE/P.Way and JE/SSE/Signal should carry out the joint inspection of such insulated joints once in year and observations recorded in TMS.

(b) Glued Insulated Joint **-** The G3L type glued joint should be provided on all run through lines. The glued joints should be tested for insulation resistance as per **Para 3.3 & 3.5** of **"***Manual for Glued Insulated Rail Joints***"** both in dry and wet condition before laying on track and in service.

(2) *Laying and maintenance of insulated joints* –

(a) Insulated joints, wherever provided, shall be maintained as square joints.

(b) Rail ends of the insulated joints shall be square and the gap between the rails should be equal to the thickness of the end post.

(c) The metal burrs at the end, if any should be removed well in time to avoid short-circuiting.

(d) Fish bolts at the insulated joints must be kept tight and the sleepers well packed in the vicinity of the joints.

(e) Rail ends shall be kept free from brake dust, dirt, sand, rust, other foreign materials etc.

(3) *Maintenance of glued insulated joints* –

(a) The ballast used in track in the vicinity of glued insulated joints shall be clean to ensure efficient packing and drainage.

(b) Care should be taken to see that the ballast is clear of rails and rail fastenings.

(c) In glued joints, normally no relative movement occurs between rails and fishplates.

In case, failure of joints occurs by separation of rail, fishplate surfaces with consequent relative movement, fishplates crack/breakages etc., the damaged glued joint shall be refurbished/replaced. Refurbishing shall be done as per "*Technical Specification for Re-Furbishing of Existing Glued Insulated Rail Joints and In-Situ Fabrication of Glued Insulated Rail Joints (provisional)*".

(d) The track at glued joint and its vicinity shall be kept clean with efficient drainage.

623 Laying of PSC Plain Track Sleepers – (*Back to **Para 625***)

(1) General – PSC sleepers shall be laid and maintained square to the rails on straights and radially on curves. The rail joints should be suspended.

(2) Relaying with mechanical equipment should be adopted while carrying out track renewals with concrete sleepers, as the manual handling of concrete sleepers is difficult and may cause damage to the sleepers.

(3) The preliminary (preparatory) work prior to relaying at site, the actual relaying process at site and the post relaying operations are described in detail in "*IRTMM".*

(4) Operations Connected with manual relaying –

(a) Manual Laying will not normally be adopted except under exceptional circumstances

(b) Loading and unloading – Concrete sleepers shall be placed perpendicular to the length of the BFR. Manual unloading, if unavoidable, shall be done sleeper by sleeper. Wooden or steel sleepers provided with hooks at the top ends for gripping the side of the BFR shall be used as ramps for sliding the sleepers down to the cess level.

Damage by over-running shall be prevented by placing the lower ends of the ramps either inside an old motor truck tyre or between gunny bags filled with wood shavings and the sleeper allowed to move down the ramp. Two men shall stand on the cess with crowbars planted into the cess and control the downward sliding of the concrete sleepers

After unloading, the sleepers shall be placed on the cess approximately alongside the final position.

(c) Laying procedure – The following procedure shall be adopted for manual laying of concrete sleepers under block protection –

(i) Just prior to the line block, a speed restriction of 20 Kmph shall be imposed on the portion to be re-laid during the block and rail sleeper fastenings shall be removed from the alternate sleepers. Ballast cribs between sleepers shall be exposed upto bottom level of sleepers. It shall be ensured that the number of sleepers taken up for replacement during the line block period shall not be more than that which can be given at least one mechanical tamping with 'on track' tamper before the first train is allowed after the replacement of the sleepers.

(ii) After taking the line block, the rails over the length to be dealt with during the line block period shall be disconnected and removed. The sleepers shall then be taken out, taking care to disturb the ballast bed only to the minimum extent.

(iii) The new concrete sleepers shall then be laid in position by means of sleeper slings taking care to ensure the correct longitudinal and lateral alignment. When the sleepers are being placed in position, the prepared ballast bed should be disturbed only as little as possible. Care should be taken not to damage the edges of the sleepers or to chip the concrete. After the sleepers are placed, rubber pads shall be placed at the rail seats. Elastic clips shall be loosely fastened at this stage. If the original rails are to be continued after relaying, the track rails shall be laid and connected on either side.

(iv) After the sleepers are packed, the rails shall be secured in position by inserting liners and elastic rail clips and firmly fastened.

(d) Renewal of concrete sleepers without block protection can be carried out along with manual deep screening as given in **Para 637**.

624 Laying of Fan Shaped Turnout Sleeper –

(1) *Loading of PSC turnout sleepers in BFRs* – Sleeper of the approach and sleepers meant for lock bar crank are loaded at right angles to the track. The remaining sleepers are loaded Parallel to the track on the BFRs. Suitable nos. of wooden battens to support the sleepers in between layers of turnout sleepers will be used as in case of main line sleepers to prevent damage.

(2) *Unloading* – Depending upon the process of laying of the turnout adopted, the sleepers shall be unloaded either near the proposed location on firm & level ground or adjacent to a nearby siding or on a goods platform by means of a crane. While unloading, due care shall be taken that the sleepers or the inserts are not damaged.

(3) *Site preparation for laying* – Ensure that a clean ballast cushion of 30 cm below the bottom of sleeper is available. The ballast bed has to be perfectly level. Enough ballast shall be stacked along the cess to enable the filling of ballast in the cribs on the same day. Longitudinal and cross drains may be provided in turnout area to avoid accumulation of water. The site preparation to be completed well before laying turnout ensuring deep screening of ballast in turnout length and 30 m on either side along the track.

(4) *Assembling* – Ensure the availability of all fittings at site strictly as per requirement of latest drawings for switch portion, lead and crossing portion. The complete turnout will be assembled on a level ground adjacent to the site of laying or on the loop line connected to turnout. Red/blue rounded marking on the sleepers should invariably be kept on the right hand side irrespective of left hand or right hand turnout.

Spacing of sleepers should be strictly as per layout drawing. The sleepers shall be perpendicular to the straight track in switch portion only. In lead portion, the sleepers will be inclined at half the angle between the normal to straight and curved track at that point.

To ensure correct layout, laying of sleeper falling at transition from switch to lead and lead to crossing portion should be paid special attention. Sleepers in the switch portion, lead portion and crossing portion are as under –

Turnout	Switch	Lead	Crossing
1 in 8½	1 to 13	14 to 41	42 to 54
1 in 12	1 to 20	21 to 64	65 to 83
1 in 16	1 to 20	21 to 75	76 to 101

The spacing of the sleepers in the switch, lead and crossing portion should be as per standard RDSO layout drawing to make a radial or fan shaped layout. The spacing has been worked out separately for both the rails. The sleepers in the crossing portion shall be perpendicular to bisector line of crossing angle. Long Sleepers in switch portion meant for providing motor may be placed for housing motor with the extended portion of sleeper in reverse direction only in circumstances where it cannot be avoided.

The approach sleeper in advance of switch portion should be provided without fail, they are for gradual elimination of slope of rail top (1 in 20). The exit sleepers behind the crossing portion should also be provided for gradual introduction of rail slope (1 in 20).

(5) *Insertion of pre-assembled turnout* – The complete assembled turnout shall be inserted in position by using T-28 machine as one unit or after breaking it into three panels viz. Switch, lead and crossing portions by means of T-28 machine or cranes or rollers.

(6) *Manual insertion* – In case the PSC turnout sleepers are to be manually inserted, then the same must be done sleeper by sleeper ensuring that at no time the alignment and level is beyond permissible limits. This work may be done under a suitable speed

restriction if necessary and adequate mechanical means for packing the sleepers must also be available.

625 Casual Renewal of Concrete Sleepers – While carrying out casual renewal of Concrete sleepers, manual handling becomes necessary and precautions indicated in **Para 623 (4)** should be observed. In addition, the provisions relating to LWR/CWR regarding the precautions to be taken for casual renewal of sleepers shall be followed. Special care shall be taken to consolidate the shoulders of the ballast section after renewal of the sleepers.

626 Corrosion of Steel in Concrete Sleepers – Both the ends of concrete sleepers should be painted with an approved type of anti-corrosive paint at the concrete sleeper manufacturing plant to prevent corrosion of the exposed ends of pre-stressing wires.

627 Maintenance of Concrete Sleeper Fastenings –

(1) *Elastic Rail Clips* – The essential feature of the elastic rail clip is the correct driving of the clip, which should be checked by the Keyman during his daily petrol. The clip should be driven so that the leg of the clip is flush with the end face of the insert. Over driving and under driving shall be guarded against by observations of the clips in position. The clips should be driven/taken out with clip applicator/extractor.

Over driving/under driving of the clip causes eccentric load on the liners and results in their displacement and variation of toe load. A vigilant watch should be kept to ascertain that no creep is taking place in any of the portion of the track or excessive movement near SEJs. The elastic fastenings should be checked for corrosion and corroded fastenings should be replaced.

(2) *Rubber Pads* – It must be ensured that the rubber pads are in correct position. Whenever it is found that the rubber pads have developed a permanent set, these shall be renewed. The loss of toe load can also be due to ineffective pads. The toe load should be checked regularly, as prescribed, and also if any creep is noticed resulting in excessive movements of the SEJs. In case of Composite GRSP, it shall be ensured that the manufacturer’s initials embossed on CGRSP are in contact with the rail bottom.

(3) *Metal Liners*- The liners should be inspected and fitted in proper position. Corroded/dent marked liners adversely affect the toe load and should be planned for replacement.

(4) *Insulating Liners* – Nylon/composite insulating liners used with clip shall be examined periodically for sign of cracking and breakage. Adequate care should be exercised while driving the clip at the time of installation to prevent damage.

On first laying, a small indentation on the nylon insulating liner will be formed due to the toe-load of the clip. This is not objectionable so long as the insulating liner does not crack. All cracked insulating liners should be replaced with fresh ones.

628 Renewal of Fastenings – Precaution during renewal of fastenings shall be taken as per the provisions of LWR/CWR (refer *Chapter 3, Part D*).

Large scale replacement of fastenings must be done under the supervision of JE/SSE/P.Way. The cause for large-scale development of defects must be investigated by ADEN.

(1) Periodicity of measurement of performance of Elastic Fastening Components –

Sample, Size and Testing frequency –

(a) Sample size – Toe load of elastic rail clip should be measured on 1% of ERCs randomly on every 100 sleepers (all 4 ERCs to be measured on one sleeper).

(b) Testing frequency – The testing of ERCs is to be done after four years or passage of 200 GMT of traffic, whichever is earlier. In corrosion prone area, the initial testing of ERC is to be done after two years or passage of 100 GMT, whichever is earlier

However, if 20% or more of sample size records toe load below 600 kg, both frequency of inspection and sample size are to be doubled.

Replacement of ERC –

(i) If 20% or more of sample size records toe load below 400 kg, which is to be confirmed by 5% sample size, proposal of through fastening renewal should be initiated.

(ii) The provisions given above are only for guidance of Railways. The Railways on the basis of the overall condition of track, pattern of traffic and the required level of maintenance should undertake the large scale replacement of the fastening.

(iii) Further, as the loss of toe load is reflective of conditions of other elastic fastening components like groove rubber sole plate, GFN/metal liners etc. as well, the railways may also record condition of these components along with measuring toe loads for elastic rail clips.

(2) *Measures to prevent corrosion and seizure of ERCs with MCI inserts* –

Initial treatment – At the base depot, all the elastic rail clips and MCI Inserts should be thoroughly cleaned. Grease to *IS: 408-1981(Specification for Grease Gr. 'O' Graphited)* should then be applied on the central leg of the ERC and eye of the MCI insert and then the clip should be driven at the time of assembly of the service panel.

Lubrication of ERCs – Grease Graphite to the specification *IS-408-1981 Gr. O* should be used for this purpose. This work should not be carried out during extreme of summer and heavy rainfall. At a time, ERCs should not be removed from more than one sleeper. If for any reason mass lubrication of ERCs is taken up, at least 15 sleepers shall be kept intact between any two sleepers taken up for lubrication of ERCs at the same time. The ERCs should be cleaned by wire brush and emery paper. The eye of the insert shall also be cleaned by suitable brush. After cleaning, grease graphite shall be applied to the inside surface of eye of insert and leg of ERC. Inside/Outside ERCs should be interchanged and fixed again.

The lubrication of ERCs and insert at the time of initial laying should be done and thereafter should be done once in a year in corrosion prone areas & platform lines and once in two years in other areas or more frequently as decided by PCE.

629 Steel sleeper for Bridges –

(1) *Maintenance* –

(a) After laying steel sleepers, tightening of all fittings including hook bolts should be done once in 15 days for initial one month. Thereafter it should be done once a month for next six months and subsequently it should be on need basis as observed by inspecting officials. Regarding hook bolts, **Para 631 (3)** should be followed.

(b) Guard rail fittings should be tightened once in three months for first six months and thereafter on need basis.

(c) The above will be in addition to daily attention by Keyman.

(d) Replacement of grooved rubber pads & elastomeric pads shall be done on condition basis.

(e) Suitable stock of spare fittings should always be maintained keeping different types of girders in view.

(f) Suitable quantity of the Steel sleepers along with fittings should be kept as emergency reserve. Emergency reserve stock of channel sleepers should be maintained keeping different types of girders in view.

(g) In case galvanized coating is damaged, it should be repaired.

(2) *Inspection of channel sleepers* –

(a) During intensive inspection, the condition of rivets, distortion or crack in sleepers or any sign of crack in girder flange and tightness of fittings should be looked for. All loose fittings should be tightened after inspection. If required, for few days in the beginning, a watch may be kept depending upon the need.

(b) During joint inspection, the effectiveness of insulation in track-circuited areas should also be checked.

630 Inspection and Maintenance of Track on Approaches of Bridges –

(1) For all bridges –

(a) On the bridge approaches, sleepers with arrangement for fixing guard rails should be provided for provision of guard rails as per **Para 228**.

(b) Full complement of track fittings at bridge approaches up to 100 metres should be provided to maintain required track geometry and effort should be made to immediately recoup deficiency noticed, if any.

(c) Rail level of track at approaches of bridges should be maintained as per designed L-section and dips in rail level immediately after the abutments should be avoided. The alignment and super elevation in case of curved track should also be maintained as per provisions of Chapter 4.

(d) Rail joints should be avoided within three metres of a bridge abutment.

(e) In case of LWR/CWR track, full ballast section as specified should be provided up to 100 metres from the abutment.

(f) Switch expansion joints should be provided at the bridge approaches in LWR/CWR track as per provisions (Refer *Chapter 3, Part D*).

(g) Joggled fish plate with clamps or two far end bolts on good AT welds shall be provided on bridges having length of water way as 100 m or more and on approaches upto 100 m length.

(2) In addition, for important and major bridge approaches, for a length of about 100 metres, width of cess should be 90 cm clear of full ballast section to maintain ballast profile.

(3) For maintaining ballast section, suitable ballast retaining arrangement should also be provided.

631 Inspection and Maintenance of Track on Bridge proper – (*Back to **Para 629***)

(1) *Condition of track* – It should be ascertained whether track is central on the rail bearers and main girders and in good line and level. Departure from good alignment is caused by incorrect seating of girders, shifting of girders laterally or lengthwise, incorrect seating of sleepers on girders or rails on sleepers, varying gauge or creep.

Departure from level is caused by errors in level of bed blocks or careless sleepering. The adequacy of clearances of running rails over ballast walls or ballasted girders at the abutments and condition of sleepers and fastening on the run off and skew spans should be inspected.

(2) *Sleepers* – The condition of sleepers and fastenings should be checked. The spacing of sleepers should not exceed the limits laid down in **Para 227 (2).** Squareness of sleepers shall be ensured. Sleepers requiring renewals should be marked with paint and renewals carried out.

(3) *Hook Bolts* – Hook bolts shall, preferably be galvanised. These should be checked for their firm grip. Position of arrows on top of the bolts should be at right angles to the rails pointing towards the rail. Hook bolts, if not galvanised, should be oiled periodically to prevent rusting.

(4) Creep and joint gaps should be checked and rails pulled back wherever necessary. Rail fastenings should be tight. Defective rails should be replaced. Where switch expansion joints are provided on the girder bridge, it should be ensured that free movement of the switch is not hindered.

(5) *Guard rails* – Adequacy of guardrail arrangements should be checked. Correct distance between the running rail and guardrail should be maintained as per the prescribed dimensions.

(6) On girder bridges adequacy of pathways for inspection should be checked.

632 Maintenance of Yard Lines – Train movement takes place through yard lines though at a slower speed. Normally track recording to these lines is not covered by TRC/OMS; hence, track Parameters on these lines will have to be measured manually or mechanized means.

Measurement of track parameters will be recorded as per proforma given in Annexure - 6/10 once in three months for passenger running loop lines including cross overs and once in six months for all other running & non-running lines including cross overs. Records of measurement and action taken will be kept in the form of registers, which will be countersigned by ADEN and SSE/P.Way (In-charge) during their Foot/Push Trolley inspections.

The defects noticed during inspection of yard lines shall be attended by deploying the gangs or machine.

Preferably, all passenger loop lines should be maintained by track machines and other loops can be maintained by manual/mechanised methods.

(ACS – 3)

633 Sand Hump / Dead End - Sand humps and dead ends are provided to give the required signal overlap. These are safety works and brought in to use when trains overshoot starter signals at danger. All sand humps shall be laid as per standard RDSO drawing as given in figure below. A sand hump or snag dead end shall not be obstructed for any purpose and when it has become obstructed, it shall cease to be a substitute for the adequate distance for the purpose of taking 'off' signals. **(See Fig. 6.1)**

634 Sample of Standard Section of Track – At or near the commencement of each gang length between stations a sample of three rail lengths of track should be maintained in accordance with all standards laid down as given below:

(1) Formation of standard width and level below rail.

(2) Clean ballast of correct size, quantity and cross section.

(3) Correct alignment, level and gauge.

(4) Sleepers and fastenings in good condition.

The object of the sample track is to indicate the standard to which the track should be maintained throughout the gang length.

635 Checking Work of Gangs by JE/SSE/P.Way –

(1) *Examination of gang's work* – The work done by a gang either on the previous day or during the interval when the JE/SSE/P.Way is next with the gang should be examined for alignment, surfacing and boxing throughout. The JE/SSE/P.Way should inspect rails and sleepers and their fastenings and check cross levels, gauge, squareness of sleepers, packing, joint maintenance, profile of ballast and depths of cess below rail level. The Mate's Muster Sheet should be checked and initialled. Instructions to the Mates should be recorded in the gang diaries.

(2) *Examination of tools and equipment –*

(a) The JE/SSE/P.Way should examine every month and replace, when necessary, worn out tools and equipment.

(b) The JE/SSE/P.Way should check the accuracy of the spirit level/gauge and straight edge every month, the result of this examination being entered in the Mate's diary book.

(c) Each gang should have the following minimum equipment –

(i) Level-cum-gauge.

(ii) Two set of hand signal flags, red and green (2 hand signal/LED lamps at night).

(iii) 10 detonators.

(iv) Steel scale 30 cm long.

(v) Straight edge 1 metre long.

(vi) Square.

(vii) Hemp cord.

(viii) Keying and spiking hammer.

(ix) Marking chalk.

(x) Rail thermometer.

(xi) Sufficient No. of shovels, powrahs, beaters, crow-bars, ballast-forks or rakes, mortar pans or baskets.

(xii) Wooden mallet or Canne-a-Boule.

(xiii) Feeler gauge.

(xiv) 2 no. whistle thunderers.

(xv) Jumper and Gloves (for electrified section) – 02 sets.

(3) *Instructions and counselling* – JE/SSE/P.Way should ensure that every man in each gang is aware of the following rules in which the men should be examined periodically and on appointment, promotion or transfer:

(a) Protecting the lines in an emergency or during work affecting the running of trains

(b) Method of fixing and safety range of detonators.

(c) Showing of signals with or without hand signal flags during day and with hand signal/LED lamps during night.

(d) Action to be taken when a train is noticed to have parted.

(e) *'Safety first'* rules.

(f) Patrolling of the line during heavy rains / storms and hot weather on LWR lengths. The JE/SSE/P.Way should instruct the men for the proper use of tools and upkeep of the road. The instructions should not be of a casual nature; they should be demonstrative.

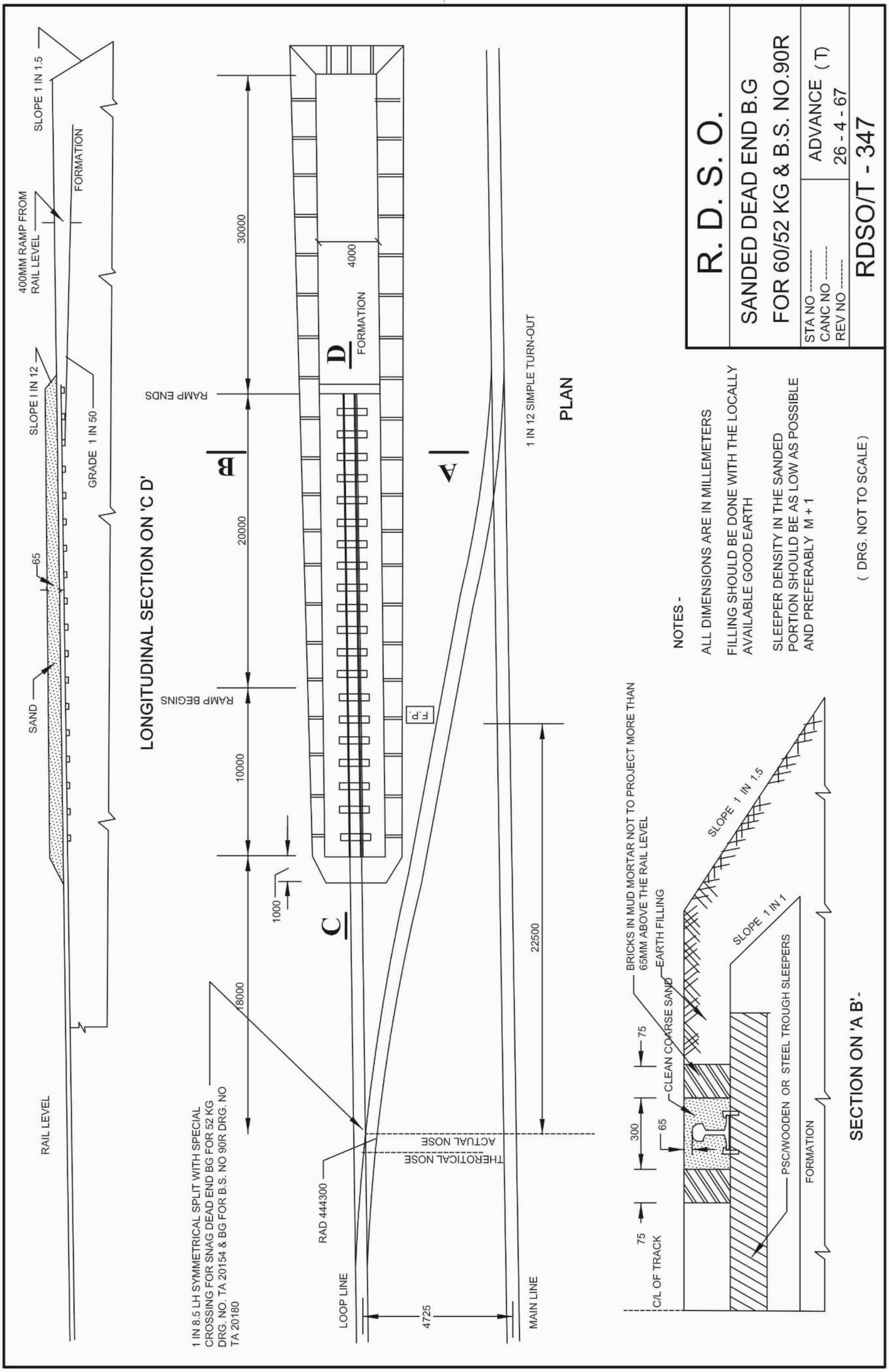


Fig. 6.1 – Sand Hump

PART – C

Works Incidental to Regular Track Maintenance

636 Deep Screening of Ballast -

(1) *General –*

(a) It is essential that track is well drained for which screening of ballast should be carried out periodically as described in *Sub Para (2)* below**.** Due to presence of bad formation, ballast attrition, excessive rainfall and dropping of fines and ore, ballast gets choked up and track drainage is impaired. In such situations, it becomes necessary to screen the entire ballast right up to the formation level /sub-ballast level. Further, through screening restores the resilience and elasticity of the ballast bed, resulting in improved running quality of track. Such screening is called "Deep screening", as distinguished from shallow screening, which is done, during overhauling.

(b) The need for intermediate screening between track renewals may be decided by the Chief Engineer depending on the local conditions.

(c) At the time of deep screening, standard ballast section should be provided invariably.

(d) Side drains in cuttings, yards etc. should also be restored after deep screening.

(e) In case of the bad formation, formation treatment should be carried out along with deep screening.

(f) The work of deep screening should be carried out continuously from one end of the section to the other.

(2) *Criteria for deep screening -*

Deep screening should be carried out in the following situations by providing full ballast cushion:

(a) Prior to complete track renewal.

(b) Prior to through sleeper renewal.

(c) Where the caking of ballast has resulted in unsatisfactory riding.

(d) Before converting existing track, fish plated or SWR into LWR or CWR, unless the ballast was screened in recent past.

(e) In addition to (a) and (d) above, criteria for deep screening during regular maintenance shall be as follows.

(i) Main Lines and Turnouts on Main Line: Proposal of deep screening works shall be initiated in Works Programme, when clean ballast cushion is less than 200 mm. Deep screening shall be carried out before clean ballast cushion reaches below 150 mm.

(ii) Passenger Running Loop Lines, Goods Running Loop Lines the derailments on which may affect the traffic movement on main lines or passenger running loop lines and turnouts on these lines: Proposals of deep screening works shall be initiated in Works Programme, when clean ballast cushion is less than 200 mm. Deep screening shall be carried out when clean ballast cushion reaches around 150 mm.

(iii) All other loop lines and turnouts on these lines: Deep screening shall be carried out when clean ballast cushion is less than 100 mm.

(ACS – 1)

637 Procedure for Systematic Deep Screening - (*Back to* ***Para 623***)

(1) *By manual method (not applicable to LWR sections)* –

(a) Survey – Before deep screening of a section is undertaken, it is necessary to survey the section. This will consist of the following operations:

(i) A longitudinal section of the track should be taken indicating the rail levels at every 30 metres, and also at changes of the grades, obligatory points like culverts, bridges, overhead structures, tunnels, level crossings, signal gantries, and points and crossings etc.

(ii) In station yards, on run through lines, cross sections at every 50 metres should be taken and plotted including platform levels, rail levels and clearance to underside of overhead structures.

(iii) On the basis of longitudinal and cross sections, the final levels will be decided by the DEN, keeping in view the depth of ballast cushion to be provided and the relative implications of lifting or lowering of track.

(iv) The possibility of eliminating humps, sags, and unevenness in the existing longitudinal section to be explored. It is not necessarily the intention that the original longitudinal section of the line should be restored.

(b) Preliminary Works -

(i) Additional ballast required, should be unloaded/spread out opposite to the place where it is required. When ballast is collected along the track, care should be taken to see that the new ballast is not mixed with the unscreened ballast.

(ii) Cess should be brought up to correct level in relation to the final rail level.

(iii) Pegs should be provided at intervals of 30 metres to indicate the final rail levels.

(iv) Slewing of curves should be done in advance.

(v) Sleeper renewal as necessary should be carried out in advance.

(c) Screening operations – General:

(i) The work of deep screening would be done under the supervision of an official not lower in rank than the (JE/P.Way).

Note – For LWR/CWR track, provisions given in Chapter 3 shall be followed.

(ii) The daily output should be predetermined, depending on the time allowance, availability of labour, extent of ballasting/screening to be done etc.

(iii) Taking the length to be deep screened daily, planning of speed restriction should be done and necessary notice should be issued to all concerned and speed restriction boards put up.

(iv) It will be desirable to proceed with the work of deep screening in the direction opposite to that of the traffic on double line.

(d) *Detailed procedure* – A day's length will be deep screened as per the procedure detailed below:

Stage I - The ballast should be removed from space 'A' and 'B' on either side of the sleeper '1' down to final formation level and wooden blocks provided to support the rail for passing trains.

Stage II - The ballast is removed from under sleeper '1' down to final formation level/sub ballast level.

Stage III - The ballast should then be screened and placed back under sleeper '1' which should then be packed.

Stage IV - The wooden blocks from space 'A' should then be removed.

Stage V - The ballast from space 'C' down to formation level should be removed and after screening, be placed in space 'A' upto bottom of sleeper. The balance may be taken outside the track and screened. The rail in space 'C' should be supported with wooden blocks.

Stage VI - The ballast should be removed from under sleeper '2' down to formation level.

Stage VII - Screened ballast should be provided under sleeper '2' and sleeper well packed.

Stage VIII - The ballast from space 'D' down to formation level should be removed and after screening, be placed in space 'B' upto bottom of sleeper; the balance may be taken outside the track and screened. The wooden blocks should be removed from space 'B' and placed to support the rail in space 'D'.

Stage IX - The ballast from under sleeper '3' should be removed and so on till the whole rail length is provided with screened ballast upto level of the bottom of sleepers.

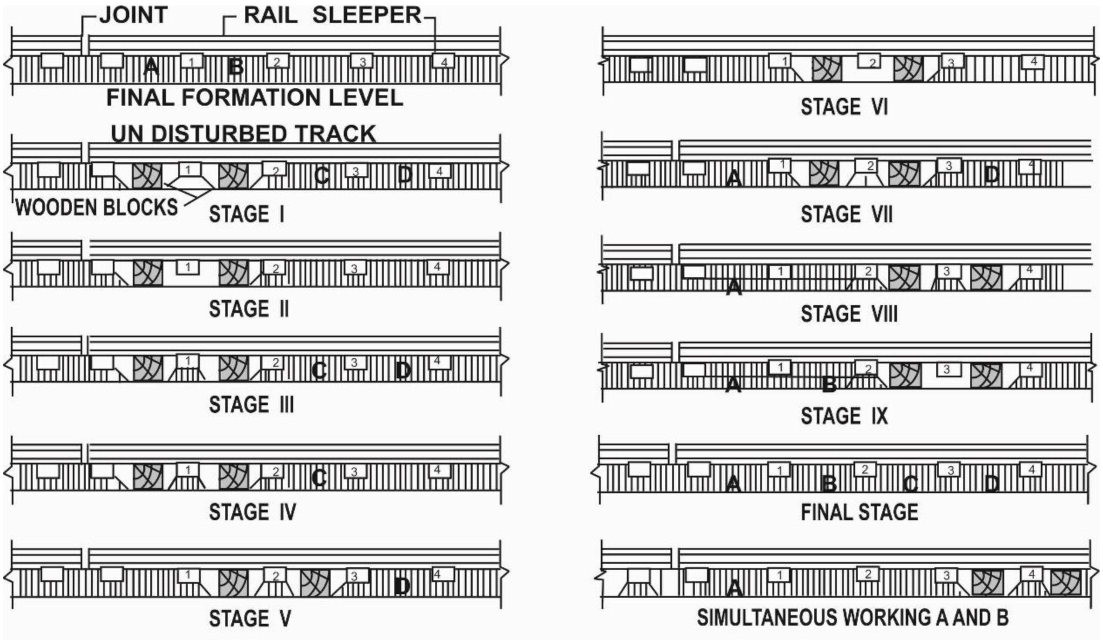


Fig. 6.2

Final Stage - The track should be lifted to provide additional cushion where required. The track should be packed in the final position and then boxed. Sequence of the operations is shown in the **Fig 6.2** above.

(e) The following points may be kept in view while doing the work –

(i) No unscreened length should be left between screened lengths of the track at the same time.

(ii) It should be ensured, that when ballast is being removed from any sleeper, invariably, there are at least four fully supported sleepers between it and the next sleeper worked upon.

(iii) Lifting should be limited to 50 mm at a time.

(iv) It should be ensured that packing, cross-levels and grade run off are satisfactory before closing the day's work.

(v) The work should be done under a speed restriction of 20 Kmph.

(vi) The speed should be gradually raised as in **Para (f)** below, which will vary depending on the type of maintenance in the section.

(f) Schedule for working and speed restriction to be observed, in deep screening works:

(i) *With manual packing* – The details of the work to be carried out in stages on various days, after the starting of the screening operation and the speed restriction recommended to be imposed are shown in **Table I.** According to the above schedule, normal Sectional speed can be resorted on the 21st day.

(ii) *With machine packing* – The details of work to be carried out in stages on various days after the start of the screening operations and the speed restriction recommended to be imposed are indicated in the schematic representation in **Table II**. According to this schedule, normal sectional speed can be resumed on the 10th day.

Table – I

Proposed Schedule for Manual Deep Screening (Manual Packing)

Day	Sequence of events	Speed in Kmph
1st	Deep Screening and initial packing	20
2nd	1st through packing	20
3rd	2nd through packing	20
4th to 9th	Picking up of slacks as required	45
10th	3rd through packing	45
11th to 19th	Picking up of slacks as required	75

Table – II

Proposed Schedule for Manual Deep Screening (Machine Packing)

Day	Sequence of Events	Speed in Kmph
1st	Deep Screening with Initial Packing	20
2nd	First Machine Packing	20
3rd to 5th	Picking up of slacks as required	45
6th	Second Machine packing	45
7th & 8th	Picking up of slacks as required	75
9th	Third Machine packing	75
10th	Normal Sectional speed	

(3) *Deep Screening with BCM (Ballast Cleaning Machine)* (*Back to* ***Para 346***)- The deep screening by BCM machine is to be carried out as detailed in IRTMM. The work of deep screening shall be followed by tamping and stabilisation of track with TTM (Tie Tamping Machine) and DTS (Dynamic Track Stabiliser) respectively. The work is to be carried out in stages on various days after the start of the screening operations and the speed restriction recommended to be imposed are indicated in the schematic representation in **Table – III**. According to the schedule, normal sectional speed can be resumed on the 8th day.

Speed raised to normal sectional speed, only after one round of tamping by machine in design mode and stabilisation in controlled settlement mode

Table— III

Schedule of Speed Restriction for Deep Screening By BCM Followed by Tamping and Stabilisation by Dynamic Track Stabilizer (DTS) Machine

Details of Work	Days of Work	Speed Restriction
Deep screening of track by BCM, ballast equalization followed by initial packing and initial stabilization by DTS in maximum settlement mode.	1st day	40 Kmph
First round of tamping followed by stabilization of track by DTS in maximum settlement mode.	2nd day (1st Tamping)	40 Kmph
Ballasting for recoupment of ballast deficiency (if required), boxing of ballast section and tidying.	3rd day	40 Kmph
Boxing of ballast section and tidying.	4th day	40 Kmph
Second round of tamping followed by stabilization of track by DTS in maximum settlement mode.	5th day (2nd Tamping)	40 Kmph
Survey of track for design mode tamping as per annexure 2.16 of IRTMM, boxing of ballast section and tidying.	6th day	75 Kmph
Inspection of track, boxing of ballast section and tidying.	7th day	75 Kmph
Third round of tamping in design mode followed by two rounds of stabilization of track by DTS in controlled settlement mode.	8th day (3rd Tamping)	110 Kmph
Footplate/last vehicle inspection and speed raising.	10th day	130 Kmph
Footplate/last vehicle inspection and speed raising.	12th day	160 Kmph
Note: The period of the schedule shown above can be suitably increased to suit local conditions of track consolidation. Full ballasting as per prescribed ballast profile to be ensured before the third round of tamping.		

(3) *Precautions to be taken during deep screening of track by BCM followed by TTM and DTS machines -*

(a) All precautions stipulated for LWR/CWR track (Chapter 3) shall be strictly followed.

(b) The cutter bar shall be removed after completion of day's work, ballast filled and packed & stabilized by TTM/DTS.

(c) Ramp shall not be located in locations like level crossing, Girder Bridge, transition portion of curve etc. It shall be kept minimum two rail length away.

(d) In case of malfunctioning of TTM and/or DTS, deep screening shall be stopped and track which has not been tamped and stabilized shall be attended manually by ballast ramming and correction of track geometry to ensure safety of running trains. Speed restriction shall be imposed and relaxed in terms of *Sub Para (1) (f) (i) or (ii)* above, whichever is the case.

(e) In case of non-availability of traffic block on subsequent days of deep screening by BCM, speed restrictions shall be imposed and relaxed in terms of *Sub Para (1) (f) (i) or (ii)* above, whichever is the case.

(f) When BRM is not deployed, adequate trackmen shall be deputed to recoup ballast, particularly in shoulder and maintain ballast profile after machine working.

(g) Lifting of track shall be resorted to after ensuring adequate availability of ballast for maintaining ballast profile for planned lifting.

(h) Adequate arrangements for supply and training out of ballast prior to deep screening should be made. Special care shall be taken by deploying watchman on stretches overdue for rail renewal.

638 Lifting of Track -

(1) Lifting of track will become necessary during re-grading and for elimination of minor sags, which develop through improper maintenance or yielding soil, to keep a good top.

(2) Correct level pegs should be fixed at suitable intervals, before lifting is commenced.

(3) Heavy lifting should always be carried out under suitable speed restriction and under the protection of corresponding engineering signals.

(4) The lifting should not exceed 50 mm at a time so as to allow proper consolidation. The easement gradient for the passage of trains should not be steeper than 25 mm in one rail length of 13 metres.

(5) The operation should be repeated until the required level is attained when the track should be finally ballasted, through packed and boxed, the cess being made up to proper level.

(6) Lifting should commence from the downhill end carried out in the direction of rising grade in case of single line. It should proceed in the opposite direction to traffic, in case of double line, care being taken not to exceed the easement grade.

(7) While lifting track under bridges and overhead structures and in tunnels, it should be ensured that there is no infringement of standard dimensions.

(8) In case of curves, it is usual to set the inner rail to the correct level and grade and to raise the outer rail to give the required super elevation, care being taken to see that the cant gradient is within the permissible limit.

(9) For LWR/CWR track, provisions given in Chapter 3 shall be followed

639 Lowering of Track -

(1) Lowering of the track should not be resorted to except where it cannot be avoided and if resorted to, it should be done under suitable speed restriction and under the protection of Engineering signals.

(2) When lowering is to be done, trenches should be made across the track at every 30 m to the final level in order to give a continuous indication, while the work is in progress. The ballast should be removed sufficiently far away from the track to prevent it getting mixed up with excavated material.

(3) The procedure is to clear the spaces between the sleepers, then slightly lift the track, break the packing beneath and level it into the space between sleepers. This material is then removed and the operation repeated until the final level is reached. The road should then be ballasted, through packed and boxed, the cess being cut down to proper level.

(4) Lowering, should be restricted to a maximum of 75 mm at a time and the grade for passage of trains should not exceed 25 mm in a rail length of 13 m.

(5) As opposed to lifting, lowering should be carried out in the direction of the falling grade.

(6) Work of lifting or lowering of track shall be carried out under supervision of JE/P.Way.

(7) For LWR/CWR track, provisions given in Chapter 3 shall be followed.

640 Side and Catch Water Drains and Waterways -

(1) For efficient drainage of cuttings, side and catch water drains of suitable type and size should be provided. The bottom of side drains should be at least 30 cm below the formation level.

(2) Adequate openings to take the full flow of side drains should be provided under level crossings where they exist in or at the end of the cuttings.

(3) In cuttings, in black cotton or similar soils, catch water drain should be provided sufficiently away from the top of the cutting to avoid any danger of a breach occurring between the drain and the cutting itself. The excavated spoil should be used to form a ‘bund’ between the drain and the top of the cutting.

(4) Ballast walls, where provided in cuttings, should be regularly inspected. The efficient maintenance of ballast walls includes regular cleaning of weep holes, the provision of

weep holes where none exist and rebuilding where necessary.

(5) The cleaning of side and catch water drains, clearing of obstructions from outfalls and cleaning water-ways of bridges and culverts shall be completed before the monsoon sets in. The spoil from cleaning drains or cuttings should not be deposited at a place from where it is likely to be washed back into the drains.

(6) In the Municipal areas, where the outfall of railway drains is in the municipal drains, close co-ordination should be maintained with the municipal authorities to ensure free flow from railway drains.

641 Drainage in Station Yards - The network of cross and longitudinal drains in yards, should be so planned that storm water is led away in least possible time. The system of surface drains of carriage-watering and carriage washing hydrants should be efficiently maintained. Proper yard drainage plan should be prepared and maintained by SSE/Works.

642 Section Limit Boards -

(1) *Boards at jurisdictional limits should be provided thus -*

(a) End of Divisions -

BB DIVN.	BSL DIVN.
D.E.N./BB	D.E.N./BSL
A.D.E.N./IGP	A.D.E.N./MMR
SSE/P.Way/IGP	SSE/P.Way/DVL

(b) End of Sub-Divisions -

A.D.E.N./TNA	A.D.E.N./KYN
SSE/P.Way/KYN	SSE/P.Way/VSD

(c) End of Sections -

SSE/P.Way/TNA	SSE/P.Way/KYN

(d) End of Gang lengths -

G-3	G-4
1+1+14	1+1+13

(2) If the gang beat ends in a curve the beat should be so adjusted that the entire curve lies in one of the beats.

Similarly, in case of yards, Gang beats should be so adjusted that the yard is maintained as far as possible by one gang, exception being in the case of big yards where the yard may have to be maintained by more than one gang.

(3) Suitable boards should also be provided indicating the state and district boundaries.

(4) When a board has to be located at an exact kilometre, it should be fixed by the side of the kilometre post.

(5) The boards, which may be of, scrap iron or RCC should throughout a division be fixed on the cess on the same side of the line. The letters and figures should be painted black on white background.

643 Kilometre and Gradient Posts - These may preferably be of RCC of suitable dimensions and fixed at right angles to the track on the cess so as to be distinctly visible. The figures, arrows and letters should be painted in black on a white background.

644 OHE Mast/Hectometre Post Numbers -

(1) Kilometerage should be indicated on OHE Mast/Hectometer Post either by painting or providing number plates thereon.

(2) Where single plates are provided, they should be fixed at 45 degrees to the track and face alternatively in the up and down directions. Where one piece angle type plates are provided, they should be fixed so that either face is at 45 degrees to the

track. Figures should be painted in black on white background.

(3) In deep-cuttings or tunnels, OHE Mast/Hectometer post numbers should be repeated at cess level.

(4) On double line section where one line is located away from the line along which the OHE Mast/Hectometer post numbers are provided and from where the figures on the Mast/Hectometer cannot be easily read, additional rail posts should be provided along the other line, which should indicate the corresponding OHE Mast/Hectometer Post numbers.

(5) On electrified sections, the kilometerage is indicated on the structure posts. The responsibility of providing number plates or painting kilometerage on the Electric structure devolves on the Electrical Department.

645 Verification of Land Boundaries -

(1) Every railway administration is responsible for the demarcation and periodical verification of the boundaries and the maintenance of proper records in connection therewith of all land in the possession of that Railway **(Para 1048-E** of *Engineering Code)***.**

(2) The SSE/P.Way (In-charge) is responsible for maintaining the railway land boundaries between stations and at unimportant stations. The unimportant stations where the land boundaries are to be maintained by the SSE/P.Way (In-charge) should be specified by the administration.

(3) The SSE/P.Way (in-charge) is responsible for reporting any encroachment that may occur as soon as they are noticed, to the ADEN who will on receipt of such report initiate measures to remove the encroachments.

(4) The SSE/P.Way (In-charge) shall submit, by the prescribed date every year, a certificate to the ADEN, copy endorsed to the DEN for information, in the following form:

I certify that I have inspected the Railway Land boundaries on my section during the year ending... …… and that they are in accordance with the land plans. There have been no encroachments except at the following kilometres that have been reported by me vide reference given against each. I further certify that missing boundary stones at the kilometrages shown below have been replaced.

No.

Date: SSE/P.Way (In-charge)

(5) During his inspection, ADEN shall ensure that railway boundaries are demarcated correctly and that there are no encroachments. In cases where he cannot prevail on the parties to remove the encroachments, he must report the facts with particulars to the DEN who will take up the matter with the Local Authorities.

646 Trolley Refuges -

(1) *Maximum distance apart of trolley refuges shall not exceed 1 km, subject to following* -

(a) Cuttings – 200 m on straight and 100 m in curve.

(b) High banks – 200 m

However, Railways may provide trolley refuges at closer interval depending upon site conditions such as speed of the trains in section, visibility, timings of the trains, gradients etc.

(2) On double line these should be staggered, alternate trolley refuges being on up and down sides respectively. The space between the track should be filled with ballast and levelled up to the rail level for easy off-tracking of the trolleys opposite to the trolley refuges.

(3) *Maximum distance apart of trolley refuges on bridges will be as under:*

(a) On bridges with main spans of less than 100 metres – 100 metres.

(b) On bridges with main spans of 100 metres or more – A refuge over each pier.

(4) In the case of tunnels, the maximum distance apart of trolley refuges shall not exceed 100 metres. For easy identification of the location of trolley refuges in tunnels and deep cuttings a distinguishing mark such as a rail post, painted with luminous paint with a mark 'R' may be erected by the side of the trolley refuge.

647 Standard Dimensions -

(1) *Infringement* – The SSE/P.Way (In-charge) should refer any work resulting in infringement of standard dimension to ADEN for instructions. Work involving permanent infringement should be referred to the Competent Authority for sanction through the CRS.

Permanent way staff shall be on the alert to prevent occurrence of;

(a) 'Slacks' in platform line causing the platform heights to exceed the standard dimension.

(b) Errors in alignment causing the minimum distance to adjacent structures infringed, for example, platform coping, over-bridges, O.H.E. structures.

(c) Excessive lifting of the track, causing minimum height to overhead structure to be infringed, for example, underside of over-bridge, roofs of tunnels, overhead contact wires.

(2) *Verification and preparation of yearly statements of infringements* – Once a year, the standard dimensions over their sections shall be verified personally by the SSE/P.Way (In-charge) according to the profiles shown in the schedule of dimensions and statements of infringements, if any, submitted to the ADEN by the end of March. ADEN after scrutiny should forward these to DEN.

The statement shall briefly indicate against each infringement the reason for its continuance together with reference to the sanction of Railway Board/ Commissioner of Railway Safety. DEN after scrutinising the yearly returns will issue necessary instructions to the ADEN. Important items should be referred to the Chief Track Engineer.

648 Felling of Trees Obstructing View - (*Back to **Para 913*****)** Trees and bushes that interfere or tend to interfere with the view from a train or trolley, of signals or level crossings or along the inside of curves, shall be cut. When cut, it should be ensured that they do not foul the track.

When trees and bushes require to be cut in terms of *Sub-Para above*, on private lands, action should be taken as laid down in ***Section 14*** *of the Railways Act 1989 (24 of 1989)* reproduced below:

"14. (1) Where in the opinion of a Railway Administration;

(a) *There is imminent danger that any tree, post or structure may fall on the railway so as to obstruct the movement of rolling stock; or*

(b) *Any tree, post, structure or light obstructs the view of any signal provided for movement of rolling stock; or*

(c) *Any tree, post or structure obstructs any telephone or telegraph line maintained by it, it may take such steps as may be necessary to avert such danger or remove such obstruction and submit a report thereof to the central government in such manner and within such time as may be prescribed."*

649 Distance Pieces to Platform Lines - Tracks adjacent to platforms should be provided, with 'distance pieces' made of unserviceable timber or any suitable material fixed at intervals of about 30 m one end of each such piece butting against the near rail and the other against the face of the platform wall or any other suitable arrangement to obviate the possibility of infringement of the horizontal distance from centre of track to face of platform coping.

650 Fouling Marks -

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

(2) (a) Fouling Mark should be placed at a location where track centre begins to reduce to:

(i) 4.265 m in existing works where normal track centre is between 4.265 m and 4.725m.

(ii) 4.725 m in existing works or new works or alteration to existing works where normal track centre is 4.725 m or more.

(b) While placing FM between two berthing lines (main and loops line or between two loop line) where points are involved, it must be ensured that glued joint is placed 3.35m inside FM for ensuring safety.

(c) It should be ensured that chainages of FM are written on ESP along with the mention of CSR (FM to FM) and CSL (from track circuit termination glued joint in rear to signal in front).

(3) The CSL (Clear Standing Length) of loop and number of wagons, which can be accommodated in a siding or a loop, should be marked on each fouling mark.

(4) The fouling marks should consist of a stone/ cement concrete block about 1500 mm in length, 250 mm wide and 125 mm thick, with the top edge rounded off and the top surface white-washed or of unserviceable rail pieces embedded in concrete support & painted white. These should be laid level with the top line of the ballast section.

651 Maintenance of P.Way Store - SSE/P.Way (In-charge) shall maintain his store duly maintaining all records in store module of TMS. He shall keep his store premises neat and clean and all P.Way material properly stacked in an identifiable manner. The material should be stacked in different category and in different locations duly marking the boards for new, second hand and unserviceable or obsolete material. He should dispose of all the scrap and obsolete material quickly as per the laid down procedure in this regard.

SSE/P.Way (In-charge) should maintain minimum imprest of the store as decided by Chief Track Engineer depending on type and condition of track, traffic density, terrain and other misc. features.

652 Action in case of Derailments -

(1) For other than LWR track -

(a) When the damage is extensive and track is distorted in such a way that it is not possible to pass traffic even at a restricted speed, the distorted track should be removed and replaced by track laid with available rails and sleepers. The traffic should be restored at a restricted speed.

(b) When the damage is not extensive and it is possible to pass traffic at a restricted speed, suitable speed restriction should be imposed after assessing the damage to track. After all the damaged sleepers are replaced and necessary repairs are done including welding of joints, normal speed should be restored after consolidation.

(2) For LWR Track -

(a) When the damage is extensive and track is distorted in such a way that it is not possible to pass traffic even at a restricted speed, the affected portion should be isolated by introducing buffer rails/SEJ on either end of the affected portion. The distorted track should be removed and replaced by track laid with available rails and sleepers. The traffic should be restored at a restricted speed. The affected portion should then be converted to long welded rails by taking usual precautions for LWR.

(b) When the damage is not extensive and it is possible to pass traffic at a restricted speed, suitable speed restriction should be imposed after assessing the damage to track, sleepers should be replaced as in the case of casual renewals taking precautions as laid down for LWR/CWR. After all the damaged sleepers are replaced, the affected portion and 100 metres on either side should be de-stressed after consolidation, and normal speed should be restored thereafter.

PART – D

Record Keeping

653 **Record of Gang Work -** Almost all the records (except few) have to be maintained in TMS. Entries in TMS have to be made by concerned JE/SSE/P.Way, which shall be periodically scrutinized by ADEN.

(1) Each Gang Mate should be supplied with a gang chart (***Annexure - 6/2)*** and a gang diary.

(a) In the gang chart, the work set to the gang for a fortnight should be indicated by suitable notations and the details of track maintenance work done over the gang length, on a day-to-day basis shall be recorded by the JE/SSE/P.Way, according to extant instructions.

(b) In the gang diary supplied to each gang, fortnightly programme of work should be entered by the JE/SSE/P.Way. Each diary should be adequate for recording the work during the complete year

(2) At the end of the fortnight, the JE/SSE/P.Way should carry out a quantitative and qualitative assessment of the work done after thorough inspection and make suitable observations in the gang diary.

Temporary gangs employed in work allied to track maintenance, should also be supplied with gang diary, wherein the details of the work set and the work carried out will be entered by the JE/SSE/P.Way.

(3) Details of maintenance work carried out by these gangs should be entered in the TMS for the respective permanent gang.

(4) Gang charts/diaries should be checked by ADEN and DEN during their inspections. They should record their observation in the gang diary.

(5) On withdrawal of gang diary and supply of fresh ones, the SSE/P.Way (In-charge) should carefully analyse the work done and take notes of kilometerages that frequently gave trouble during the previous year, with a view to formulating such special measures as may be necessary.

(6) Maintenance attention given to the signalled loop lines and turnouts should be recorded in TMS and Gang Chart.

(7) Whenever the gang equipment are checked by JE/SSE/P.Way, the same should be recorded in gang dairy against the date on which such inspection is done. Inspecting officials should initial against the date and also make suitable entries in gang diary.

(8) Six months after the end of each year, the gang charts will be collected by the SSE/P.Way (In-charge) and maintained as record. Thus, for the overlapping period of six months, the gang will have two gang charts with them. A six months record will, therefore, always be available with the gang for reference. Normally, this record should be kept for at least five years. When a particular kilometre or section is under special observation, the record may be maintained for a longer period at the discretion of P.Way officials.

654 **Record of Work of Artisans and Other Workmen Employed -** Each artisan/workman will be supplied with a diary in which entries will be made by the artisan/workman showing his movement by train and the details of daily work performed by him. The JE/SSE/P.Way will scrutinise the work during his inspection and make suitable observations in the artisan's/workman's diary. At the end of the month, these diaries will be sent to the Office of the SSE/P.Way (In-charge).

655 Half-Yearly Report on the Condition of Permanent Way -

(1) The SSE/P.Way (In-charge) shall submit half- yearly Reports on the state of track in his charge, to DEN through ADEN in the format placed at **Annexure - 6/3.**

(2) In this Report the SSE/P.Way (In-charge) shall make candid statement of the defects in the track, reasons for defects and proposals for rectifying them.

(3) The ADEN should check the track during his trolley inspections and verify the conditions mentioned by the SSE/P.Way (In-charge), and also study the proposed remedial actions. Remedial actions as necessary should be ordered within his power or referred to DEN for further orders.

(4) DEN should scrutinize the half-yearly reports of the SSE/P.Way (In-charge) and the comments forwarded by the ADEN, and give his orders thereon to the SSE/P.Way (In-charge) through ADEN. ADEN and SSE/P.Way (In-charge) should promptly attend to the orders issued by the DEN.

(5) Submission of half-year reports does not absolve the SSE/P.Way (In-charge) of this basic responsibility of maintaining the track in fit condition for the load and speed sanctioned for the section.

656 SSE/P.Way (In-charge)'s Section Register -

(1) Each SSE/P.Way (In-charge) shall maintain a Section register containing all important information including a brief history of the section. The details as under shall be entered in the register -

(a) Administration –

(i) Change in JE/SSE/P.Way and Clerks.

(ii) Change in jurisdiction.

(b) Permanent Way –

(i) Formation – Sections giving frequent trouble with brief history and remedial measures adopted, if any.

(ii) Track structure, method of maintenance, details of particular locations giving frequent trouble and remedial measures adopted if any.

(iii) Details of kilometerages of track laid as short welded panels, long welded rails, continuous welded rails, etc. incidence of buckling, maximum and minimum rail temperatures observed.

(iv) Grades – Re-grading done, with brief details of lifting or lowering of track.

(v) Curves – Change in geometry or design Parameters of curve.

(vi) Particulars of deep screening carried out year wise.

(vii) Permanent Way renewals – Major renewal carried out as relaying, re-railing and re-sleepering; large-scale renewal of track components at a section should also be shown.

(viii) Station yards and sidings – Extension or alteration to yard layouts, sidings, and platforms.

(ix) Material under trial – Brief particulars- Connect reference to notes in the 'Materials-under-trial' register.

(c) Bridges and floods –

(i) Yearly record of rainfall showing month wise distribution.

(ii) Important repairs and renewal to bridges, details of extensive repairs to bridges, dismantling and rebuilding bridges, strengthening of girders, renewal of girders, extension of bridges and through renewal of sleepers, should be shown. Ordinary repairs need not be recorded.

(iii) Damage due to floods – Extent of damage with particulars of rainfall, arrangements made for labour and material, time and labour spent for restoration and approximate cost. Cause of damage and notes of remedial measures.

(iv) List of railway affecting works with brief history.

(v) List of vulnerable locations, where stationary watchmen are to be posted.

(d) Miscellaneous –

(i) Encroachment and steps taken to remove them.

(ii) Infringement particulars.

(iii) Accidents attributable to Permanent Way with details.

(iv) Any other important information necessary.

(2) The entries made in the section registers shall be brought up-to-date from time-to-time and these shall be scrutinised in the beginning of every year by ADEN.

657 Permanent Way Plans and Diagrams -

(1) ADENs shall have in their possession complete set of the following -

(a) The IRS Track manual or IRS type plans, pertaining to track sections and turnouts over their jurisdictions.

(b) Plans and longitudinal sections of the line, to a scale of 50 metres to 1 cm horizontal (1:5,000) and 5 metres to 1 cm vertical (1:500) and Index Plans and sections to a scale of 0.5 km to 1 cm horizontal (1:50,000) and 10 metres to 1 cm vertical (1:1,000) showing the physical features, alignment, grades, location of bridges and level crossings.

The longitudinal section of the line shall be updated by surveying the longitudinal profile of the line at least once in five years.

The necessary action for elimination of humps, sags and unevenness or providing vertical curves as provided in ***Para 417*** be taken if the survey reveals variations in grades.

Such an action may also become necessary as a result of track works viz. renewal of rail/sleepers, lifting/lowering of track, bridge works etc.

(c) Drawing of bridges, level crossings and protective works and yard layouts over their jurisdiction.

(d) Working drawings or diagrams pertaining to track and components on their sections, issued from time-to-time.

(e) The permanent way track diagram of the railway line showing the type of track and fittings when laid, type of ballast, type of formation with classification of soil as per RDSO's circular, blanket thickness, type of formation trouble (if any) and indication of how the railway boundary is demarcated. Chainage points in the track diagram shall be indicated correct to the nearest metre (details as in **Annexure - 6/4**).

(f) The Permanent Way diagrams of station yards showing complete dimension of running lines, sidings, type of track and turnouts. (Details as per **Annexure - 6/7**).

(2) The SSE/P.Way(In-charge) shall have in their possession complete sets of drawings and diagrams mentioned in item (a) and (d) to (f) pertaining to their jurisdictions; he shall have in his possession the land plans pertaining to his jurisdictions covering those between stations and unimportant station yards.

(3) Plans pertaining to their jurisdictions shall be maintained up-to-date by the ADEN and SSE/P.Way (In-charge).

658 Musters -

(1) The attendance of the Permanent Way staff and artisans and others shall be checked by the JE/SSE/P.Way under whom the staff are employed according to such instructions as issued by the Administration.

(2) No over-writing in the muster sheet should be permitted. Corrections should be attested and initialled by the JE/SSE/P.Way.

(3) Separate musters should be allotted and issued to each batch of workmen such as Track Maintainer, Gatemen, Trolleymen and Artisans.

(4) The muster sheet should be kept by the head of each batch and at the site of work for checking attendance by the JE/SSE/P.Way concerned.

(5) The muster sheet of Trolleymen and office staff should be kept and maintained in the office concerned.

(6) For each wage period, the muster sheet should be collected and fresh ones issued. Before commencement of a month, the ADEN should issue requisite number of blank muster sheet forms to each SSE/P.Way (In-charge) for the purpose of recording the attendance.

(7) Before issue, ADEN, as a token of its authenticity, must initial on the top of each blank muster sheet.

(8) The leave availed by each employee should be recorded in the leave register debiting this leave to his account before the musters are dispatched to the DEN's office.

(9) The ADEN should check the musters of the staff on their sub- division and initial the muster sheet at least once in two months during his trolley inspection.

659 Strength and Jurisdiction of Gangs -

(1) Formula for Gang Strength: The formula for calculation of gang strength based on different activities being carried out by gang, working of track machine and other factors is MCNTM (*Committee on Manpower and Cost Norms for Track Maintenance*) formula of 2010.

(2) The strength of each maintenance gang shall be worked out by approved formula and should be sanctioned. Yearly calculation of gang strength should be done for each gang duly taking in to account any changes in track structure and addition/alteration of ETKM or any other feature. Before any new track is commissioned, the additional gang strength required for its maintenance should be calculated and got sanctioned in advance through Divisional Office. A register should be maintained by each SSE/P.Way (In-charge) and in the Office of the DEN and ADENs having the required strength of manpower, sanctioned strengths of gangs, Gatemen, Watchmen, Lookout men, Trolleymen and other staff. No deviation from the sanctioned strength of gangs and other staff shall be permitted without the approval of the Chief Track Engineer. All details related to gang strength shall be entered in TMS.

660 Custody of Gang Tools - For the safe custody of gang tools, boxes should be provided at appropriate locations with proper locking arrangements. They may be provided near gang quarters, gate lodges or in stations. The Gang mate shall ensure that all tools are deposited in the tool box after working hours and kept locked.

Track maintainers should not leave any tool unprotected during the course of working or during mid-day-break.

661 Records of Material Under Trial -

(1) CTEs of Zonal Railways may order limited trials of simple items, which do not infringe with existing provisions of standard specification or instructions laid down in Manuals/Codes. Before undertaking the trial, complete scheme of trial should be well chalked out including the Parameters to be periodically measured/checked, official to measure/check, periodicity of measurement/checking as per proforma given in TMS. All measurements/observations are to be recorded in TMS. CRS may also be kept informed about such trials.

(2) The Zonal Railways should periodically inform RDSO through TMS about such trials to maximize advantage.

(3) *Recording* – All observations related to materials under trial duly indexed shall be maintained by the SSE/P.Way and cross checked by ADEN.

(4) *Particulars of entries* – Particulars regarding each item should be completed in regard to:

(a) Name of material.
(b) Kilometerage where laid.
(c) Date of laying.
(d) Object of trial.
(e) Nature and condition of ballast.
(f) Nature and type of formation.
(g) Track details.
(h) Behaviour.
(i) Any other relevant information.

In the case of items designed for improved track performance, notes should be made about the extent to which such appliances are producing the desired results, particulars being quoted, whenever possible.

(5) *Trial lengths* – Material under trial should, where practicable be laid near ADEN's headquarters. In the case of sleepers under trial, a special kilometre or kilometres should be utilized for the purpose.

(6) *Indication plates* – Materials under trial should be indicated by plates of suitable dimensions fixed on the cess at either end of the trial length, the description and number of item, date laid and kilometerage, being shown thus: (*Back to* ***Para 354***)

Reconditioned sleepers Nos. 1000, January 2021 Km 72/0 – km 72/12

(7) *Removal of materials under trial* – In every case where sleepers or other materials under trial have to be removed because of relaying or alterations, the ADEN concerned should report to the DEN and ask for disposal instructions. When material is removed for any reason, a full note should be made by the ADEN on its condition after thorough examination. When material under trial is removed and re-laid in another ADEN's length, the previous history of the material shall be copied and recorded in the TMS of the sub-division where it is now laid.

(8) The DEN should take interest in the trials in progress in his jurisdiction and ensure that the stretch, where such material is laid, is maintained to the desired standard.

PART – E

Maintenance of Track in Track Circuited Areas

662 Provision and Maintenance of Signalling Fixtures in Track -

(1) *Provision of signalling fixtures in track* –

(a) No signal fixtures/installation, which interfere with maintenance of track should be provided on track unless the approval for same is available from Track Directorate of RDSO or Railway Board.

(b) S&T Department shall provide adequate number of personnel for opening of signal rod, signal gears, other installations etc. to facilitate mechanized track maintenance. Opening of signal rods, signal gears etc. shall not be required where In-sleeper Point Machine has been provided.

(2) *Precautions to be taken while working in track circuited area* –

(a) JE/SSE/P.Way should instruct the staff not to place across or touching two rails in the track, any tool or metal object which may cause short circuiting.

(b) All gauges, levels and trolleys used in the track-circuited length should be insulated.

(c) Steel or C.I. pipes used for carrying water/gas under the track should be run sufficiently below the rails to prevent any short-circuiting.

(d) While carrying out the track maintenance, various S&T/Electrical installations should be got removed, wherever they interfere with the maintenance activities so as not to cause any damage of track circuit fittings like rail bonding wires, lead wires to rails, boot leg, jumper wires etc. .

(e) Use of steel tapes should be avoided in track-circuited section.

(f) Pulling back of running rails in track should be done in track-circuited areas in the presence of S&T staff, where signalling connections are involved.

(g) Proper drainage should be ensured so as to avoid flooding of track, during rains, particularly in yards, where watering of coaches is done. It would be desirable to provide ballastless track on platform lines, where watering of coaches is done.

(h) Ballast must be kept clean throughout the track circuited section and care should be taken to see that minimum ballast resistance per kilometre of track should not be less than 2 ohms per km in station yard and 4 ohms per km in the block section as per **Para 17.28** of **"***Signal Engineering Manual***".** On PSC sleepers track, availability of insulated liners upto a minimum level of 97% shall be ensured.

(i) Any hole drilled in the rail for providing S&T fixtures should be at the neutral axis of the rail and chamfered.

(j) In case of curves in track circuited area, efforts should be made to keep inner rail as positive rail so as not to exert additional lateral thrust on GFN liners.

PART – F

Maintenance of Track in Electrified Areas

663 General Instructions to Staff -

(1) *General Knowledge of Engineering Staff* –

(a) Every engineering official working in electrical traction area shall be in possession of a copy of rules framed for the purpose of the operation of the Traction Power Distribution system pertaining to Engineering Department and ensure that staff working under him are also acquainted with the rules. He will ensure that rules pertaining to carrying out engineering works are strictly observed.

(b) All electrical equipment, every power line or cable shall be regarded as being 'live' at all times. No work shall be commenced adjacent to any electrical equipment except on authority issued in writing by a competent official of the Electrical Department to the effect that the equipment has been made dead and earthed.

(2) *Defects in Overhead Equipment* – Defects or break-downs in the overhead equipment including track and structure bonds noticed by the Engineering staff shall be reported immediately to the Traction Power Controller. When defects in the overhead equipment that are likely to cause damage to pantographs or trains, are noticed and it is not possible to convey information to Station Masters or signalmen to enable them to issue caution orders, the line shall be protected by the staff noticing such defects according to GR 3.62.

(3) *Traction Bonds* – In electrified areas the return current fully or partially flows through the rail. To ensure reliable electrical circuit continuity and also to ensure proper earthing in case of leakage of current, various types of traction bonds as described below are provided at suitable places and maintained by the Electrical Traction Department.

(a) *Longitudinal Rail Bonds* – In the case of D.C. traction system, practically the whole return current flows through the rail. Therefore, two flexible copper bonds offering minimum resistance to the flow of current are provided at each rail joint under the fish-plates. Two solid lugs at the two ends of the copper bonds are inserted in holes drilled at the two rail ends between the fish bolt holes and are pressed by using a bend press to rivet them firmly to the rail. On points and crossings and at junction fish-plates where continuity bonds of the above type cannot be provided due to space constraint, continuity of return current path is achieved by using mild steel straps or G.I. wire ropes.

Absence of such bonds may cause unsafe working condition and in extreme cases may damage the rail ends.

(b) *Cross Bonds* – Cross bonds are provided between adjacent tracks at regular intervals to reduce resistance of the current to the minimum. Such cross bonds are also known as transverse bonds.

(c) *Structure Bonds* – All structures supporting overhead equipment either in AC or DC track circuited areas are connected to the running rails for ensuring good earthing. Failure of insulator or leakage of current switches off the supply from the sub- station so that men coming in contact with supporting structure etc. do not get electric shock. Removal or tampering of such bonds can, therefore, result in unsafe conditions. Since the structures are grouted in concrete, they are likely to become charged in case such bonds are kept disconnected. Similarly, other steel structures such as foot-over bridges, sheds, etc., in the vicinity of O.H.E. lines are also connected to rails through similar structure bonds.

(d) Any hole drilled in the rail for providing OHE bonds should be at the neutral axis of the rail and chamfered.

(e) While carrying out the track maintenance, various OHE installations should be got removed, wherever they interfere with the maintenance activities so as not to cause any damage to such fixtures.

664 Special Instructions to Staff Working in Traction Area -

(1) *Need for precautions* – Precautions are required to be taken on account of following:

(a) *Proximity of a live conductor* – The risk of direct contact with live O.H.E. is ever present while working in electrified sections such as for painting of steel work of through spans of bridges and platform cover.

(b) *Build up of potential due to return current in rails* – The return current in the rails may cause a potential difference:

(i) Between rail and the surrounding mass of earth.

(ii) Between two ends of a fractured rail.

(iii) Between the two rails at an insulated joint.

(iv) Between earth and any other metallic mass.

(2) The following precautions should, therefore, be taken while working in traction areas:

(a) No work shall be done within a distance of two metres from the live parts of the O.H.E. without a *'permit-to-work'*.

(b) For work adjacent to overhead equipment the Engineering Inspector shall apply to the proper authority sufficiently in advance for sanctioning the traffic and power block required.

The traction power controller through Traction Foreman will arrange to isolate and earth the section concerned on the date and at the time specified in consultation with the Traffic Controller. He shall then issue 'permit-to-work' to the JE/SSE/P.Way. On completion of the work the 'Permit-to-work' should be cancelled and Traction Power Controller advised, who will then arrange to remove the earth and restore power supply.

(c) No part of the tree shall be nearer than 4 m from the nearest live conductor. Any tree or branches likely to fall on the live conductor should be cut or trimmed periodically to maintain the safety clearances. The responsibility for wholesale cutting of the trees, i.e. cutting of tree trunks, will rest with the Engineering Department. In the electrified territories, however, the cutting of the trees shall be done by the Engineering Department in the presence of authorized TRD staff to ensure safety and satisfactory completion of the work. The day to day trimming of the tree branches, wherever required, to maintain the 4 m safety clearances from OHE shall be done by the authorized TRD staff and Supervisors.

In case of dispute, the decision whether to cut or trim a tree, shall be taken through a joint inspection of Engineering and Electrical officials.

The modalities to be adopted for cutting/ trimming of the trees i.e. contractually or departmentally, may be decided by the respective departments based on local conditions. Accountal and disposal of trees cut wholesale will be done by the Engineering Department. While the disposal of the trimmed tree branches will be the responsibility of the TRD Department. The expenditure for cutting/trimming of trees to maintain safe clearance for OHE, shall be debited to revenue grant of TRD Department."

(d) No fallen wire or wires shall be touched unless power is switched off and the wire or wires suitably earthed. In case the wires drop at a level crossing, the Gatekeeper shall immediately make arrangements to stop all road traffic.

(e) *Work on station roofs and signal gantries* – Staff working on station roofs and signal gantries and similar structures adjacent to live overhead equipment shall not use any measuring tapes, tools and materials when there is a possibility of their being dropped or carried by wind on to the live overhead equipment.

(f) *Earth Work* – For excavation work adjacent to tracks, the following action is taken:

(i) In D.C. traction areas, intimation should be given in writing sufficiently in advance to the concerned Traction Distribution Officer to enable him to depute the Traction staff to be present in order to prevent possible damage to the traction underground feeder cables witch are always located near the running lines.

(ii) In A.C. traction areas, intimation should be given to the concerned officers of the Electrical General Services and also S&T Department, since all the S&T and Electrical lines are cabled on account of Electrical Induction.

In all A.C. and D.C. traction areas, cable markers showing location of cables are provided by the Traction Department. In addition, the cables are protected by tiles and bricks, and during excavation if workmen come across such tiles or bricks in an arranged manner, they should at once report the matter to the higher officials. Any further excavation should be carried out only in the presence of the authorised staff of Electrical Traction and or S&T Department as the case may be.

(g) *Alteration to Tracks* – The relative alignments of the centreline of the track with respect to the alignment of the contact wire must be maintained within the specified tolerances. This applies to both horizontal and vertical clearances. Slewing or lifting of track must not be done outside the agreed maintenance limits, unless the position of the contact wire is altered at the same time. Adjustment of cant has a magnified effect of the horizontal displacement of the centreline of the track with respect to the alignment of the contact wire.

Horizontal clearances to structures within the limits laid down in the Schedule of Dimensions must be maintained. For Slewing or alterations to track involving adjustment of contact wire (outside the agreed maintenance limits) sufficient notice should be given to the traction staff so that they arrange to adjust the overhead equipment.

(h) *Alterations to Track Bonding* – All bonds removed by the staff of the Engineering Department shall be replaced by the staff of the Engineering Department and all such removals and replacements shall be reported to the Assistant Electrical Engineer, Traction Distribution in-charge, concerned without delay.

(i) *Working of Cranes* – No crane shall be worked except on the authorised *'permit-to-work'*. In every case of working a crane, arrangement should be made for the presence of authorised overhead equipment staff to ensure that all safety precautions are taken.

(j) *Inspection of Tunnels* – For inspection of roofs and sides of a tunnel, the overhead equipment shall be rendered *'dead'*. Special insulated apparatus should be used if sounding the unlined portions to locate loose rock in the roof and sides, is required to be carried out, when the overhead equipment is *'live'*.

(k) As far as possible closed wagons shall be used for material trains. In case open or hopper wagons are used, loading and unloading of such wagons in electrified tracks shall be done under the supervision of an Engineering Official not below the rank of a JE/P.Way, who shall personally ensure that no tool or any part of body of the workers comes within the 'danger zone' i.e., within 2 m of O.H.E.

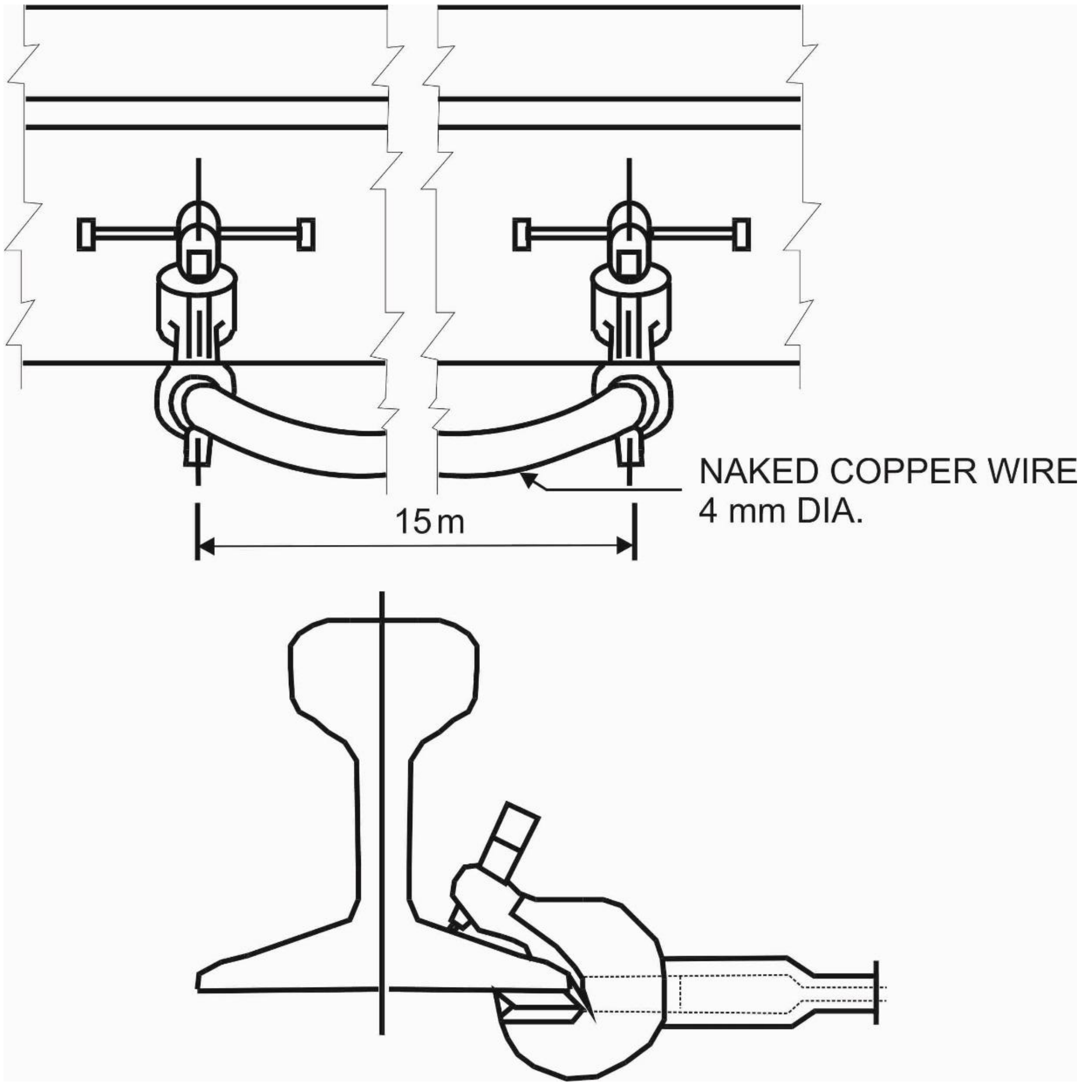
(l) Steel tapes or metallic tapes with woven metal reinforcement or metallic staff should not be used in electrified tracks. Linen tapes are safer and, therefore, should be used even though they are not accurate.

(m) The top foundation blocks in electrified structures should be kept clear of all materials.

665 Maintaining Continuity of Track -

(1) During maintenance or renewal of track, continuity of the rails serving electrified tracks shall invariably be maintained. For bridging gaps which may be caused during removal of fish-plates or rails, temporary metallic jumpers of approved design shall be provided as under. The necessary jumper will be provided by the electrical department on requisition.

(2) In case of rail fracture, the two ends of the fractured rail shall be first temporarily connected by a temporary metallic jumper of approved design (as shown in the sketch below). In all cases of discontinuity of rails, the two parts of the rail shall not be touched with bare hands; Gloves of approved quality shall be used.



(3) In the case of track renewals temporary connection shall be made as shown in **Annexure - 6/8.**

(4) In the case of defective or broken rail bond, a temporary connection shall be made as shown in *Sub-Para (2) above.*

(5) Before fish-plates are loosened or removed temporary connection shall be made as in *Sub-Para (3) above.*

666 **Additional Precautions in A.C. Traction Area -** The following additional precautions are required to be taken in A.C. traction areas:

(1) Build-up of potential due to induction in metallic bodies situated close to O.H.E**.** – It is important to note that dangerous voltages may be induced in metallic masses such as fencing posts in the vicinity of traction conductors. To avoid possibility of shock due to such voltages, the metallic structures are bonded together and earthed.

(2) *Unloading of rails* – When unloading rails along tracks, care shall be taken to ensure that rails do not touch each other to form a continuous metallic mass of length greater than 300 metres.

(3) Permanent way staffs are advised to keep clear of the tracks and avoid contact with the rails when an electrically hauled train is within 250 m.

667 **Fire in Electrified Areas -** The permanent way officials noticing a fire likely to result in loss of life or cause damage to property shall take all possible steps to prevent it from spreading and to extinguish it. In case the fire is on adjacent to any electrified equipment, the permanent way official shall make no attempt to extinguish the fire but shall report the occurrence of fire to the nearest Station Master by most expeditious means.

668 **Catch Sidings -** Normally all catch sidings, except, those which are sanded, shall be kept alive. On sanded catch siding, the rails shall be kept clear of sand for a length of 21.5 metres, beyond the section insulators in the overhead lines and the switches controlling the sanded catch sidings shall be kept in the neutral position. If an electric engine or single or multiple unit train runs into the sanded length of a catch siding, it may possibly be insulated from earth except through the buffers or couplings if connected to other vehicles. Therefore, these sidings shall not be made alive when an electric engine or single or multiple unit train or any vehicle coupled thereto are standing in the sanded tracks, until, all staff have been moved away from positions where they are likely to make contact between the Permanent Way formation and any part of the locomotive or single or multiple unit train or coupled vehicles. No person shall attempt to enter or leave or in any other way make contact between the permanent way formation and the electric engine or single or multiple unit train or any vehicles coupled thereto while the overhead equipment of the sanded length of siding is alive.

669 **Permanent Way Tools -** Permanent way tools (insulated and un-insulated) along with gloves shall be used in manner as approved by the Chief Track Engineer of the railway.

670 **Treatment of Persons Suffering from Electric Shock -** When persons receive electric shock, practically in every case they can be revived with prompt application of First-Aid.

Method of resuscitation – The method of resuscitation resorted to should be that known as artificial respiration.

Continuity of treatment – The efforts to restore breathing must be continued regularly and with perseverance and must not be discontinued until a Doctor has taken charge of the case.

671 **Accident to Power Lines of Outside Bodies -** The engineering inspector shall be in possession of the name and address of the officer-in-charge of each power line across Railway land to enable an immediate report of any defect or accident appertaining thereto being made, under advice to the ADEN/DEN.

Annexure - 6/1 (Para 604)

List of Equipment

(A) Communication Equipment		
1	Walkie Talkie	4 Sets
2	Portable field telephones	4 Sets
3	CUG mobile Set	1 No.
(B) Rail cutting/Drilling Equipment		
4	Abrasive Disc Cutter	2 No.
5	Rail Drilling Machine	1 No.
6	Chamfering kit	1 No.
(C) Rail Welding Equipment		
7	Rail Welding Equipment	2 Sets
8	Generator	2 No.
9	Weld Trimmer	1 No.
10	Rail profile Grinder for welded	1 No.
(D) Spot Tamping with lifting Lining		
11	Off Track Hand Held Tamper	4 No.
12	Tamping Tools	4 No.
13	Lifting Jack-hydraulic /mechanical	4 Sets
14	Lifting-cum Slewing Device	2 Sets
(E) Material Handling Equipment		
15	Rail Dolly	4 No.
16	Mono Rail Wheel Barrow	2 No.
(F) Material Handling Equipment		
17	Joggled Fishplates	10 No.
18	C Clamps	20 No.
19	Fish plate 600 mm: 60kg/52kg each	10 No.
20	Fish Plate 1 m:60kg/52kg each	10 No.
21	Fish Bolt	50 No.
22	SEJ nut and bolts	20 No.
23	Plate Screws	50 No.
24	Fire Extinguisher	1 Set
25	Wooden Blocks	10 No.
26	Box Spanner	4 No.
27	Fish Plate Spanner (Small)	4 No.
(G) Gas Cutting Equipment with Accessories		1 Set
(H) Tools:		
28	Crow Bars (low carbon with alloy steel)	20 No.
29	Sledge Hammer	6 No.
30	Small Hammer	2 No.
31	Spanner (low Carbon steel, chromium and vanadium alloy) (in set)	2 No.
32	Rail Tongue	6 No.
33	Sleeper Tongue	6 No.
34	Pick axe	2 No.
35	Powrah	4 No.
36	Mortar Pan (Steel light weight)	10 No.
37	Chisel	6 No.
38	Sickle	3 No.
39	Wire Claw	10 No.
40	Tool Box	1 No.
41	Shovel	2 No.

42	Axe	2 No.
43	Motorized Wood Cutting Saw	2 No.
44	Hand Wood Cutting Saw	2 No.
(I) Manual & Codes		
45	Working Time Table	1 No.
46	G & SR Book	1 No.
47	Accident Manual	1 No.
48	IRPWM	1 No.
49	Track Machine Manual	1 No.
50	USFD Manual	1 No.
51	LWR Manual	1 No.
52	PN Book	1 No.
53	AT Welding Manual	1 No.
54	Small Track Machine Manual	1 No.
(J) Safety & Protection Equipment		
55	Detonators	20 No.
56	Banner Flag	4 No.
57	Red Flag	4 No.
58	Green Flag	2 No.
59	Tricolour Torch	4 No.
60	First Aid Medical Box	1 No.
(K) Measuring Equipment		
61	P.Way Kit	1 Set
62	Gauge-Cum-Level	2 No.
63	Straight Edge 1 M	1 No.
64	Measurement Tape 15 m	1 No.
65	Rail Thermometer	1 No.
66	Vernier Callipers	1 No.
67	Micrometre	1 No.
(L) Miscellaneous		
68	Welding Material Portion	20 No.
69	Rail Closers of various lengths	10 No.
70	Safety Belt	6 No.
71	Aluminium Ladder	1 No.
72	Safety Goggles	6 No.
73	Halogen Set	1 No.
74	Safety Helmet with miner light	10 No.
75	Water Dispenser with cans	2 No.
76	Tarpaulin	3 No.
77	Rail Cutting Disc	10 No.
78	Grinding Wheel	10 No.
79	Mould Shoes(Pairs)	2 No.
80	Safety Apron for welding	10 No.
81	Chain link	1 No.
82	Hand Gloves	10 Pairs
83	Wire Rope 15 M	1 No.
84	2T Oil	500 ml
85	Transmission Oil	5 Ltr.
86	Nylon Rope-15 m	1 No.

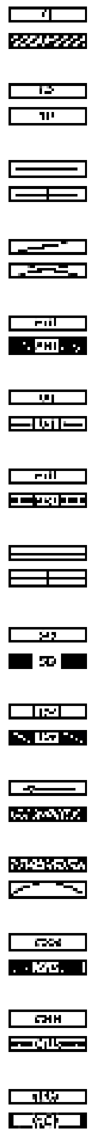
Annexure - 6/2 (*Para 653*)

Gang Chart

DIVISION ____________ SUB-DIV. ______________ SSE/P.Way _______________

SUB SEC. ___________ SEC BET ____________ AND ______________

1	CHART FOR GANG No.	________	OVERHAULING	WORK SET WORK DONE
2	KILOMETRE	________	ORDINARY THROUGH PACKING	WORK SET WORK DONE
3	MATE (NAME)	________	PICKING UP SLACKS	WORK SET WORK DONE
4	GANG STRENGTH	________	ATTENTION TO PTS & XING	WORK SET WORK DONE
5	RAILS	________	PRETAMPING OPERATION	WORK SET WORK DONE
6	SLEEPERS	________	MACHINE TAMPING OPERATION	WORK SET WORK DONE
7	FASTENINGS	________	POST TAMPING OPERATION	WORK SET WORK DONE
8	DEPTH OF BALLAST CUSHION BELOW SLEEPER (mm)	________	MISC/SQUARING JOINTS	WORK SET WORK DONE
9	DEEP SCREENING	________	CLEANING SIDE DRAINS	WORK SET WORK DONE
10	OVER HAULING	________	ATTENTION TO CESS REPAIRS	WORK SET WORK DONE
11	DESTRESSING	________	PULLING BACK CREEP	WORK SET WORK DONE
12	GAP SURVEY & RECTIFICATION	________	REALIGNMENT OF CURVES	WORK SET WORK DONE
13	DETAILS OF CURVES/BRIDGES	________	CASUAL SLEEPER RENEWAL	WORK SET WORK DONE
14	L-XING & SEJ	________	CASUAL RAIL RENEAL	WORK SET WORK DONE
			OVERHAULING OF L XING	WORK SET WORK DONE



ATTENDANCE   SIGNALLED LOOP LINES   T/OUTS ON RUNNING LINES

| M | K | G | TOTAL | KILOMETER → | LOOP No. | T/OUT No.

KM   KM   KM   KM   KM   KM   KM

Annexure - 6/3 *(Para 655)*

Half-Yearly Permanent Way Report

Report for the half-year ending:

31st March } ……… regarding the section of track under SSE/P.Way:

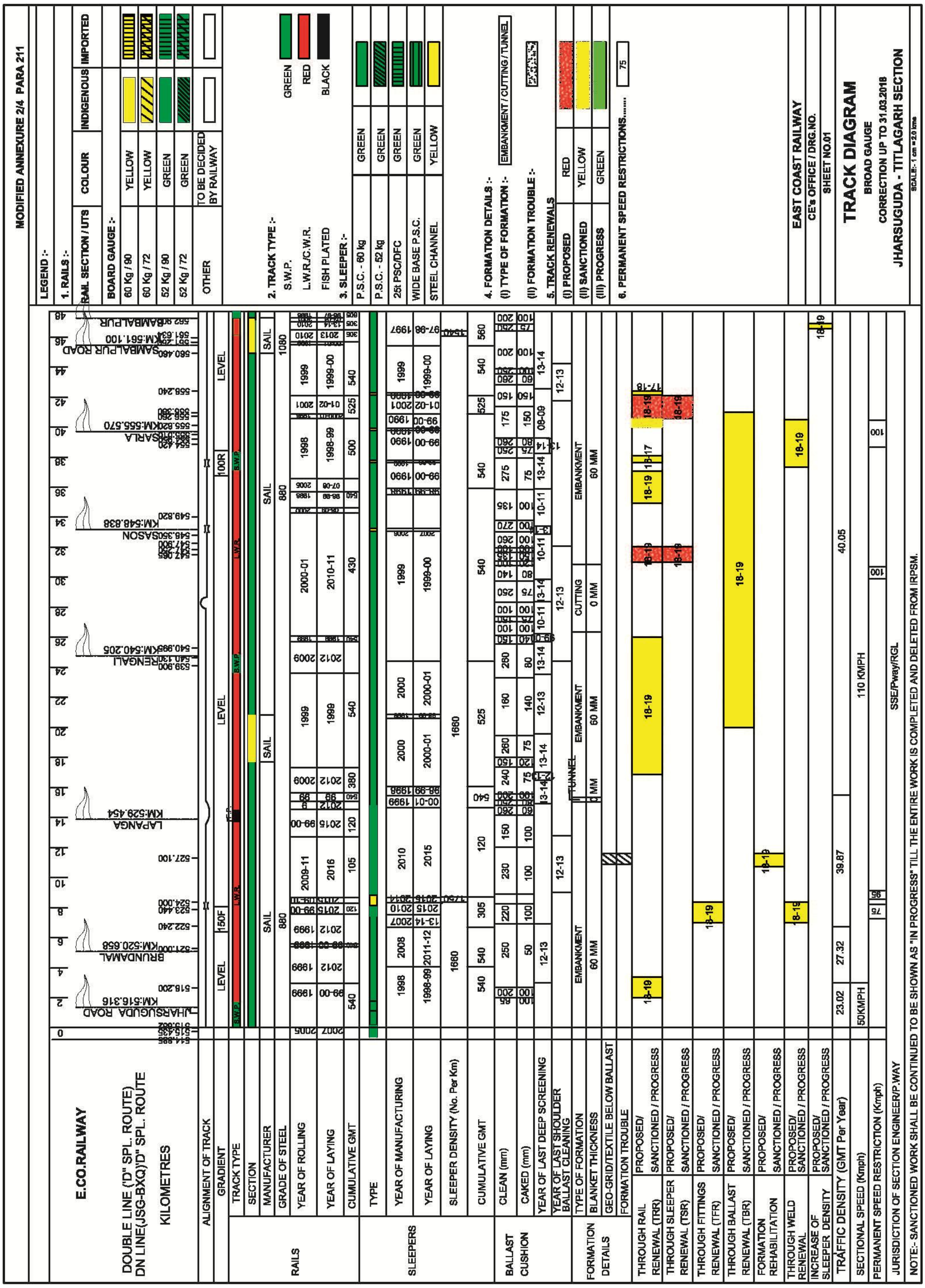
30th September }

Name: Section:

Head Quarter: Km: to Km:

Item No.	Particulars of Item	SSE/P.Way's Remarks			AEN's remarks	DEN's remarks	Details to be entered under Problem areas by SSE/P.Way
		Major Important work done in last 6 months	Problem areas	Assistance required			
1	2	3	4	5	6	7	8
1	Track						Rails, fastenings, sleepers, ballast, formation and drainage.
2	Points and crossing						Details of turnouts requiring frequent attention.
3	Bridges & approaches						Details of bridges having problem of creep, condition of sleepers and fittings.
4	Level crossings						Details of level crossings having road surface and approach road requiring attention, slope of approach road, visibility, overdue overhauling.
5	Fencing and Boundary Post.						
6	Imprest (Store/ Cash)						Complete or not, any delay in supply/ recoupment.
7	Man power						Adequate or not, absence for sickness, seasonal absence, low output due to overage/higher average age, man days lost due to special features (such as patrolling etc.), vacancies.

8	Infrastructure						Availability of traffic block, working of material trains/ ballast trains, machines for maintenance and renewal works (their workings and shortfalls in schedule and problems, if any)
9	Vulnerable locations						
10	Engineering Materials in ARTs.						
11	Small Track Machines						
12	Functioning of Reconditioning workshop for turnouts and SEJs.						
13	Periodical Medical Examination/ Refresher of safety category staff.						Details of staff overdue for Periodic Medical Examination/ refresher.
14	Encroachment on Rly. Land between stations						
15	Items to which special attention is directed in the interest of the safety of the travelling public.						Refresher to be made to previous items and where the supply of stores is involved, requisition numbers should be quoted.
16	Material Under Trial.						Progress and performance.


MODIFIED ANNEXURE 2/4 PARA 211
E.CO.RAILWAY
DOUBLE LINE ('D' SPL. ROUTE) DN LINE(JSG-BXQ)'D' SPL. ROUTE
KILOMETRES
EAST COAST RAILWAY
CE's OFFICE / DRG.NO.
SHEET NO.01
TRACK DIAGRAM
BROAD GAUGE
CORRECTION UP TO 31.03.2018
JHARSUGUDA - TITLAGARH SECTION
NOTE:- SANCTIONED WORK SHALL BE CONTINUED TO BE SHOWN AS "IN PROGRESS" TILL THE ENTIRE WORK IS COMPLETED AND DELETED FROM IRPSM.

Annexure - 6/5 ***(Para 613)***

……………………… RAILWAY

Proforma for Measurement of Liner bite/corrosion of Rail

Division: Sleeper Between Stations

Track Structure (rail) Sleeper Density Annual GMT

Whether corrosion prone area (Yes/No):

Date of recording	Location (KM/TP)	Sleeper No.	Corrosion depth in mm.								Remarks with signature
			Left Rail				Right Rail				
			Vertical		Lateral		Vertical		Lateral		
			GF	NGF	GF	NGF	GF	NGF	GF	NGF	
1	2	3	4	5	6	7	8	9	10	11	12

Where, GF – Gauge Face Side, NGF – Non Gauge Face Side.

Annexure - 6/6 (Para 617)

……………………… RAILWAY

Proforma for Reporting Rail Failures

Broken/Cracked/Defective rail removed on date _____________.

1.0 General Information:
- 1.1 Division:
- 1.2 Section (name of the line or branch):
- 1.3 Between Stations _______________ and _______________.
- 1.4 Kilometerage:
- 1.5 Line:
- 1.5.1 Up/Down/Single:
- 1.5.2 BG/MG/NG:
- 1.6 Alignment:
- 1.6.1 Straight/Curve (Indicate degree of Curvature):
- 1.6.2 Inner/Outer in case of curve:

2.0 Characteristics of Traffic and Traction:
- 2.1 Traffic Density in GMT/annum:
- 2.2 Total traffic carried in GMT before failure (for release rails, also add previous traffic carried):
- 2.3 Maximum axle load with type of vehicle on section:
- 2.4 Maximum permissible speed:

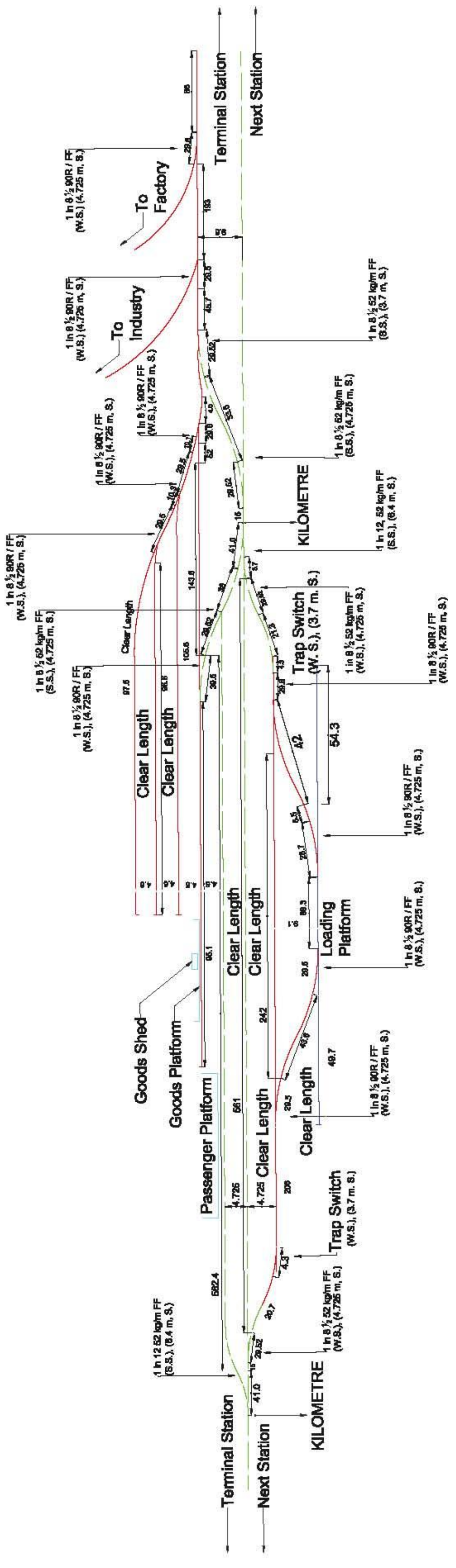
3.0 Characteristics of Rail:
- 3.1 Rail section: _____ kg/m.
- 3.2 Rolled Marking: _______________

4.0 Characteristics of Track:
- 4.1 If fracture occurred at or within 100 mm of weld, indicate date of welding:
- 4.2 Position of fracture:
- 4.3 Type of sleepers and density:
- 4.4 Depth of ballast:

5.0 Particulars of Defect or Fracture:
- 5.1 Detected – Visual/By Flaw detector:
- 5.2 Remarks, if any:
- 5.3 Classification of failure in code:

____________________	____________________	____________________
Signature of SSE/P.Way (In-charge)	Signature of ADEN	Signature of DEN

Annexure - 6/7(*Para 657*)



RLY.: ______

PERMANENT WAY DIAGRAM

OF ______ STATION YARD

STANDARD - INTERLOCKING

52 Kg/ F.F.	13 m.	1538	STEEL LOOSE JAW

FILE No. ______ SCALE: ______ DRG. NO ______

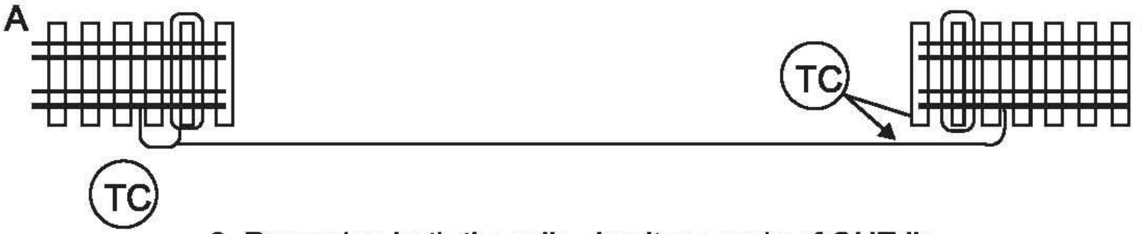
APPROVED BY : DEN DEV./ DISTT.

NOTE:

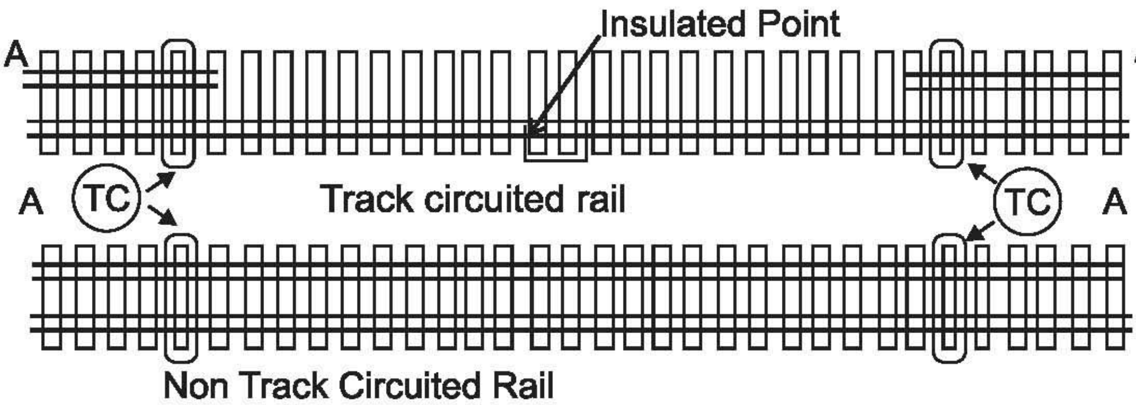
ALL DIMENSIONS ARE IN METRES

COLOUR	RAILS TYPE	RAILS LENGTH	SLEEPERS No. PER Km	SLEEPERS TYPE
	52 kg/ FF	13 m	1538	STEEL LOOSE JAW
	90 Lbs/ RFF	12 m	1333	STEEL LOOSE JAW
	80 Lbs/ BH	9 m	1330	STEEL 2 KEYED

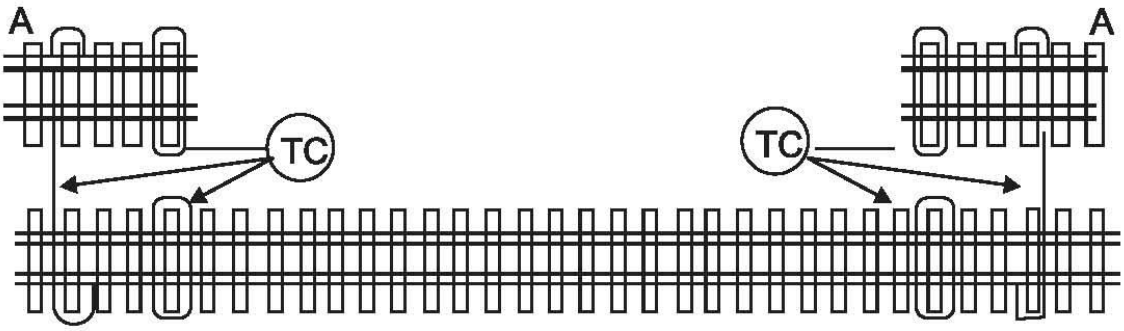
1. Removing of OHE rail
Both the rails insulated for track circuiting



2. Removing both the rails simultaneously of OHE line
Both the rails insulated for track circuiting



3. Removing of OHE rail
One rail only insulated for track circuiting



4. Removing both the rails simultaneously of the OHE Line
Alternative to no. 2 above.

TC = Temporary Connections

Details of the 8 operations of Systematic Through Packing are as detailed below:

1. *Opening of Road* – Ballast should be opened out on either side of the rail seats to the extent from end of sleepers to 450 mm inside of the rail seat to a depth of 50 mm below the packing surface without disturbing the cores under the sleepers.

   The ballast should be drawn by phowrahs/ shovels or rake iron ballast outwards and inwards i.e. that portion of the ballast on the outside of the rail should be drawn outwards, the portions between the rails being drawn towards the centre, care however, should be taken to see that the ridge between the rails does not project more than 50 mm above rail level.

2. *Examination of rails, sleepers and fastenings* –

   (i) Rails should be examined, the underside for corrosion, the ends for cracks, the head for top and side wear, rail joints for wear on the fishing planes, fish bolts for tightness.

      1) If rails on curves wear at an unusually rapid rate, lubrication of the gauge face should be done.

      2) Rust and dust must be removed from the corroded rails by using wire brushes.

      3) Kinks in rails should be removed by Jim crowing.

   (ii) Sleepers should be inspected for their condition and soundness particularly at the rail seats.

   (iii) Fastenings and fittings should be examined to ensure that they are in good order, appropriately tightened so that they firmly hold the rails. Broken ones should be replaced immediately.

3. *Squaring of sleepers* – Gauge variations and kinks inevitably result from sleepers getting out of square, therefore the spacing of sleepers on the sighting rail should first be checked and correctly chalk – marked. Corresponding marks should then be made on the other rail using the square at every point.

   The core of sleepers that are out-of-square should then be ‘picked’ with the pick ends of beaters, the fastenings loosened and the sleepers levered and squared to correct position.

   Squaring should be done by using mechanical/hydraulic spacer or by planting the crow bars firmly against the sleeper and pushing it. Under no circumstances should sleepers be hammered. Sleepers that are squared should be re-gauged immediately, the fastenings tightened and repacked.

4. *Slewing of track to correct alignment* –

   (i) Heavy slewing will only be required during realignment of curves when it will be necessary to loosen the rail, joints and the packing cores being broken with the pick-ends of beaters. Slewing for normal maintenance will be of a small order and should be done after opening out the road, loosening the cores at ends and drawing out sufficient ballast at the ends of the sleepers.

   (ii) Slewing of track shall be directed by the Mate, who should sight the rail from a distance of 30 to 60 meters on straight track. On curves, the Mate should sight the outer rail.

   (iii) Slewing is best done in the morning unless it is cloudy, as later on, sighting conditions become unfavourable.

(iv) Slewing should preferably be done using hydraulic/mechanical jacks or TRALIS. If crow bars are used, these should be planted well into the ballast at an angle not more than 30 degrees from the vertical; otherwise lifting of the track may occur.

5. *Gauging* –

(i) Preservation of gauge is an important part of track maintenance especially through points and crossings. For good riding, the basic requirement is uniform gauge over a continuous stretch of track and such gauge should be allowed to continue so long as it is within the permissible limits of tightness or slackness.

(ii) Gauging should only be done after ensuring that sleepers are truly square.

(iii) The track gauge cum level should be held firm with one lug against the base rail, and the other end being swivelled over the opposite rails. The tightest position obtained determines the correct point to test the gauge. The gauge cum level should not be forced as that causes considerable wear on the gauge lug.

(iv) While it is desirable to maintain correct gauge, it may not be possible to maintain correct gauge due to wear in rail and sleeper inserts. It is good practice to work within the tolerances of gauge, as specified in **Para 525 (1),** provided generally uniform gauge can be maintained over long lengths.

6. *Packing of sleepers* –

(i) The aim of packing is to have each sleeper firmly and uniformly packed to ensure that the rails are at their correct relative levels i.e., level on the straight track and to the required cant on curves and that no sleeper has any void between it and its bed.

(ii) Before packing is commenced, it is necessary to ensure that all the fittings are intact. Wherever feasible packing is to be done by worksite tampers. However, if worksite tampers are not available, manual packing as detailed below may be done.

(iii) The Mate shall sight the base rail with eye along the lower edge of the head of rail and any dip or low joint lifted correctly. The adjacent sleepers should then be packed and the top checked. After two rail lengths have been attended to, the rail on the other side should be brought to the correct level by checking cross level with the gauge-cum-level at every rail joint and at every fourth sleeper. The next two rail lengths should then be taken up and the process continued.

(iv) No joint or dip should be lifted higher than the proper level in the expectation that it will settle to the correct level. Instead it will settle more under traffic as a result of being high and cause rough running.

(v) Having aligned the track and the rail table adjusted, Track Maintainers should be distributed in batches of two for packing all sleepers in a systematic manner, commencing from one end. Four men should deal with every sleeper successively, two at each rail seat. The ballast under the sleeper should be packed by the men standing back-to-back and working their off track hand held tampers diagonally under the rail seat at the same time to ensure firm packing. Where off track hand held tampers are not available the packing can be done by crowbars / straightening bars.

(vi) While using crowbars, it is important that the cores are thoroughly broken before packing and re-packed.

(vii) After packing the rail seat, the packing should be continued outwards and inwards to the requisite extent on each side of the rail seat i.e., end of the sleeper to 450 mm inside, the strokes being kept as nearly horizontal as possible. Care must be taken to avoid forcing any large stone under the sleeper so as not to cause uneven bearing and to avoid striking the edges of the sleepers. All men should aim to work the crowbars from the same height so that the sleepers are uniformly packed. Higher or lower lifting of the crowbars results in uneven compactness.

(viii) Before final dressing is done, it should be ensured that no sleeper is centre-bound by working the pick-ends over the central range. Centre bound sleepers cause vehicles to roll from side to side.

(ix) Care must also be taken while packing to ensure that the work does not result in the sleepers adjoining those being packed, lifted off their bed, thus creating artificial voids under them.

(x) The packing on the inside and outside at every rail seat should, before boxing the track, be checked by the Mate by tapping with a rubberised Canne-a boule. An inadequate rebound would indicate defective packing, which should be attended to again.

(xi) As soon as the packing is completed, slight distortions in alignment and top should be checked and corrected by the Mate, the sleeper disturbed for this purpose being finally repacked.

7. *Repacking of joint sleepers* – The joint and 'shoulder' sleepers should be repacked, before boxing is done and the cross- levels at joints checked. The rail joint being the weakest portion, firmness of its support is essential.

8. *Boxing of ballast section and tidying* –

(i) After completing the preceding operations in sequence, clean ballast should be worked in with ballast forks or rakes. The ballast section should be dressed to the specified dimensions; a template being used for the purpose. Hemp cords 6 mm dia. of sufficient length should be used for lining the top and bottom edges of the ballast section. Where the quantity of ballast is inadequate, full section of ballast should be provided near the rail seat, the deficiency being reflected along the centre of the track and not under the rails or in the shoulders.

(ii) The cess should then be tidied up.

(iii) Where earth ridging exists at the edge of the bank, it should be removed.

(iv) Cess should be maintained to the correct depth below rail level according to the ballast-section and formation profile. Too high a cess affects drainage; too low a cess results in ballast-spread and wastage.

Annexure – 6/10 (Para 632) (ACS – 3)

Proforma for Measurement of Track Parameter on Yard Lines

S. No.	Date of Inspection	Line No./ X-over No.	PRL/ NPRL/ X-over	Station/ Location	Station no. (1, 2, 3, … at every 5th sleeper)	G	XL	Twist	Versine of curve/ Turn in curve	Signature of Sectional JE/ SSE/ P.Way	Remarks, if any	Parameters after attention				Date of attention	Name and signature of the supervisor who has attended the deficiency	Remarks, if any
						Values beyond new acceptable limits to be highlighted with red circle						G	XL	Twist	Versine of curve/ Turn in curve			

CHAPTER – 7

PERMANENT WAY RENEWALS

701 Classification of Renewals –

(1) *All track renewals can be classified generally into one of the following categories:*

(a)	Complete Track Renewal (Primary)	Abbreviated as	CTR(P)
(b)	Complete Track Renewal (Secondary)	Abbreviated as	CTR(S)
(c)	Through Rail Renewal (Primary)	Abbreviated as	TRR(P)
(d)	Through Rail Renewal (Secondary)	Abbreviated as	TRR(S)
(e)	Through Sleeper Renewal (Primary)	Abbreviated as	TSR(P)
(f)	Through Sleeper Renewal (Secondary)	Abbreviated as	TSR(S)
(g)	Casual Renewal		
(h)	Through Turnout Renewal	Abbreviated as	TTR
(i)	Through Fitting Renewal	Abbreviated as	TFR
(j)	Through Fitting Renewal (R)	Abbreviated as	TFR (R)
(k)	Through Weld Renewal	Abbreviated as	TWR
(l)	Through Bridge Sleeper Renewal	Abbreviated as	TBSR
(m)	Scattered Renewal		
(n)	Through Ballast Renewal	Abbreviated as	TBR

(2) Primary renewals are those where only new materials are used and secondary renewals are those where released serviceable materials are used.

(3) *Scattered Renewal* – In this case, unserviceable rails, sleepers and fastenings are replaced by identical sections of serviceable and nearly the same vintage track components. These are carried out in isolated locations and not more than 10 rails and/or 250 sleepers in a gang beat in a year. Such renewals are part of normal maintenance operations.

(4) *Casual Renewal* – In this case, unserviceable rails, sleepers and fastenings are replaced by identical sections of serviceable and nearly the same vintage or new track components. These are carried out in isolated locations of continuous but small stretches. Such renewals are not a part of normal maintenance operations and cannot be covered under scattered renewals.

(5) *Through Fitting Renewal (R)* – In this case, through fittings renewal without replacement of ERCs is carried out i.e. only liners and GRSPs/CGRSPs are renewed.

702 Factors Governing Permanent Way Renewal –

(1) *Criteria for Rail Renewal* **-** The following are to be considered in connection with the criteria of rail renewals –

i. Incidence of rail fractures/failures.
ii. Wear on rails.
iii. Maintainability of track to prescribed standards.
iv. Expected service life in terms of Gross Million Tonnes of traffic carried.
v. Plan based renewals.

(a) *Incidence of Rail Fractures/Failures* – A spate of rail fractures on a particular section having 5 withdrawals of rails per 10 km in a year due to fracture and/ or rail flaws detected ultrasonically falling in the category of IMR will have priority while deciding rail renewals. In case the rail failures at fish plated/welded joints are pre-dominant, end cropping with or without welding could be considered. Through Rail Renewal is also allowed in locations of track where more than 30 defective welds per track km are existing.

(b) *Wear on Rails* – (*Back to **Para 429***)

(i) *Limiting Loss of Section* – The limiting loss in rail section, as a criterion for recommending rail renewals shall be as follows:

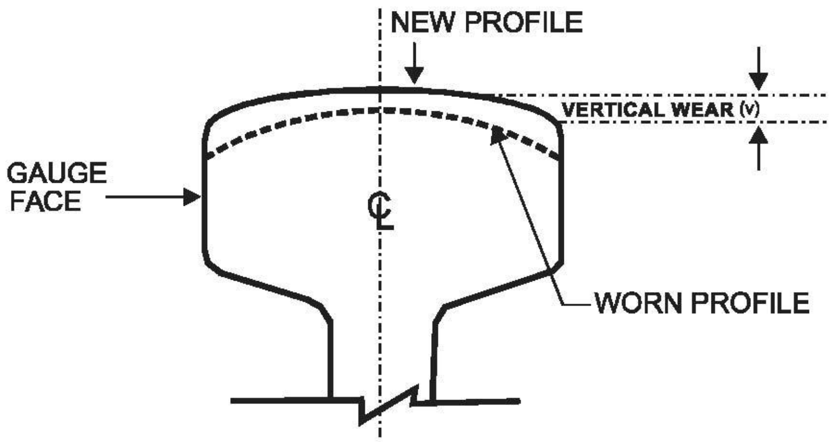
Rail Section	Loss in section in percentage
52 kg/m	6
60 Kg/m	7

Rail wear may be determined by actual weighment, taking rail profiles at ends after un-fishing joints and taking rail profiles with special profile measuring gadgets.

(ii) *Wear due to corrosion* – Corrosion beyond 1.5 mm in the web or foot may be taken as the criterion for wear due to corrosion. Existence of the localized corrosion such as corrosion pits, especially on the underside of the foot and liner biting etc. on rail foot, act as stress raisers for the origin of fatigue cracks and would necessitate renewals.

(iii) *Vertical wear* is to be measured at the centre of the rail either by measuring the height of the worn-out rail by callipers or by plotting the profile. In the first case, the wear is the difference between the height of the new rail and the height of the worn-out rails.

A typical profile showing the measure of vertical wear of the rail is given below –



VERTICAL WEAR

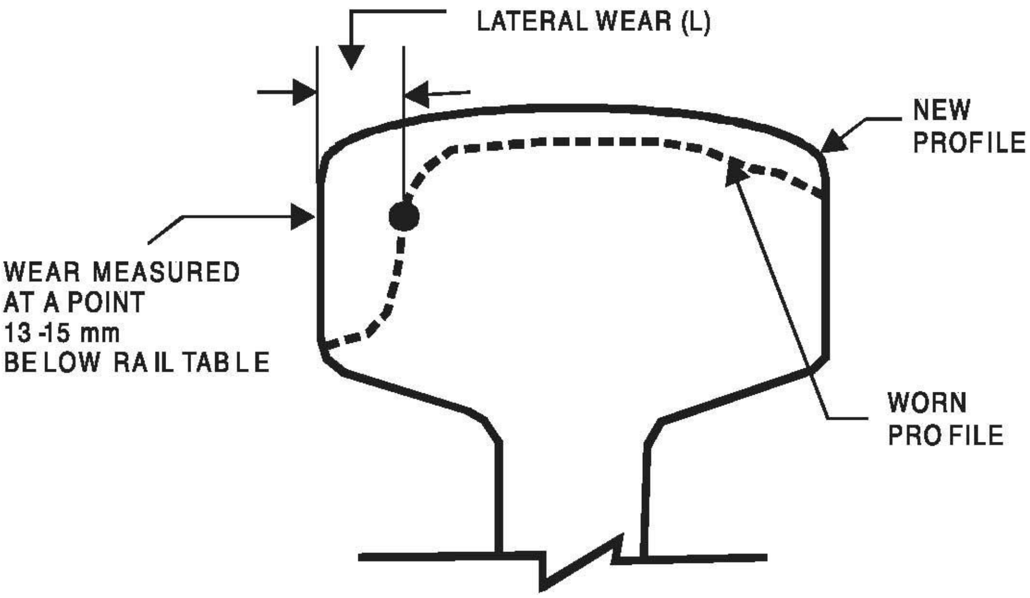
Limits of Vertical wear

Rail Section	Vertical Wear
60 kg/m	13.00 mm
52 kg/m	8.00 mm

(iv) *Lateral Wear* – Limits of lateral wear from relaying considerations are as under

Section	Category of track	Lateral wear
Curves	'A' & 'B' Routes	8 mm
	'C' & 'D' Routes	10 mm
Straight	'A' & 'B' Routes	6 mm
	'C' & 'D' Routes	8 mm

A typical profile of the worn rail showing the measurement of lateral wear is shown below –



Lateral wear is to be measured at 13 to 15 mm below the rail top table. Worn rail profile should be recorded and superimposed over new rail profile to find out the lateral wear.

(c) Maintainability *of track to prescribed standards* – There may be cases, where renewals may be necessary on the following considerations viz,

(i) Poor running quality of track in spite of extra maintenance labour engaged for maintaining the same,

(ii) Disproportionate cost of maintaining the portion of track in safe condition.

(iii) The condition of rails with regard to hogging/battering, scabbing and wheel burns and other conditions such as excessive corrugation of rail as can be ascertained by visual inspections, which affect the running quality of track, and make the track maintenance difficult, should be taken into account while proposing renewals.

Note: Renewals of rail due to hogged and battered rails ends should be considered only if other remedies have not been found to be effective.

(d) *Renewals on consideration of service life in terms of total GMT of traffic carried* –

(i) The rail shall be planned for through renewal after it has carried the minimum total traffic as shown below –

Rail Section	Total GMT carried for	
	72 UTS rails	**90 UTS rails**
60 kg/m	550	800
52 kg/m	350	525

(ii) Service life in terms of total GMT of traffic carried for considering through rail renewal of 60 kg 90 UTS rail would be 1000 GMT on the routes covered by Rail Grinding, provided condition of rail is satisfactory as per the other stipulated criteria mentioned in Para 702 (1)(a), (b) and (c) above.

(iii) The service life in terms of total GMT of traffic carried for considering through rail renewal on the bridge proper and in approaches (up to 100 m on either side) for all the important bridges and such of the major bridges where height of bank is 5.0 m or more, all tunnels and their approaches (up to 100 m on either side) shall be half of the GMT specified above.

(e) *Plan based renewals* – Renewals to pre-determined plan with the objective of modernizing the track structure on selected routes in the quickest possible time may be planned even if it involves premature renewals.

(f) *Renewal of special track components like SEJ, Glued joints etc.* - Renewal of such special track components to be planned after they have degenerated to a level where they are not able to serve their desired purpose.

(2) *Criteria for Renewal of Sleepers* – *(Back to **Para 717, 721**)* Generally a sleeper is serviceable if it can hold gauge, provide satisfactory rail seat and permit rail fastenings being maintained in tight condition, and retain the packing underneath the sleepers. Concrete sleepers will be considered for replacement/renewal if they have developed notches more than 3 mm at rail seat locations, their inserts are broken or elongated, or they are not able to provide required toe load, sleeper themselves are broken or any other reason for which they are not able to hold gauge and level. Where re-sleepering only is justified, this should be carried out in continuous stretches, the released serviceable sleepers being utilized for casual renewals elsewhere. Through sleeper renewal should be considered if the percentage of such sleepers exceeds 20% in a patch. On girder bridges when several sleepers are defective, renewals should be carried out for the full span, the released serviceable sleepers being used for casual renewals on the other spans.

703 Planning of Renewals – Renewals may be planned in as long and continuous lengths as practicable, within the available resources with priorities to meet the projected traffic. Short isolated stretches of 10 km and less, not due for renewal on condition basis may be programmed along with the adjoining lengths, if these stretches do not confirm to the required standards. Priority in planning renewals should be given to busy and important lines.

Track renewal programmes shall be framed by the Chief Track Engineer of each Railway taking into consideration the proposals submitted by the DENs.

704 Track Renewal Programme –

(1) Initiation *of Proposals* – Track renewal proposals are submitted to the DEN by the ADEN on condition basis and on the basis of various inspections carried out during the year. The DEN shall personally check the details submitted by the ADEN at site, compile and initiate the track renewal proposal indicating the priorities. The justification for track works shall be prepared on the basis of factually correct data and submitted through IRPSM. It shall include an abstract estimate of the cost of work and detailed narrative justification covering technical and financial aspects. The DEN should personally satisfy himself about the reasonableness of the proposal and certify that the justification furnished is factually correct. The ADEN should keep a close watch on the condition of all track on their sub-divisions so that every length which after careful and judicious examination requires renewal, is included in the proposals, bearing in mind that the programme is prepared a year in advance and as much as two years may elapse before renewals are carried out. The proposals should reach the Chief Engineer's Office as per the schedule prescribed under IRPSM from time to time.

(2) *Verification of proposals by the Track Cell in the Chief Engineer's Office* – Important items relating to complete track renewal, through sleeper renewal or through rail renewal shall be test checked by the nominated administrative officer of the Headquarters who will –

(a) Co-ordinate the proposals received from the divisions;

(b) Frame programmes for renewal taking into account the sections planned for renewal;

(c) Decide priority for the works;

(d) Satisfy himself that the renewal is unavoidable in the case of track renewal proposals which are justified primarily on condition basis but are premature as far as quantum of traffic carried (GMT) is concerned and

(e) Finalise the track renewal proposal and submit the same to the Chief Track Engineer/Chief Engineer for his approval. On receipt of Railway Board's sanction to the track renewal proposal, arrangements will be made by the Headquarters for supply of track Materials to the Divisions and for co-ordinated execution and control over the works.

705 Track Standards for Renewals – (*Back to **Para 715***)

(1) *Rails* – The recommended section of rail to be adopted for track renewals shall be in accordance with ***Para 205.*** In case of Secondary Renewals, if the condition of rail is satisfactory, it is a good practice to crop the rail ends and weld them into SWR and use them in lesser important lines. The rails should be ultrasonically tested before use. The rails released from primary relaying and not fit for use in secondary relaying should be used in sidings or non-passenger running lines in yards.

(2) *Sleepers and Fastenings* – The recommended types of sleepers and fastenings to be adopted for track renewals should be as given below.

(a) All primary renewals in future shall be carried out with PRC sleepers.

(b) PRC sleepers to be used on loop lines and private sidings.

(3) *Sleeper Density and Sleeper Spacing* –

Sleeper density and spacing of sleepers shall be in accordance with the provisions in ***Para 209.***

(4) *Ballast Section* – The ballast section to be adopted should confirm to the standards laid down in ***Para 212.***

706 Planning for Posting of Staff and Other Facilities –

(1) Special JE/SSEs/P.Way with clerical staff at the executive and office levels as provided in the estimates shall be posted. Provision of gazetted staff may be made in the estimate in the case of large scale permanent way renewals according to the yard sticks laid down.

(2) The JE/SSE/P.Way (In-charge) of track renewal will take over the maintenance of suitable lengths of the section to be re-laid a few days in advance of the actual commencement of the work. He will be responsible for its maintenance till the section is handed over to the maintenance JE/SSE/P.Way after completion of the work.

(3) Watchman for Materials at site and at depots should be appointed. Watchman should be drawn from the permanent gangs.

(4) The Special JE/SSE/P.Way shall make all arrangements for the transportation of Materials, selection of camp sites etc. A fully equipped First Aid Box should be kept at the site of work.

707 Traffic Facilities for Renewals –

(1) In the case of big relaying works, additional sidings as necessary should be provided at the depots for receipt and dispatch of Materials as well as for working of track relaying machines.

(2) Arrangements for special rakes for movement of rails and sleepers should be made by the DEN in consultation with the Operating Department. Where necessary, separate power and crew should be arranged. Provision of additional Engineering Time Allowance in the working time table should be arranged with the Traffic Department.

(3) Traffic blocks may be necessary depending on the method of relaying adopted. In such cases, the DEN should give adequate notice to the Operating Department well in advance for the period during which the track renewal work will be carried out. Such information is useful to the Operating Department in framing the timetable and making the required time available by regulating certain trains, as necessary. In case of any difficulty, the DEN should refer the matter to the Chief Engineer, who will arrange for the required blocks in consultation with the Chief Operating Manager. A minimum block of 2 to 3 hours duration is necessary where renewal works are carried out manually. In the case of mechanical relaying, a minimum block of 3-4 hours is desirable depending upon the type of machines deployed for the work.

(4) When work is being carried out between trains in a location from where the JE/SSE/(P.Way) cannot readily communicate with the Station Master at either side of the block section, a field telephone, on controlled sections may be installed, in order to obtain permit and utilize every suitable interval between trains.

(5) The DEN, in consultation with the Operating Department Officers, should manage to carry out permanent way renewals with the minimum obstruction and detention to traffic.

Whenever possible, the following arrangements should be made in consultation with the Operating Department –

(a) On double line, the traffic of both lines may be worked over the unaffected line under the “Single line-working” regulations.

(b) If there are triple or more lines, two lines may be worked as the up line and the down line respectively, subject to compliance with single line working regulations in respect of the line over which trains run in a direction contrary to the normal usage of that line.

(6) Arrangements should be made for –

(a) Notification by the Operating Department to all concerned regarding work to be executed by Engineering Department.

(b) Imposition of blocks and protection by temporary Engineering fixed signals.

(c) Issue of caution orders to Drivers by Station Masters on daily advice of actual kilometerage received from the SSE/JE in-charge of the work.

708 Speed Restrictions – (*Back to **Para 714*****)** The speed restrictions to be imposed during various sequences of work are given in *Table I, II* and *III* which are as shown below:

Table I
Manual Packing

Day	Sequence of events	Speed in Kmph
1st	Opening, relaying and initial packing	20
2nd	1st through packing	20
3rd	2nd through packing	20
4th to 9th	Picking up of slacks as required	45 (after 2nd through packing)
10th	3rd through packing	45
11th to 19th	Picking up of slacks as required	75 (after 3rd through packing)
Speed raised to normal sectional speed, only after one round of tamping by machine in design mode and stabilisation in controlled settlement mode		

Note – The work of Track renewals on double line should normally proceed in the direction opposite to Traffic.

Table-II (A)
Machine Packing followed by stabilisation using DTS
(Manual laying of sleepers)

Day	Sequence of Events	Speed in Kmph
1st	Opening , Relaying and Packing	20
2nd	Ballasting and Manual packing	20
3rd	1st Tamping in smoothening mode and 1st stabilisation in maximum settlement mode.	40 (after tamping and stabilisation)
4th & 5th	Ballasting	40
6th	2nd tamping in smoothening mode and 2nd stabilisation in maximum settlement mode.	75 (after tamping and stabilisation)
7th & 8th	Survey of track for design tamping as per IRTMM, boxing of ballast etc.,	75
9th	3rd tamping in design mode and 3rd stabilisation in controlled settlement mode.	Speed up to 110 (after tamping and stabilisation)
10th	Checking ride quality and attention as required	Normal speed

Table-II (B)
Machine Packing followed by stabilisation using DTS
(Mechanised laying of Track by TLE)

Day	Sequence of Events	Speed in Kmph
1st	Opening, Relaying and equalisation of ballast	20
2nd & 3rd	Rail renewal and welding & attention to track as required	20
4th	1st tamping in smoothening mode and 1st stabilisation in maximum settlement mode.	40 (after tamping and stabilisation)
5th	Ballasting	40
6th	2nd tamping in smoothening mode and 2nd stabilisation in maximum settlement mode.	75 (after tamping and stabilisation)
7th & 8th	Survey of track for design tamping as per IRTMM, boxing of ballast etc.	75
9th	3rd tamping in design mode and 3rd stabilisation in controlled settlement mode.	Speed up to 110 (after tamping and stabilisation
10th	Checking ride quality and attention as required	Normal speed

Table-II (C)
Machine Packing followed by stabilisation using DTS
(Mechanised laying of Track by TRT)

Day	Sequence of Events	Speed in Kmph
1st	Opening, Relaying and equalisation of ballast	30
2nd	Welding and Manual attention to track as required	30
3rd	1st tamping in smoothening mode and 1st stabilisation in maximum settlement mode.	40 (after tamping and stabilisation)
4th	Ballasting	40
5th	2nd tamping in smoothening mode and 2nd stabilisation in maximum settlement mode.	75 (after tamping and stabilisation)
6th & 7th	Survey of track for design tamping as per IRTMM, boxing of ballast etc.	75
8th	3rd tamping in design mode and 3rd stabilisation in controlled settlement mode.	Speed up to 110 (after tamping and stabilisation)
9th	Checking ride quality and attention as required	Normal speed

Note: The above schedule for relaxing speed is based only on expected track Parameters and consolidation likely to be achieved after tamping and stabilisation. Other factors like ballast deficiency, rail condition or joints in track may further restrict the speed mentioned above.

Table – III(A)

Mechanized laying of track by Track Laying Equipment (TLE) followed by machine tamping without Dynamic Track Stabilizer (DTS)

Day	Sequence of Events	Speed in Kmph
1st	Opening, relaying, equalization of ballast and manual packing.	20
2nd & 3rd	Rail renewal, welding and attention to track as required.	20
4th	First tamping in smoothening mode.	20
5th & 6th	Ballasting, Picking up of slacks and stabilization of track by passage of traffic.	40
7th	Second tamping in smoothening mode.	40
8th & 9th	Survey of track for design mode tamping as per annexure 2.16 of IRTMM, boxing of ballast section and tidying. Stabilization of track by passage of traffic.	75
10th	Third tamping in design mode.	75
11th & 12th	Boxing of ballast section, tidying and stabilization of track by passage of traffic.	110
14th	Foot plate/last vehicle inspection and speed raising	130
16th	Foot plate/last vehicle inspection and speed raising	160

Note: ***i.*** *Above schedule is based on para 337(5) and shall be followed for minimum 10 GMT traffic density routes. For routes having traffic density less than 10 GMT, consolidation period provided should be suitably increased to ensure passage of minimum 50000 tonnes of traffic before relaxation of speed after each round of tamping.*

ii. *Full ballasting as per prescribed ballast profile to be ensured before the third round of tamping.*

Table – III(B)

Mechanized laying of track by Track Relaying Train (TRT) followed by machine tamping without DTS

Day	Sequence of Events	Speed in Kmph
1st	Opening, relaying, equalization of ballast and manual packing.	30
2nd	Welding and manual attention to track as required.	30
3rd	First tamping in smoothening mode.	30
4th & 5th	Ballasting, Picking up of slacks and stabilization of track by passage of traffic.	40
6th	Second tamping in smoothening mode.	40
7th & 8th	Survey of track for design mode tamping as per annexure 2.16 of IRTMM, boxing of ballast section and tidying. Stabilization of track by passage of traffic.	75
9th	Third tamping in design mode.	75
10th & 11th	Boxing of ballast section, tidying and stabilization of track by passage of traffic.	110
13th	Foot plate/last vehicle inspection and speed raising	130
15th	Foot plate/last vehicle inspection and speed raising	160

Note: ***i.*** *Above schedule is based on para 337(5) and shall be followed for minimum 10 GMT traffic density routes. For routes having traffic density less than 10 GMT, consolidation period provided should be suitably increased to ensure passage of minimum 50000 tonnes of traffic before relaxation of speed after each round of tamping.*

ii. *Full ballasting as per prescribed ballast profile to be ensured before the third round of tamping.*

709 Project Report for Track Renewal Works – Systematic and meticulous planning for various items of execution of track works is essential for achieving quality, economy and timely completion of works. For every sanctioned track work e.g. CTR, TSR, TRR, deep screening, bridge sleeper renewal etc., a detailed project report should be prepared. The report should, inter alia, cover the following aspects:

(1) *Details of Work* – Pink book detail, scope of work, location details, cost and estimate particulars etc.

(2) *Existing track structure* – Inventory of existing track structure including the rails, sleepers, fittings, turnouts, SEJs, Glued Joints, ballast quantity/deficiency in track, width of formation, details of level crossings, bridges, electrical fittings, curves, height of bank/ cuttings, yards, sidings, etc. and other details should be taken as prescribed in P.Way diagram.

(3) *Classification of Track Materials* – During inventory of the existing track structure by foot by foot survey, identification, classification and colour marking of existing track Materials as second hand and scrap would be done as provided in ***Para 721 & 722***. The classification should be approved by the competent authority. Action plan for stacking/ storage and disposal of the released materials should be clearly indicated. Inventory of existing track materials would normally be prepared jointly by the SSE/P.Way of the section and the SSE/JE/P.Way (Spl).

(4) *Proposed Track Structure* – The proposed P.Way diagram of the affected length should be prepared in the same format as done for the existing track structure and incorporated in the project report.

(5) *Existing/Proposed Gradient Profile* – The levels of existing track should be taken at every 20 metres and a gradient diagram prepared. Introduction of vertical curves should be critically examined and to be shown in the diagram where required. Lowering of track should be avoided. Precise lift of track at girder bridges should be worked out and a separate scheme developed for lifting of girders on each of the affected bridges. Similarly, the magnitude of lifting at level crossing should be worked out and indicated in the report. Care should be taken to keep the road surface at one level on level crossings spanning to across multiple tracks. This may require regrading of adjacent lines too.

(6) *Realignment of Curves* – All curves should be measured afresh and slews worked out for realignment wherever necessary, keeping the obligatory points in view.

(7) *Method of execution* – The work should be executed “bottom upwards” i.e. sequence of execution of works will be in the following order –

Formation → Ballast → Sleepers → Rails

(8) *Formation* –

(a) Repair and widening of cess – The project report should indicate the requirement of and plan for widening of formation in both banks and cuttings wherever necessary. Provision of proper drains in cuttings should also be planned.

(b) Formation treatment – Areas needing formation rehabilitation should be identified and a study for possible solutions and method of execution of the rehabilitation scheme should form part of the project report.

(9) *Ballast* – The requirement indicating bifurcation of cess supply and depot supply and the source and means of each should be spelt out clearly (mode of providing ballast cushion i.e. deep screening or raising should be identified along with sketches of cross sections present and proposed). Sleeper renewal would normally not be started unless adequate arrangements for supply of ballast have been made.

(10) *Transportation of P.Way Materials* – The mode of transportation for various track

components and unloading of rails and sleepers in particular, at the work sites should be indicated in the project report.

(11) *Welding* – The complete details of welding requirements, the arrangements need to be made for its execution whether departmentally or through contract should be clearly indicated in the report.

(12) *Renewal of Turnouts, Bridge Sleeper, etc.* – The project report should cover the complete details of turnouts, bridge sleepers, level crossings, etc. where renewal is to be carried out. Whether turnouts are to be laid manually or by mechanized means, should be clearly brought out indicating the arrangements made(the report should also include the mode and agency for overhauling, track laying and making up of road surface at the level crossings).

(13) *Use of Machines* – The requirement of machines for renewal (if mechanized renewal is planned) deep screening (if mechanized deep screening is planned) and tamping/ stabilizing and the duration for which the machines are required should be indicated. The machines that would be deployed should be identified and staff nominated. The planning for repair of machines at the works site, supply of fuel and other consumables should be planned. The requirement of additional lines in the existing yards for making base depot and arrangements made for the same should be indicated.

(14) *Contracts* – The contracts that are required to be entered into for various activities of works and the activities, which are to be done departmentally, should be spelt out. The planning for deployment of staff/supervisors for execution at various activities should be indicated.

(15) *Material Planning* – The material requirement should indicate the materials to be arranged by the headquarters and by the Divisions. Against each material, the proper nomenclature and drawing number should be indicated. Rails nos. and sizes (including lead rails, checkrails etc.), sleepers (including specials), rails and sleeper fastenings, switches and crossings, level crossing and bridge sleepers and fittings, etc. should be fully covered. The consignee particulars and the destination, the mode of transport should also be indicated.

(16) *Manpower Planning* – The requirement of manpower including the officers, supervisors, artisan and other staff should be worked out with minute details. The arrangements made for camping of these officials and mobilization should be reflected.

(17) *LWR/CWR plans* – For welding of rails into LWR/CWR, the LWR plan should be got approved by the competent authority in advance. Such plan should form part of the project reports.

(18) *Requirement of Speed Restrictions, Traffic Blocks and other Material Train* – Planning for execution of track renewal works should be such that the time loss on account of speed restriction is minimal and is within the permissible limits. The report should indicate requirement of speed restrictions and traffic blocks together with duration. The corridor for blocks is required to be planned in consultation with the Operating Department and accordingly reflected in the report after obtaining the approval of DRM. Arrangements made for various types of wagons for transportation of ballast, sleepers, etc. together with requirement of locomotives should be indicated in the report in consultation with Sr. DOM and with the approval of DRM.

(19) *Monitoring Mechanism* – The list of all activities involved and the time estimation for each activity should be worked out. These activities should be sequenced and co-related in logical manner and network diagram prepared duly identifying the critical activities. These should form part of the project report.

(20) The detailed project report covering the various points as mentioned above should be prepared as soon as the approval of Board to include the works in FWP is conveyed

to the Railways. These reports should be submitted to headquarters for scrutiny and approval.

710 Preliminary Works –

(1) Where complete track renewal or through sleeper renewal is planned, deep screening of ballast should also be planned and executed. The progress of deep screening should match with the progress of renewals and should precede complete track renewal or through sleeper renewal by a couple of days.

(2) Treatment of bad formation should be carried out in advance of the relaying.

(3) Reference for Centre line and level for realignment of curves and straight should be fixed beforehand. Where necessary, curves should be realigned and transitioned. Longer transitions should be provided to cater for future increase in speed wherever possible. In case heavy slewing is necessary for providing longer transitions, centre line indicating revised alignments should be fixed and new track laid accordingly. The formation should be suitably widened.

(4) On sections where creep is noticeable, joints should be squared and gaps rectified for short length at the point of commencement.

(5) On section with single rail and 3 rail panel, as a preliminary measure, the JE/SSE/P.Way should actually mark out the position of the new rail joints with a tape. The lengths marked out should be the length of the new rail together with one expansion space. On a curve, the rail lengths should be set out along each rail, starting from a point on the straight where the sites of the two joints have been set out opposite one another by means of square. The square should be used at each joint on the curve to determine the amount by which the inner rails gaining over the outer rail. As soon as the lead of the inner rail is equal to half the distance between fish bolt holes, a length shall be sawn off the end of the rail equal to the full distance and a new fish bolt hole drilled. The length of cut rails varies according to the degree of each curve, and should be determined beforehand; a cut rail will be required after every two or three full length rails depending on the curvature.

(6) Sufficient track gauges, gauge-cum-levels, spanners, keyman hammers, insert cleaning brush, wire basket, crow bars, tommy bars, claw bars, beaters, ballast rakes, wire claws, forks, wire brushes, ballast screens, rail thermometers, expansion liners, slotted fish-plates, rail closures, combination fish-plates, and all tools and equipment necessary for efficient execution of work including that for rail cutting, rail drilling and mechanical tampers where used, should be arranged by the JE/SSE(P.Way), in advance. Before starting and during the course of work, the track gauges and the gauge-cum-levels should be checked periodically for their accuracy.

(7) Labour should be properly organized and suitably distributed to ensure maximum efficiency.

(8) Before carrying out track renewal work in electrified areas sufficient notice should be given to the Electrical Traction Distribution Department so that they can arrange for adjustment of overhead wires to conform to the new alignment and level. They will also arrange for bonding the new track. In track circuited sections and in yards where change in yard layout is contemplated notice should be given to the Signalling Department for getting assistance in executing joint works. Advance Notice as laid down by the respective railway should be given to the Operating Department of the actual commencement of work by the JE/SSE/P.Way, for sending advice to all concerned. The safety of traffic is of Paramount consideration.

711 Unloading of Rails, Sleepers and Fastenings –

(1) It should be ensured that Materials are unloaded fairly opposite to the position where they are to be laid. Care should be taken to avoid unloading of Materials in excess of the actual requirement, so as to avoid double handling.

(2) Utmost care should be exercised in unloading rails. Ramps made of unserviceable rails should be used for unloading. Short welded panels as well as rail panels for laying welded rails may be unloaded by “end-off-loading” method, wherever possible.

(3) The unloaded panels should be carefully stacked on a level base; care being taken to prevent formation of kinks. Flat footed rails, as a rule should rest on the foot. Any carelessness in unloading and stacking is liable to cause irreparable damage, resulting in bad running. While carrying rails they should be supported at several places by rail tongs or rail slings. Carrying of rails and heavy articles on the head or shoulder should be avoided. Kinked rails must be jim-crowed and straightened. Punch marks on rails or marking by chisel should be prohibited as these cause incipient failures.

(4) New rails and sleepers for the next day’s work should be hauled from the place of unloading to opposite to the place, where they are to be laid.

(5) Material new or old, lying alongside the track is always a potential source of danger and efforts should be made to remove the same as soon as possible.

(6) Detailed guidelines on unloading of rails and related to operation of End Unloading Roller Rakes as contained in *RDSO’s Guidelines for Handling and Stacking of Rails (CT-35)* shall be followed.

712 Methods of Carrying out Renewal – Complete track renewal is carried out by any one of the following methods –

(1) With Mechanical equipment.

(2) Manual Method of Relaying.

Detailed instructions shall be issued by the ADEN regarding the method of relaying, which depends on the site conditions and availability of machines.

713 Relaying with Mechanical Equipment – This method should be adopted while carrying out track renewals with concrete sleepers, as the manual handling of concrete sleepers is difficult and may cause damage to the sleepers. It can be used with advantage for carrying out relaying with other types of sleepers also.

The preliminary (preparatory) work prior to relaying at site, the actual relaying process at site and the post relaying operations as described in IRTMM should be followed.

714 Manual Method of Relaying -

The method described can be followed for single rail, 3 rail panel and LWR track. For LWR track, in addition to the following, the precautions described in ***Para 346 & 347*** shall also be followed.

(1) *General* – In this method Through Sleeper Renewals (TSR) is carried out first. Through Rail Renewal (TRR) is carried out after the track gets consolidated by three rounds of through packing and also on account of passage of trains. This method can be carried out when the section of the new rail is the same as the existing rail or where 52kg/m rails are renewed by 60 kg/m rails.

(2) *Preparatory Work before Relaying –*

(a) The exact position of rail joints after allowing for one expansion gap each is marked accurately with steel tape on the base rail.

(b) Position of new sleepers is then marked on the base rail with white paint and transferred to the opposite rail by means of T-square.

(c) A speed restriction of 20 Kmph is imposed and temporary Engineering restriction boards are fixed at appropriate places.

(3) *Work during Relaying –*

(a) Deep screening is carried out under speed restriction. While carrying out the deep screening work, renewal of sleepers is also carried out simultaneously. The work is so programmed that at the end of a day's work both deep screening and re-sleepering is completed in a continuous stretch without leaving any gap.

(b) At the end of the day's work, the track is lifted and packed to the final level and suitable ramp should be provided to meet with the levels of the existing track.

(c) After three rounds of through packing, through rail renewal is carried out under suitable short block.

(d) The final round of through packing is undertaken and the speed relaxed to normal in accordance with the time scheduled described in **Para 708 Table I***.*

Note – If adequate blocks are available for carrying out the work of deep screening, both the deep screening and sleeper renewal works are carried out in a continuous stretch. If, however, the work is carried out under speed restriction, as described above, every fifth sleeper is renewed leaving at least four sleeper space in-between intact.

(4) *Post Relaying Works –*

During this period, special attention is given to the following items –

(a) Alignment, surfacing, gauging, cross-levels, tightening of fittings & greasing of ERCs.

(b) Boxing and providing full ballast section.

(c) Making up cess to the required width.

(d) Providing curve boards over each curve, providing correct super-elevation on curves.

(e) Cleaning of side drains,

(f) Removal of all released Materials and clearing the site.

715 Essential Points to be observed During Linking –

(1) *Laying of Rails –*

(a) Correct expansion gap should be provided according to the temperature at the time of laying, in accordance with the existing instructions as contained in ***Para 319*** in the case of SWR. In the case of free rails (single rails) the recommended initial laying gap for 12/13 m rail length for various temperature ranges is as follows:

Rail temperature range	Recommended initial laying gap for12/13 m rail length
0° to 10°C	10 mm
10° to 25°C	8 mm
25° to 40°C	6 mm
40° to 55°C	4 mm
55° to 70°C	2 mm
Above 70°C	Zero

(b) Fishing surfaces of rail and fish-plates should be greased before putting the fish-plates in position.

(c) Bent rails shall on no account be put into the track. These should be straightened with a jim crow, before laying.

(d) The rails used at Level Crossings and Station Yards should be given a coat of anticorrosive painting as per ***Para 613(2)*** before laying.

(e) The shortest length of rails to be used in track shall be as per **Para 614***.*

(f) Rails of the same length should be used in pairs.

(2) *Rail Joints* –

(a) Rail joints shall be laid square to track. Provisions of ***Para 421 and 422*** will apply while laying track on curves.

(b) Provision of rail joints at Level Crossings and approaches will be governed by provisions in ***Para 918.***

(c) Provision of rail joints on Bridges and approaches will be governed by provisions in ***Para 226*****.**

(3) *Spacing of Sleepers* – ***Para 209*** lays down the standard spacing to be adopted in the case of fishplated track, SWR and LWR.

(4) *Gauge on Straights and Curves* – The standards laid down for gauge in ***Para 520 (3) (a)*** may be followed while relaying is carried out.

(5) *Provisions of Creep Posts* – Provision in ***Para 321(5)*** may be followed.

716 Track Laying standards –

(1) Utmost care should be taken during linking to ensure good quality of work, which on no account should be allowed to suffer.

(2) As a good practice, the laying standards of track geometry during primary renewals should be achieved (Track laid with new Materials). The track geometry will be recorded three months after the speed is raised to normal.

(a) Track Parameters to be measured in floating condition **(refer *Para 520 (3))***

(b) Standard Deviation and Peak based limits for unevenness and alignment as measured by TRC, shall be as per ***Para 520(2).***

717 Renewal of Points and Crossing –

(1) *Renewal of Points and Crossing shall be planned under following conditions:*

(a) Wear on switches and crossing reaches as per **Para 429 (2) (c)** and **Para 429 (3) (e).**

(b) After it has carried the minimum total traffic as shown below or on condition basis as decided by Chief Track Engineer of the Railway for item at SN 1 & 2 below:

S. No	Item	GMT carried	
		52 Kg	60 Kg
1	Fabricated switch (ORS)	250	300
2	Thick Web Switch	500	800
3	CMS crossing after three rounds of in-situ reconditioning using Robotic welding machine	350	350
4	WCMS Crossing after three rounds of in-situ reconditioning using robotic welding machine	-	350

(c) Renewal of Sleepers when they become due as per **Para 702 (2)**

(d) When the rail section on either side is changed to a higher section in through running lines.

(2) Any modification in the layout of passenger lines should be carried out with the sanction of the Commissioner of Railway Safety.

(3) The following aspects should be considered while relaying points and crossings in station yards –

(a) When points and crossings are renewed, particular care should be taken to effect improvements in the lay out.

(b) The renewal should as a rule be carried out with standard rail sections, in accordance with the standard drawings and not with obsolescent sections. Special crossing in main line, loops and sidings should be replaced with standard crossings.

(c) At least one rail length on either side of the turnout should have the same section of rail as the turnout.

(d) References must be fixed for the centre line of new assembly, particular care being taken to fix accurately the inter-section point of the turnout track and the main line track, from which measurements are taken to fix other points.

(e) Joints on the SRJ and lead rail should be welded.

(f) *Gauge tie Plates* – New gauge tie plates in replacement of the unserviceable ones should be fitted jointly by the JE/SSE/P.Way and the JE/SSE (Signal). The JE/SSE/P.Way will be responsible for the correct gauging of the switches and the JE/SSE (Signal) for the correct fixing of the interlocking apparatus.

(g) *Switches* – Before stretcher bars are connected, each tongue rail should be examined to see that it lies properly housed against the stock rail upto JOH, without any pressure being applied to keep it in position. If a tongue rail does not fit properly against the stock rail, it should be carefully jim-crowed.

In case of interlocked points close co-ordination should be maintained by the JE/SSE/P.Way with the JE/SSE/Signal and JE/SSE (Elect/TRD) (in case of electrified sections) and work should be carried out jointly.

(4) *Actual procedure of carrying out renewals* –

(a) Before renewing points and crossings, the ballast in the layout should be deep screened. After deep screening, the ballast should be laid only up to the bottom of the sleepers and extra quantity of ballast kept ready by the side of the layout for fully ballasting the layout, after renewal. Equipment for rail cutting and rail drilling should be kept ready at site.

(b) Renewals can be carried out by any of the following methods –

(i) *Building up at the site (Manual)* – In this method, all the Permanent Way Materials for the turnout are brought to the site and the turnout assembled at site in its correct position after dismantling the old turnout.

(ii) *Slewing of Pre-assembled turnout at site (Manual)* – The layout is assembled by the side of the existing layout. The ground on which the turnout is to be assembled is levelled first. If necessary room is not available, additional space is created by doing extra earthwork or by constructing a working platform with the old rails and sleepers. The assembly is usually built on a rail grid, the top surface of which is greased beforehand to facilitate easy slewing. During the block period, the existing layout is dismantled and removed and the pre-assembled layout is slewed in its correct position, aligned and packed.

(iii) Preassembling &laying with mechanical (Machines) – *IRTMM* may be referred for mechanized laying of turn out**.**

718 Renewal of Track Fittings and other track components- (*Back to **Para 702***)

Renewal of track fittings to be planned after they have degenerated to a level where they are not able to serve their desired purpose. Service Life of different fittings are as under:

S. No.	Item	Location	Criteria for Renewal
1	GFN-66 Liners	Plain Track	200 GMT or 4 years whichever is earlier or on condition basis as decided by CTE
2	Metal Liner	Plain Track	400 GMT or 8 years whichever is earlier or on condition basis as decided by CTE
3	ERC	Plain Track	400 GMT or 8 years whichever is earlier or on condition basis as decided by CTE
4	GRSP	Plain Track	200 GMT or 4 years whichever is earlier or on condition basis as decided by CTE
5	CGRSP	Plain Track	400 GMT or 8 years whichever is earlier or on condition basis as decided by CTE

Note: The service life of P.Way components at special locations like turnout, washable aprons, Ballastless Track being used as washable apron, Curves sharper than 5 Degree, SEJ, Gradient sharper than 1 in 100, coastal areas, station yards including approaches etc. is 50% that of plain track or on condition basis as decided by CTE.

719 Sleepers in Yards and Running Lines –

(1) *Sleeper Density –*

(a) For loop lines, sleeper density would be as per ***Para 209(2)***.

(b) For other running lines and busy lines in the yards, sleeper density would be M+4.

(c) Other yard lines should have a sleeper density of M + 2.

Where, M is the length of free rail (of 13m).

(d) For symmetrical splits where speeds on the main and loop lines will be the same, the sleeper density to be adopted on the loop line shall be the same as that on the main line.

(2) *Types of Sleepers –*

Concrete sleepers should be used for both running lines and yard lines.

720 Rails in Station Yards –

(1) In non-running lines of yards, only class II rail will be used.

(2) While carrying out through rail renewals or complete track renewal in yards, short welded panels of 3 rail length may be used. However, it is preferable to weld them into LWR.

(3) LWR may be provided in yards in terms of and subject to conditions laid down in **Chapter No 3, Part D** pertaining to provisions on LWR.

721 Classification and Use of Released Material – (*Back to **Para 709***)

(1) *Need for Classification-*

(a) After a section of track has been renewed, the released Material shall be carefully sorted out so that greatest possible use may be made of them. They should then be classified by the SSE/P.Way. Tools and plant left over should also be classified and action taken on their disposal.

(b) The rails should be graded according to their weight and condition into groups suitable for re-use in running lines, non-running lines and for conversion into posts or structural members for various purposes or for sale as scrap. Where rail-ends are worn or hogged, the feasibility of "Cropping" the ends should be considered if the condition of the rail is otherwise satisfactory.

(c) The sleepers should be sorted into various grades suitable for re-use in the track or as unserviceable Material not fit for use in track works.

(d) Fish-plates, fish-bolts, ERCs & Liners should be sorted into those suitable for re-use and the rest as scrap.

(e) If the switches and crossings themselves are badly worn to be re-used, the small fittings such as stretcher bars, switch anchors, stud-bolts and blocks can generally be used. Switches and Crossings should be reconditioned by welding, if the wear is not excessive.

(2) *Basis for Classification* – For the purpose of classification, Permanent Way Materials should be divided into three classes depending upon the section and condition as detailed below –

(a) Class I Material is that which is new and of standard section. New items of obsolescent sections, which are interchangeable with standard Materials and are purchased from time to time to prevent wastage of other serviceable Material, should be brought on to the stock account as Class I Material. These items should be included in the price lists for the miscellaneous and common items.

No other Material of an obsolescent section is to be treated as Class I, even though it may never have been put in the track.

(b) Class II Material includes all new Material of obsolescent sections other than those included under Class I and all standard and obsolete Material released from the track and fit for further use on track.

Class II released rails should be classified and sub-divided as under –

Class II (a) rails fit for use in running lines.

Class II (b) rails fit for use in non-running lines.

(c) Class III Materials shall include all Materials that has become unserviceable. This is either metal scrap or unserviceable sleepers. This class will include all rails which are neither Class I nor Class II.

(3) *Accountal of released P.Way Materials* –

(a) The quantity of released Materials from every work included for track renewal/ gauge conversion will be based on yardsticks for loss of weight to be fixed on the basis of data collected during foot by foot survey. If there is more than one work on the same route, near to each other and under similar ground conditions, only one set of yardsticks would suffice.

(b) List of Materials likely to be released will be prepared indicating the quantum of such Materials separately as second hand (SH) and scrap following the instructions given in sub *Para (2)* above.

(c) While second hand Materials will be indicated only in length/nos. in case of scrap Materials, the accountal will be following:

(i) Rails – in length, then converted to weight.

(ii) Sleepers – nos. separately as whole and in parts.

(iii) Fittings & fastenings – by weight.

(d) During foot by foot survey, actual observations will be recorded jointly by SSE/P.Way and ISA/Stock Verifier giving the percentage loss of weight over the new component for each and every Material likely to be declared as `scrap'. This can be done by actual weighment of few representative samples. Concrete sleepers that have been replaced on condition basis as per ***Para 702 (2)*** shall be declared as scrap.

(e) The yardsticks will then be approved by the Sr.DEN/DEN personally based on the report duly test checked by ADEN or DEN. These will specify the maximum percentage loss of weight for different components under different ground conditions as per format given in the ***Annexure - 7/1.***

(f) The conversion to weight in case of each of the items for purpose of accountal will then be done by the SSE/P.Way on the basis of the specified percentage loss of weight over the new components. In case, however, some abnormal variation of weight is observed after the Materials have been released and the percentage loss is more than that specified for that category, specific justification will have to be recorded for the same by the SSE/P.Way and all such cases would have to be certified by DEN/Sr.DEN after actual sample checking at site.

(g) In case, however, the actual loss after release is seen to be lower than the yardstick the accountal will be done on the basis of the actual.

(h) After actual releases of Materials, the SSE/P.Way will take the releases on books on the basis of summary sheet as per ***Annexure - 7/2*****.**

(i) The sectional ADEN will carry out test checks to the extent of 20% of each item and make entries to this effect in the summary sheet. The sectional DEN/ Sr.DEN will also carry out random checks to ensure that the category and weight of releases are correct to the maximum possible extent.

(j) The periodical returns for track renewals/gauge conversions are to be submitted at the laid down periodicity as per rules and the existing procedure for checking should be streamlined to ensure that the returns are looked into detail in the ADEN's office in nos.as also their conversion in weight. The returns will be specifically checked with regard to the correctness of input/output Materials having been prepared on the basis of instructions given in Sub Para (2) above.

(k) As an internal check by the department, one of the works accountants in the division with engineering department or with construction department should be made responsible to carry out methodical checks of all MAS (Material At Site) accounts of track renewals/gauge conversion works.

(l) In cases where the track work is to be done by contractor, the list of released Materials shall be jointly prepared on the basis of a field survey to be conducted by the SSE/P.Way and contractor's representative after the work has been awarded but before the dismantling work is allowed to commence. The contractor shall be bound to hand over the Materials according to the said agreed list and should be responsible for any shortages.

722 Marking of Permanent Way Material – All Permanent Way Material should be distinguished as follows or as otherwise directed – (*Back to* ***Note of Annexure - 2/1***, ***709***)

(1) *Class I* – No marks.

(2) *Class II*

(a) For rails –

(i) Class II (a) Second hand rail fit to be re-laid in running lines – Ends to be painted with a daub of white.

(ii) Class II (b) Second hand rail fit for use in non-running lines – Ends to be painted with a daub of yellow.

(b) *For other track Materials like sleepers etc.,* -Second hand fit for use in track works to be painted with a daub of white.

(3) *Unserviceable Material Class III - not fit for use* – Ends to be painted with a daub of red.

It should be ensured by the ADEN and JE/SSE/P.Way that the Materials of each class including fittings, are separately stacked for convenience of accounting and despatch and indication plates erected accordingly.

723 Works to be attended after completion of relaying –

(1) *Classification and loading of released Materials* – Materials as and when removed during the progress of relaying should be collected and classified and despatched to the destination. No released Material should be left at the site of the renewals. Relaying work shall not be considered complete until all released Materials are removed from site and necessary credit accorded.

(2) *Temporary strengthening of gangs* – After the relaying is completed it would be necessary to strengthen the regular maintenance gangs temporarily to maintain it to the required standard for the maximum permissible speed on the section.

(3) *Description Boards* – Boards displaying information in regard to track Materials laid for special or experimental purposes should be erected at each end of the length over which the trial is being conducted & maintained only for so long as the Materials remain under trial.

(4) *Revision of Permanent Way Diagrams* – As soon as the rail or the sleeper replacement work is completed, the Permanent Way diagrams, the station yard diagrams and the index section that embody the detailed particulars of the track in regard to the year of laying, section of rail, type of sleepers, fish-plates& fittings should be amended up-to-date in the Divisional office and head-quarter. The same should be advised to all concerned. The daily progress details will also be updated in TMS. Copies of amended diagrams should be issued by the DEN to the ADEN & SSE/P.Way concerned for record in their offices.

(5) *Closing of the Accounts* – The account for relaying works should be closed within 3 months of completion of the work & completion report submitted.

Annexure - 7/1- *Para 721*

Loss of Weight of Released Scrap (P.Way Components)

Description of Work:____________________________________

Foot by Foot Survey Carried Out by: __________________________________

Date: ______________________

Division: __________________

S. No.	Description of Material (Rail, Sleeper, Fittings etc.)	Weight of New item	Max.% loss of weight on release	Weight of released item	Remarks
(1)					
(2)					
(3)					
(4)					

Annexure - 7/2-*Para 721*

Summary of P.Way Material to be released

Name of work____

Division……………………section…………………..SSE/P.Way………………………

DEN/Sr.DEN____

Period of execution of work from dd/mm/yy to dd/mm/yy__________________________

Km	Category of section	Name of Material	List of Material to be released				Remarks for abnormality, if any	Sign. of JE//SSE/P.Way (In charge/ Spl)	Test check by ADEN	Remarks
			Service-able or scrap	If scrap						
				No/ Length	Rate (/Wt.)	Wt.				

CHAPTER – 8

ENGINEERING RESTRICTIONS & INDICATORS, WORKING OF TROLLIES, LORRIES & MATERIAL TRAINS

PART – A

Engineering Restrictions & Indicators

801 Work Involving Danger to Train or Traffic – A gang shall not commence or carry on any work which will involve danger to trains or to traffic without the previous permission of the JE/SSE/P.Way or of some competent railway servant appointed on this behalf by special instructions. The railway servant who has given the permission should be himself present at site to supervise the work.

802 Carrying Out of Works, in case of Emergency – In the case of emergency, when the requirements of safety warrant the commencement of the work by the railway servant at site, he shall himself ensure that engineering signals are exhibited at specified distances according to rules and flagmen are posted with necessary equipment to man them, before commencing the work.

803 Responsibility of the Railway Servant In-charge of the Work – The railway servant in-charge of the work, who is present at the site of work, shall ensure that Engineering signals are exhibited at the specified distance according to rules and flagmen are posted with necessary equipment to man them. Trains shall be permitted over the track under repair at such restricted speed as is specified, only after the track is rendered safe for the traffic. He should ensure that the provisions of **Para 804** are fulfilled before commencing the work.

804 Works, which Obstruct the Line –

(1) *Precautions before commencing operations, which would obstruct the line* – No person employed on the way, works or bridges shall, cause discontinuity in track, disconnect points or signals or commence any other operation which would obstruct the line without obtaining the written permission of the Station Master who shall ensure that all necessary signals have been placed at 'ON'. In addition, the employee mentioned above shall also ensure that the necessary stop signals like banner flags, detonators and hand signal flags have also been placed/exhibited at the prescribed locations as per **Para 806.**

Provided further that in emergent cases the persons undertaking such operations shall first bring the train to stop as stipulated in **Para 812** and advice the driver of the train about the need to stop the train through a written memo. The railway servant shall simultaneously arrange to send a message to the Station Master for the need to block the track as per **Para 810** and obtain written confirmation of the same. The work which may lead to obstruction to the track shall however be done only during the traffic block, the written confirmation for which shall be obtained from the concerned Station Master. On completion of the work again the authorized railway servant shall advise the driver through a written memo to proceed at the prescribed speed.

(2) *Works* requiring *complete block protection* – The following category of works will necessarily require complete block protection:

- (a) Category of works where track is required to be occupied:
  - (i) Working of on-track machines
  - (ii) Working of material trains or girder specials
  - (iii) Working of dip-lorries
  - (iv) Working of motor trollies

(v) Working of push trolley in heavily graded sections.

(vi) Working of push trolley in sections where visibility is obstructed

(vii) Push trolley in long tunnels.

(b) Works where discontinuity in track is created or such conditions are created which may result in discontinuity or obstruction to running track:

(i) Through rail renewal

(ii) Casual replacement of rail

(iii) Replacement of SEJs or replacement of buffer rail with SEJ

(iv) Insertion or replacement of glued joints

(v) Temporary/Permanent repairs of rail fractures

(vi) Temporary/Permanent repairs of rail on account of buckling

(vii) Replacement of switch/crossing or any part of turnouts

(viii) De-stressing of LWRs

(ix) In-situ welding of rails

(x) End cropping and welding

(xi) Through renewal of bridge sleeper

(xii) Replacement of girders with slabs

(xiii) Removal of rail from track for any purpose

(xiv) Renewal of sleeper on important and major bridges,

(xv) Changing of guard rails on important and major bridges.

Note:

1. Some of the works listed above may also necessitate mandatory imposition of speed restrictions.

2. The list of works indicated above is indicative only and other works may be required to be done under block protection based on site-specific conditions as decided by P.Way officials.

805 Categories of Engineering Works: Engineering works can be broadly divided into three categories –

(1) *Category 1 – Works of routine maintenance*, requiring no speed restriction, not necessitating exhibition of hand signals and involving no danger to trains or traffic.

These include works of routine maintenance such as through packing, picking up slacks and overhauling of track etc.

(2) *Category 2 – Works of short duration:*

(a) Works such as casual renewals of rails and sleepers, adjustment of creep and lubrication of rail joints which are completed by sunset of the day of commencement and no restriction of speed thereafter is required, are termed “works of short duration”.

(b) Hand-signal and banner flags and fog-signals shall be used at specified distances to protect the trains.

(3) *Category 3 – Works of Long Duration:*

(a) Works such as relaying and deep screening of track, bridge construction, diversions which extend over a few days or weeks during which period a continuous restriction of speed is to be in force, are termed as “works of long duration”.

(b) Temporary engineering fixed signals shall be used at specified distances to protect the trains. These works should be carried out to a programme, about which all concerned will be advised in advance.

806 Works of Short Duration (*Back to* **Para** ***114(9), 114(17), 321(7), 619, 804,868*****)**

Protection in block section and procedure for passing of trains – Before commencing any work of such category the JE/SSE/P.Way or authorised Railway servant should issue a notice to the Station Master/Block-hut in-charge at each end of the Block section and obtain their acknowledgment. Depending as to whether the train is to be passed through the work site after stopping or at a restricted speed, the line should be protected in the following manner:

(1) *When the train is required to stop at the site of work (in Block section)* –

(a) Post a flagman with hand signals at a distance of 30 metres in rear of the place of obstruction, to show stop hand signals.

(b) Post a flagman with hand signals and place a banner flag across the track at a distance of 600 metres in rear of the work. The flagman will show stop hand signals.

(c) Post a flagman with hand signals and detonators at a distance of 1200 metres in rear of the work. The flagman shall fix three detonators on the line 10 metres apart and stand at a place not less than 45 metres from the three detonators, from where he can obtain a clear view of the approaching train. He will show stop hand signals.

(d) The man at the site of obstruction shall give proceed hand signal to indicate to the Driver, when he may resume normal speed after the train has been hand signalled past the obstruction **(Annexure - 8/1).**

(2) *When the train can pass over the work spot at restricted speed in block section* - The following protections should be adopted in the above cases –

(a) Post a flagman exhibiting caution hand signals at a distance of 30 metres from the place of obstruction.

(b) Post a flagman exhibiting caution hand signals at a distance of 1200 metres for Broad Gauge from the place of obstruction.

(c) Post an intermediate flagman with hand signals at a distance of 600 metres for Broad Gauge from the place of obstruction. He will also place a banner flag across the track. The intermediate banner flag must be kept across the line until the speed of the train has been reduced, after which the banner flag shall be removed and the train hand signalled forward.

(d) The railway servant at the site of work should give proceed hand signals to indicate to the Driver, that he may resume normal speed after the train has been hand signalled past the site of work- **(Annexure - 8/2).**

(3) The following points should be kept in view, while protecting the track in the cases mentioned in *Sub-Para (1) and (2)* above:

(a) On single line, the line must be so protected on both sides of the work.

(b) At places where there are curves or falling gradients and at times of poor visibility the distances laid down in *Sub-Para (1) and (2)* above may be suitably increased wherever necessary and intermediate flagman posted to relay hand signals.

(c) The location of the banner flag, detonators and hand signals should be so selected as to avoid stopping of trains, as far as possible, on continuous steep rising gradients.

(d) If in an emergency, it becomes necessary to carry out such works at night, the provisions for protection of line as detailed in *Sub-Para (1) and (2)* must be complied with except that red light must be exhibited in the direction of approaching trains in place of red hand signalling flags and banner flags.

(e) In an Emergency, when it is necessary on considerations of safety, the JE/SSE/P.Way, or authorised railway servant may commence such work after protecting the line as per **GR 15.08 and 15.09**, before issuing notice to the Station Master. If the work is likely to be prolonged, he should notify the Station Master as soon as possible.

(4) *Works to be carried out in station limits* –

(a) No work should be commenced on running line at a station without the written permission of the Station Master and until the relevant signals have been placed at 'ON'.

(b) Before commencing a work on a line which can be isolated from the other running lines, the JE/SSE/P.Way should ensure that the line has been isolated and retain the keys of locking device in his possession. Where isolation is effected by the setting of points, they must be locked by means of clamps or bolts and cotters.

(c) Before commencing work on a line which cannot be isolated from other running lines as provided for above, the JE/SSE/P.Way should provide the prescribed hand signals, detonators and banner flags as detailed in **Para 806 (1) & (2)**.

(5) *Works in Automatic Territory,* **Para 15.09 (3)(a)** of *General Rules 1976-* – In automatic territory, if the distance from the place of works/obstruction to the automatic signal controlling entry of a train into the signalling section is less than 1200 metres and the automatic signal is secured at 'ON' the banner flag and three detonators may be provided at 90 and 180 metres respectively.

807 Works of Long Duration –

(1) Preliminary Arrangements –

(a) For doing such works the Engineering Department will arrange with the Operating Department for the issue of the circular/ notice as per extant instructions.

(b) The concerned Divisional Engineer will be responsible for obtaining the sanction of Commissioner of Railway Safety wherever necessary and sending Safety Certificate on completion of such works.

(c) The SSE/P.Way (In-charge) should obtain permission to commence work from DEN/ ADEN and should arrange to block the line when work is proposed to be done under block with the permission of the Controller/Chief Controller on the day of block and issue a notice to the Station Master on either side.

(d) Caution orders will be issued by the Station Masters concerned as necessary.

(e) The necessary temporary Engineering fixed signals as prescribed should be provided.

(f) In an emergency, when it is necessary on considerations of safety, the JE/SSE/P.Way or authorised railway servant may commence such work before issuing the notice, under the protection of hand signals and banner flags as per **GR 15.08** and **15.09**. As soon as possible, he should issue the notice and replace the hand signals and banner flags by temporary engineering fixed signals.

(2) *Protection of line in block section –*

(a) In case where stop dead restriction is to be imposed when restriction is to last for more than a day, the following temporary engineering indicators should be exhibited at the appropriate distance.

(i) Caution indicator.

(ii) Stop indicator.

(iii) Termination indicators.

(b) In case where the train is not required to stop (non-stop restriction) and the restriction is likely to last for more than a day, the following temporary Engineering indicators should be exhibited at the appropriate distances –

(i) Caution indicator.

(ii) Speed indicator.

(iii) Termination indicators.

Note –

(i) **Annexure - 8/3** *and* **8/3 A** *indicate the distances at which these are to be fixed.*

(ii) When during the course of the work, on consideration of safety it is not desirable to pass trains over the site of work for the time being, the track should be further protected by hand signals and banner flags, by the authorised railway servant.

(3) *Protection of line in station limits*, **Para 15.09(2)** of *General Rules (1976)* **-** Protection of the line as prescribed for block section may be dispensed with if the affected line has been isolated by setting and securing of points or by securing at "ON" the necessary manually controlled signal or signals and approach signal shall not be taken 'OFF' for a train unless the train has been brought to a stop at the first stop signal, except in cases where the loco pilot has been issued with caution order at the station in rear, informing him of the obstruction and the details thereof.

808 Temporary Engineering Fixed Signals – Location and Details –

(1) These consists of

(a) Caution indicator.

(b) Speed indicator.

(c) Stop indicator.

(d) Termination indicators (T/P & T/G).

(2) *(a) Multi Speed Restriction (i.e. existence of two or more than two speed restrictions in continuation)* – When work of deep screening or sleeper renewal is in progress, there is situation of having two or more than two speed restrictions in continuation. In such situation, placement of speed boards for following speed restriction shall be as under:

(i) In case of following speed restriction being more restrictive, a minimum of 200 m track should be under earlier speed restriction zone. If not, then only one SR board should be provided, considering that the previous speed restriction is at par with the following SR, which is more restrictive.

(ii) In case of following speed restriction being less restrictive, corresponding speed indicator board for following speed restriction shall be placed at a distance equal to the length of the longest goods train operating on the section after termination point of previous speed restriction zone.

(b) The details and position of fixing each indicator are detailed in **Annexure - 8/3, 8/3A and 8/4.**

(3) For intermediate tracks on triple or multiple lines, engineering indicators should be fixed between tracks to within 300 mm from rail-level, to avoid infringements of standard dimensions.

(4) All indicators should be placed on the left hand side as seen by the Drivers except on Centralised Traffic Control (CTC) sections (single line) where they should be placed on Right hand side.

(5) One termination indicator bearing letters T/G should be located at a distance equal to the length of the longest goods trains operating on the section from the place of work. Another Termination indicator bearing the letters T/P should be located at a distance equal to the length of the longest passenger train operating on the section from the place of work, which will help the passenger trains to pick up speed after reaching T/P indicator, without losing time. The Guard of a passenger train shorter than the longest passenger train will exhibit an "all-clear" signal to his Driver when the rearmost vehicle has cleared the restricted length and the Driver will resume normal speed. In the case of light-engines or single unit rail cars, the Drivers will resume normal speed after clearing the restricted length.

809 Procedure for Passing Trains at Stop Dead Restrictions – The flagman at the stop indicators shall present his restriction book to the Driver who should stop in the rear of the stop indicator.

The "Restriction Book" should be to the following form:

Engineering indicator at km…………………

Date	Train No.	Time	Signature of the Driver

After the flagman has obtained the signature of the Driver at the indicator, he should exhibit proceed with caution signal to the Driver. The Driver will then be authorised to pass the stop indicator and continue at this speed until his train has cleared the restricted length, after which he will resume normal speed.

810 Procedure for Blocking Line for Engineering Purposes – (*Back to* ***Para 804)***

(1) *Arrangements for Block –*

(a) Except in very urgent cases arrangements for blocking the lines between stations shall be made by the DEN in consultation with the Divisional Operating Manager, sometime before the block is imposed.

(b) The Divisional Operating Manager will issue instructions to the Station Masters on either side of the section to be blocked and Station Masters/Yard Masters of train ordering stations concerned about the last train to pass over the section before the block is imposed, the trains to be cancelled because of the block and any other particulars and will conclude by stating which official of the Engineering Department will impose and remove the block. The instructions will be acknowledged by those to whom issued.

(c) In an emergency when there is no time to refer to Divisional Operating Manager or where block will not interfere appreciably with the traffic the Station Master (after consulting control on controlled section) will arrange block directly.

(2) *Imposition of engineering block –*

(a) The JE/SSE/P.Way or authorised railway servant who wishes to block the line should transmit a message to the nearest Station Master on section to be blocked, copy to the DEN, ADEN, SSE (Loco), Controller of controlled sections and Divisional Operating Manager, advising them the time from which the block is to be imposed and the kilometerage and asking for acknowledgement from the concerned Station Masters.

(b) The Station Master receiving the message for transmission will sign for it, noting the time of receipt and shall transmit the message to the Station Master on the other side of the block section, which is to be blocked, and to the Controller. The Station Master on the other side will acknowledge receipt by a message addressed to JE/SSE/P.Way or authorised railway servant and the Station Master of the transmitting station.

(c) On receipt of this message the Station Master of the station from which the message was transmitted will block the line in the manner prescribed and hand over a signed copy to the JE/SSE/P.Way.

(d) Field telephone should be used for liaison with the Control during the block.

(3) *Removal of engineering block –*

(a) When removing a block, the JE/SSE/P.Way or authorised railway servant responsible will transmit a message to any one of the Station Master on either side of the block section blocked, copy to the DEN, ADEN, SSE (Loco), Controller and Divisional Operating Manager, advising them that the block has been removed and asking for acknowledgement from Station Masters. Particulars of kilometerage, restriction of speed and position of Engineering Indicators should be given in the telegram.

(b) The Station Master who receives the message for transmission will sign for it, noting the time of receipt and transmit the message to the Station Master of the other station. The message must be acknowledged by the latter, addressed to the JE/SSE/P.Way and Station Master of the transmitting station.

On receipt of this acknowledgement the Station Master who originally imposed the block, will remove it in the manner prescribed. The Control or the Divisional Operating Manager will advise the Station Masters on the train ordering stations when a block is finally removed.

(4) *Issue of Caution Orders to Drivers* – Caution order to Drivers of all trains will be issued by the Station Masters for temporary engineering restrictions. Caution order will indicate the exact kilometrages, speed restrictions, stops, as the case may be, but will not include permanent restrictions that are notified in the working time-table.

811 Works at Times of Poor Visibility – In thick foggy or tempestuous weather impairing visibility, no rail shall be displaced and no other work, which is likely to cause obstruction to the passage of trains shall be performed except in case of emergency.

When such work has to be undertaken and the site is protected by temporary engineering fixed signals, 2 detonators on the line 10 metres apart should be fixed not less than 270 metres in rear of the caution indicator and a caution hand signal exhibited to approaching trains.

812 Temporary Signals in Emergency – (*Back to* ***Para*** ***114(9)*****,** ***114(17), 804, 1005*****)**

(1) Whenever in consequence of an obstruction of a line or for any other reason it is *necessary* for a railway servant to stop approaching train he shall plant a danger signal at the spot and proceed with all haste in the direction of an approaching train with a danger signal (red flag by day and red light by night) to a point 600 metres from the obstruction and place one detonator on the line after which he shall proceed further for not less than 1200 metres from the obstruction and place three detonators on the line 10 metres apart. He should then take a stand at a place not less than 45metres from there, from where he can obtain a good view of an approaching train and continue to exhibit the danger signal, until recalled. If recalled, he shall leave on the line three detonators and on his way back pick up the intermediate detonator continuing to show the danger signal.

(2) On single line the line must be protected on each side of obstruction.

(3) Where there are adjacent lines and it is necessary to protect such lines, action should be taken on each such line in a similar manner.

813 Periodical Notice of Engineering Restrictions – For works involving restriction of speeds of trains the DEN will arrange publication in the periodical gazette of the railway furnishing following details –

(1) The names of the block stations on either side of the site where the engineering work will be undertaken in order that caution orders may be issued.

(2) Kilometerage of site of work.

(3) Restricted speed and stop dead restriction to be observed by the Driver.

(4) Nature of work being undertaken or reasons for restriction.

(5) Probable duration.

814 Permanent Speed Restriction Indicators –

(1) *Permanent speed restrictions boards –*

(a) Permanent speed restrictions in force are notified in working time-table. The speed indictors are erected to indicate to the Drivers the speed restrictions to be observed e.g., between stations, and at stations due to weaker track/bridges, restrictions on curves, grades and points and crossings etc.

(b) The indicators to be used are similar to those used for temporary restrictions, namely, caution indicator, speed/stop indicators and termination indicators (T/P & T/G). The details of the indicators and the distance at which they are to be fixed are the same in both the *cases* **(Annexure - 8/3 & 8/4)**.

(2) *Siding Boards* – When speed restriction has been imposed on account of facing points of an outlying siding an 'S' marker (a circular board of1 metre dia. painted yellow, with 300 mm letter 'S' painted in black on it) should be fixed at the points in addition to the speed and caution boards fixed in rear of the points. Where however, the sanctioned speed of the section does not exceed 50 Kmph the speed indicator and the 'S' board need not be provided except where the speed over the points is less than sanctioned speed of the section. 'S' marker should be so fixed that the centre of the board is 2 metres above the rail level.

(3) *Board indicating speed over points* – Where the speed over the points at a station is less than the speed sanctioned at other stations on the same section, a permanent speed indicator should be fixed on the first approach signal of the station.

(4) The posts of permanent speed indicator marker boards should be painted with 300 mm high bands in white and black.

(5) Where a permanent speed restriction is in force on any intermediate track on triple or multiple lines, the engineering indicators should be fixed between tracks to within 300 mm from rail-level to avoid infringement of standard dimensions.

815 Indicators (General):

(1) Where indicators are provided under special instructions to furnish information to Drivers, these should be in black letters or figures on yellow back ground.

(2) *Whistle indicator –*

(a) Whistle boards should be provided in rear of all places where the view of the Drivers is obstructed by cuttings or tunnels or curves and where it is necessary to give audible warnings of the approach of a train to those working on the track. The whistle boards are fixed at a distance of 600 metres.

(b) *Whistle indicator for Level Crossings* – Whistle boards are also provided on the approach of all level crossings, where a clear view is not obtained. These bear the letters W/L. The details of these whistle boards are described in **Para 915**.

(3) *Shunting Limit Boards (SLB)* – They are provided at an adequate distance in advance of the trailing points. This shall consist of 600 mm x 1000 mm rectangular board painted yellow with a black cross on the top and words "shunting limit" written in black below it. Its height should be 2 metres from the rail level to the underside of the portion containing the cross and the post on which it is fixed, painted with 300 mm high bands in white and black. It should be fitted with a lamp/light showing white light in both directions.

816 Detonating Signals – Detonating signals otherwise known as detonators or fog signals are appliances, which are fixed on the rails, and when an Engine (or vehicle) passes over them, they explode with a loud sound so as to attract the attention of the Driver.

(1) Care and Custody –

(a) Detonators should be protected against dampness. They should be stored in tin cases with papers wrapped over them, a layer of waste cotton must be kept at bottom and top of the tin cases to avoid contact with the metal.

(b) In one tin case not more than ten detonators should be kept.

(c) The tin cases should be stored in wooden boxes which should be kept in dry places and not left in contact with the brick walls, damp wood, chloride of lime or other disinfectants; these should not be exposed to steam or other vapours.

(d) Unexploded detonators should not be, as far as possible, sent from place to place by consignment; they should be conveyed personally or by a messenger.

(2) Stock with Engineering Official –

(a) Each P.Way, Works and Bridge Engineer shall have a stock of detonators sufficient to recoup the number annually tested and any which may be exploded for works and emergency. The SSE/P.Way (In-charge) shall ensure that all Gangs, Gatemen, Keymen, Patrolmen and Watchmen are equipped with the specified number of detonators.

(b) Every ADEN, Gang Mate, Keyman, Gateman, Patrolman and Watchman, whose duties include protection of track shall carry the specified stock of detonators with him on duty, for use during an emergency.

(c) The month and year of manufacture are shown on the label outside each case and also stamped on each detonator. Detonators should be used in the order of the dates stamped on them, the oldest being used first. To facilitate ready withdrawal in this sequence, they should be stored also accordingly.

(3) Use of Detonators –

(a) The staff in possession of detonators shall not make any improper use of them. All Engineers are responsible to ensure that the staff working under them know how and when to use detonators.

(b) A detonator when required to be used shall be placed on the rail with the label or brand facing upwards and shall be fixed to the rail by bending the clasps around the head of the rail.

(4) Testing –

(a) Once a year, one detonator shall be taken by the SSE/P.Way (In-charge) from his own stock and from Gang Mate, Keyman, Gateman, Patrolman and Watchman for testing, one also from each of the lots in the personal custody of DEN, Bridge Engineer, ADEN, SSE (Works), JE/SSE/P.Way where the headquarters of these officials falls within the SSE/P.Way's jurisdiction. The oldest detonators should be selected for the test.

(b) The testing of detonators should be done under an empty 8-wheeled wagon propelled by an engine and moving at walking speed under the direct supervision of the SSE/P.Way (In-charge), who shall ensure safety range during testing. Results of tests should be entered in a Register.

(c) The SSE/P.Way (In-charge) shall submit by the end of the year (31st December) a certificate in duplicate to the ADEN to the effect. *"I certify that I have tested the detonators from stocks mentioned below in accordance with standing orders for the year ending …… and append a list of those that failed to explode."* The ADEN shall countersign and forward one copy of the certificate to the DEN with remarks, if any. Orders regarding the return or destruction of those lots, the samples from which failed to explode, shall be issued by the DEN.

(5) *Life of Detonators* – The normal life of detonators is five years. The life of the detonators can be extended to eight years on a yearly basis subject to the condition that two detonators from each lot of over 5 year old ones are tested for their effectiveness as discussed above and the results being found satisfactory. Such time extended detonators can be used on all sections after satisfactory testing. In case the results are not satisfactory, they should be destroyed as envisaged in *Sub-Para (6) below*. In any case, no detonator should be kept in use after 8 years.

(6) *Disposal of time-barred detonators* – No detonator that bears any sign of rust and is time- barred shall be held in stock. Such detonators shall be destroyed by one of the following methods

(a) By soaking them in light mineral oil for 48 hours and then throwing them one by one into fire with due precautions.

(b) By burning them in incinerator.

(c) By detonating them under wagon during shunting operations.

(d) By throwing them in deep sea.

The destruction of time-barred detonators should be done in the presence of a JE/SSE/P.Way who should ensure that every care is taken to see that splinters of detonators do not cause any injury to life and property. They should not be buried or thrown in places from where they could be recovered.

(7) *Safety Range* – When detonators are being tested, no person should be allowed within a radius of 45 metres from the detonators to be exploded; the engine crew shall remain well within the cab. In practice, splinters from detonators when exploded seldom fly in a direction to the rear of the wheel, which detonates them. Staff should therefore, when observing the safety radius, place themselves, as far as possible on the rear side.

817 Warning Signal - Descriptions – (*Back to **Para 910*****)** The signals to be used to warn the incoming train of an obstruction shall be red flashing hand signal lamp at night or red flag during day as per **Para 3.65** of *General (Amendment) Rules***.**

818 Use of Warning Signals – When it becomes necessary to protect an obstruction in a Block section, a warning signal may be used, as prescribed under **Para 3.66** of *General (Amendment) Rules* while the railway servant proceeds to place detonators. A warning signal is to be shown to give timely warning to a driver of approaching train of any obstruction such as derailed train obstructing adjacent lines, breaches, wash away, floods, landslides etc., when the railway servant does not have adequate time to do the protection in the normal manner with the detonators as envisaged under rules. The knowledge and possession of warning signals shall be ensured by every railway servant concerned with the use of warning signals as stipulated in **Para 3.67** of *General (Amendment) Rules.*

819 Safe Working of Contractors – A large number of men and machinery are deployed by the contractors for track renewals, gauge conversions, doublings, bridge rebuilding etc. It is therefore essential that adequate safety measures are taken for safety of the trains as well as the work force. The following measures should invariably be adopted:

(1) The contractor shall not start any work without the presence of railway supervisor or his representative and contractor's supervisor at site.

(2) Wherever the road vehicles and/or machinery are required to work in the close vicinity of railway line, the work shall be so carried out that there is no infringement to the Railway's Schedule of Dimensions. For this purpose, the area where road vehicles and/or machinery are required to ply, shall be demarcated and acknowledged by the contractor. Special care shall be taken for turning/reversal of road vehicles/machinery without infringing the running track. Barricading shall be provided wherever justified and feasible as per site conditions.

(3) The look out and whistle caution orders shall be issued to the trains and speed restrictions imposed where considered necessary. Suitable flagmen/detonators shall be provided where necessary for protection of trains.

(4) The supervisor/workmen should be counselled about safety measures. A competency certificate to the contractor's supervisor as per proforma annexed shall be issued by ADEN which will be valid only for the work for which it has been issued. **(Annexure - 8/5)**.

(5) The ballast/rails/sleepers/other P.Way materials after unloading along track should be kept clear off moving dimensions and stacked as per the specified heights and distance from the running track.

(6) Supplementary site-specific instructions, wherever considered necessary, shall be issued by the engineer in-charge.

(7) The engineer in-charge shall approve the methodology proposed to be adopted by the contractor, with a view to ensure safety of trains, passengers and workers and he shall also ensure that the methods and arrangements are actually available at site before start of the work and the contractor's supervisors and the workers have clearly understood the safety aspects and requirements to be adopted/ followed while executing the work.

There shall be an assurance register kept at each site, which will have to be signed by both, i.e. railway supervisor or his representative as well as the contractor's supervisor as a token of their having understood the safety precautions to be observed at site.

PART – B

Working of Trollies, Motor Trollies and Lorries

820 The rules for working trollies, motor trollies and lorries are contained in **Para 15.18** to **Para 15.28** *of Chapter XV-B of General Rules for Indian Railways (1976),* supplemented by the Subsidiary Rules issued by individual railways. The instructions contained in this chapter are in amplification of these rules and will not supersede the *General and Subsidiary Rules of Railways*.

821 Distinction between Trolley, Motor Trolley and Lorry –

(1) A vehicle which can be lifted bodily off the line by four men shall be deemed to be a trolley. Any similar but heavier vehicle (which includes dip lorry) shall be deemed to be a lorry.

(2) Any trolley which is self-propelled, by means of a motor, is a motor trolley.

(3) A trolley shall not, except in cases of emergency, be used for the carriage of permanent way or other heavy material, and when a trolley is so loaded, it shall be deemed, to be a lorry.

822 Certificate of Competency –

(1) No trolley, motor trolley or lorry shall be placed on the line except by a qualified person appointed by special instructions.

(2) Such qualified person shall accompany the trolley, motor trolley or lorry and shall be responsible for its proper protection and for its being used in accordance with special instructions.

(3) The qualified person shall hold a certificate of competency which shall be issued according to prescribed instructions in **Chapter 14**.

(4) Staff in whose favour a certificate is issued should be literate, having knowledge of Hindi or other local languages, should have passed the prescribed Medical test and should be conversant with the rules for working of trollies, motor trollies and lorries, as the case may be. The certificate of competency will be issued for a specified period by an officer authorised to do so and renewed periodically.

823 Officials Permitted to use Trollies, Motor Trollies and Lorries – Subject to their being certified competent, the following officials of the Engineering Department are permitted to use Trollies/Lorries:

(1) *Trollies/Lorries* –

(a) All officers and JEs/SSEs of Engineering Department.

(b) Gang Mates, Head Trolleymen as may be authorised.

(2) *Motor Trollies* – All officers of Engineering Department, motor trolley Drivers and such JEs/SSEs as may be authorised.

824 Responsibility for Safe Working –

(1) The official-in-charge of trolley/motor trolley/lorry is responsible at all times for its safe working. When more than one person holding competency certificate travels in a trolley, the official-in-charge of the trolley is responsible for its safe working.

(2) It shall be clearly understood by officers and staff that they are to take every possible precaution and protection against accidents. When entering a tunnel or cutting or proceeding over a long bridge or curve, the official-in- charge will make sure that no train is likely to be met. While approaching a level crossing the official-in-charge, should look out for road traffic and ensure safe passage of his vehicle over the level crossing.

825 Efficient Brakes – No lorry, trolley or motor trolley shall be placed on the line unless, it is fitted with efficient brakes. The brakes should be tested before the commencement of each journey. It is desirable that trollies and lorries working on Ghat section are fitted with screw down brakes in addition to ordinary hand/foot brakes. It will be the responsibility of the official-in-charge to ensure the adequacy of braking.

826 Attachment to Trains Prohibited – No trolley/motor trolley/lorry shall be attached to a train.

827 Working on Track Circuited Sections and Sections Provided with Axle counters – Each Railway shall issue subsidiary rules for the working of trolley/motor trolley/lorries in sections where axle counters or track circuits form part of the Block instruments or where automatic signalling has been provided.

828 Numbering of Trollies/Motor Trollies/Lorries – Each trolley/motor trolley and lorry shall be marked with its number, code, initials of the department, the designation and headquarters of the official-in-charge.

829 Conveyance of Trollies/Motor Trollies/Lorries by Trains –

(1) No trolley/motor trolley/lorry should be loaded in a train without the consent of the Guard in-charge of the train, who will direct where it is to be placed.

(2) In the case of an accident/emergency, trollies/motor trollies may be carried by Mail/ Express trains on which there are restrictions normally for loading of Trolley/Motor Trolley.

(3) When loading a motor trolley with petrol in the tank, it shall be ensured that;

- (a) The flow of petrol in the carburettor has been cut off;
- (b) Any pressure has been released from the tanks;
- (c) The tank is in sound condition and closed by a well fitted cap;
- (d) The engine has been run by the official- in-charge until the carburettor has become exhausted and the engine stops automatically.

830 Trollies, Motor Trollies and Lorries not in Use –

(1) A trolley, motor trolley or lorry, when not in use shall be placed clear of the line, and wheels thereof secured with a chain and padlock.

(2) When a trolley/motor trolley is placed on a platform to be loaded into a train, it should be under the charge of a Trolleymen and placed where it will not be in the way of passengers or working staff.

(3) Whenever possible, motor trollies, should be placed in a shed, the key of which, shall be in the possession of the official-in-charge.

831 Conveyance of Non-Railway Officials – Trollies shall not be used for the conveyance of persons other than railway officials. In special cases, Magistrates, Police, Civil, Telegraph, Military, Medical and Forest Department Personnel or a person requiring medical aid, may be conveyed by trolley by order of the competent authority (ADEN or above), after a bond on form in **Annexure - 8/6** is signed indemnifying the Railways against all liabilities and risks.

Contractors and their Agents may be conveyed on trolley in connection with works, provided they have executed a general indemnity bond similar to Form **Annexure - 8/6.**

832 Trolley-Permits for Private Sidings – A non-railway official is permitted to use a trolley on private sidings when he is in possession of a permit signed by the competent authority. Such permits are granted for use of the trolley on sidings where there is no passenger traffic. The party shall execute a bond on Form **Annexure - 8/7** indemnifying the railways against all liabilities and risks. The issue of trolley permits will be subject to such rules as may be prescribed. In such cases, the Head Trolleyman shall hold a certificate of competency issued by the authorised railway official.

833 Military Officers Using Trollies in Ordnance Depots – Railway shall not accept any liability whatsoever for damage or compensation arising out of accidents caused in the working of trollies used by Military Officers on duty in Ordnance Factories in respect of claims of officers themselves or third persons.

834 Trolley Refuges and Observation Posts –

(1) *Trolley Refuges* – Trolley refuges over long Bridges should be provided at such intervals, as prescribed in the Schedule of Dimensions. In cuttings and high banks trolley refuges should be provided at suitable intervals.

(2) *Observation Posts* – Where, owing to curves in cuttings or other causes view of the line is restricted, "observation posts" should be established at such sites as command the best view in both directions for the use of Flagmen, thus enabling hand signals being conveyed to the trolley on line.

835 Equipment for Trolley / Motor Trolley / Lorry – Each trolley/motor trolley/lorry shall have the following equipment:

(1) Two hand signal lamps/tri colour LED Flashing hand signal lamp;

(2) Two red and two green hand signal flags;

(3) Detonators 10 Nos;

(4) A chain and a padlock;

(5) A copy of the working time table and all correction slips and appendices, if any, in force on that section of the railway over which the trolley, lorry or motor trolley is to run;

(6) A motor horn and a search light (for motor trolley only);

(7) Two banner flags and additional detonators (for lorry only); and

(8) Such other articles as may be prescribed by the Railway Administration in this behalf.

Note – The official-in-charge of the trolley/motor trolley/lorry shall also be in possession of a watch in addition to the prescribed equipment.

836 Signals for Trolley/Motor Trolley/Lorry –

(1) *Day Signal* – Every trolley, motor trolley or lorry when on the line shall show a red flag by day, fixed to a staff which will be placed on a socket and conspicuously visible in both directions.

(2) *Night Signal* – On a double line the night signal shall be red light in the direction from which trains are expected and white in the other direction and on a single line, red in both directions. Where on double line, single line working is introduced, the night signal should be as per a single line. When working within the station limits, the light displayed at night shall be red in both directions.

(3) *Signals within long tunnels* – On sections where there are long and dark tunnels, the night signals prescribed must be displayed during the day in addition to the red flag, in the case of trollies, motor trollies and lorries. In the case of thick foggy or tempestuous weather impairing visibility, light signals must be displayed in addition to the red flag.

(4) *Removal of trolley/motor trolley/lorry* – As soon as a trolley/motor trolley/lorry is removed from the track and placed clear of it, the red flag or light signal shall be removed, but care should be taken to see that this signal is not taken off before the lines have been cleared of all the obstructions.

837 Working of Trollies –

(1) *Manning of Trollies* – Trollies in all cases shall be manned by four men.

(2) *Mode of working of trolley* – Trollies in all cases should be pushed and not pulled.

(3) *Working under block protection* –

(a) Trolley may be worked under block protection wherever it is possible to do so without interference to train service.

(b) Trollies should be worked under block protection in the night.

(c) During daytime in foggy weather and during dust storm, when the visibility is poor, a Trolley should be worked under block protection.

(d) Sections with restricted visibility due to curves, cuttings or due to other local conditions specified by railway Administration, wherever practicable, should be traversed under block protection.

(e) When working under block protection trollies will be worked in the same manner as trains.

(4) *Working without block protection* – (*Back to* ***Para 838***)

(a) During day time in sections with normal visibility the official-in-charge shall before leaving a station/block post, ascertain the whereabouts of the trains likely to be met and set off on trolley.

(b) In sections with restricted visibility specified sections, *(Sub-Para (3)(d))* when the official-in-charge, is not able to block the section and work under Block protection, he will follow the following procedure:

(i) The Station Master/Signalman will on receipt of advice from official- in-charge (in triplicate on form **Annexure - 8/8**) giving his trolley programme ascertain and fill in particulars of trains running on the section, retain one copy and return the other two to the official-in-charge of the trolley.

(ii) As a reminder that the block section is occupied by the trolley and caution orders must be issued, a small placard with words “trolley on line”, will be hung in front of the block instrument, until advice of the removal of the trolley is received.

(iii) If telegraph and telephone communications are interrupted and the Station Master/Signalman is unable to communicate with the station at the other end of the block section, the official-in-charge of the trolley will be advised of this fact and form **Annexure - 8/8** endorsed accordingly. When communication between the two stations is restored, the messages referred to above will be exchanged, if the trolley has not cleared the section or removal report has not been received.

(iv) From the time of exchange of the messages, until intimation has been received that the trolley has cleared the block section, the Station Master/ Signalman at both ends of the block section shall issue caution orders to Drivers of all trains entering the block section. On the double line, caution order should be issued for both up and down trains.

(v) The issue of caution orders in no way relieves the official-in-charge of the trolley of the duty of complying strictly with the rules for protecting the trolley.

(vi) On arrival of the trolley at the other end of the block section, the person- in-charge of the trolley shall fill in the removal report and send it to the Station Master/Signalman who will return the third copy signed. The Station Master/Signalman will then advise the Station Master/ Signalman at the other end of the block section of the trolley having cleared the section.

(vii) If the trolley is removed from the track at the station not provided with telegraph or telephone instruments or in the block section and if it is not intended to place it on the track again, the official-in-charge of the trolley shall fill in the removal report and send it to the Station Master/Signalman at the nearest block station. In the former case, the Station Master will send written advice by the first train in either direction to the next block station. The Station Master/Signalman at the latter station should then advise the Station Master/Signalman at the other end of the removal of the trolley.

(viii) Station Masters/Signalmen at the both ends, of the block section will enter remarks in the train registers pertaining to the block section concerned showing the times at which the trolley entered and cleared the block section and the number of the trolley.

(5) *Protection in Block Section* – (*Back to **Para 838***)

(a) When a trolley is worked other than under the rules for working of trains i.e., without block protection and when a clear view is not obtainable for an adequate distance of 1200 m, the following precautions should be taken **(Annexure - 8/9)**

(i) On a double line, he must depute a Flagman with detonators to precede or follow the trolley, and to exhibit a hand danger signal at a distance of not less than 1200 m in the direction from which trains may approach.

(ii) On single line, depute a Flagman with detonators to precede and another to follow the trolley and to exhibit hand danger signals at a distance of not less than 1200 m.

(iii) Where necessary, intermediate Flagman should be posted to relay signals.

(b) The flagman should only be withdrawn when a clear view of at least 1200 m can be obtained in the direction from which trains may approach.

(c) When a train is sighted, the Flagman should wave the red flag vigorously to warn the official-in-charge of the trolley of the approach of the train, and at the same time place three detonators 10 m apart on the line to protect the trolley. The detonators should be removed only on receipts of hand signals from the official- in-charge by waving of a green flag to withdraw the danger signal indicating that the trolley has been removed.

When conditions are such that the Flagman cannot be seen by the official- in-charge of trolley, the latter must arrange before entering the section to take with him sufficient men with hand signals who will be placed in suitable positions between the trolley and the Flagman so that the signals from the Flagman can be repeated to the person- in-charge of the trolley and vice-versa.

(d) On sighting an approaching train or the Flagman's signal, the trolley must be removed clear of the line and kept in such a manner that it cannot roll towards the line.

(6) *Trollies travelling together* – When two or more trollies are running together in the same direction in the same line, care should be taken to ensure that they are kept at least 100 m apart to safeguard the trolley in rear from colliding with the front one, in case the front trolley has to be stopped suddenly for any reason.

838 Working of Motor Trollies –

(1) A motor trolley shall be run only under block protection or following a train/motor trolley in accordance with special instructions.

(2) When a motor trolley that is worked under block protection or following a train /motor trolley, breaks down (i.e. it cannot be propelled even by hand) in the block section, the official-in-charge should remove it clear off the track and send a written advice to the nearest Station Master/Block Hut-in-charge returning the 'Authority to proceed'/ Motor Trolley permit/ line clear ticket/ token/ tablet or advise the nearest Station Master/Control through the emergency telephone with exchange of Private Number about the same. He should not place again the motor trolley on the line without the written permission of either Station Master/ Block Hut-in-charge at the end of the block section concerned.

(3) *Following a Train/Motor Trolley* – Motor trolley may follow a fully vacuum/air brake train or a light engine or another motor trolley in the same block section during day light hours and in clear weather under special instructions issued by the Railway Administration.

(ACS – 6)

839 Working of Lorries –

(1) *Mode of working of Lorry* – Lorries should be worked only under block protection. Lorries in all cases should be pushed and never pulled. Riding of persons on the same is prohibited.

(2) *Manning of Lorries* – Lorry must be accompanied on foot by not less than four men in addition to the number of men required for expeditiously loading and unloading materials being conveyed on the lorry.

(3) *Actual* working *of Lorry* –

(i) Before obtaining line clear, the official-in-charge of a lorry should advise the Station Master/Block Hut- in-charge, whether it is his intention to return to that station, to run to the other end of block section, or to remove the lorry in mid-section.

(ii) The official-in-charge, after getting the authority to proceed in the form of line clear ticket/token, double line certificate or shunting key, as the case may be, should work his lorry.

(iii) He should, after completion of his work, hand over the authority to proceed to the concerned Station Master/Block Hut-in-charge and remove his lorry.

(iv) In case the lorry is off loaded in the mid-section, the authority to proceed should be returned by a special messenger to the nearest station after ensuring that the lorry is kept clear off the line.

(v) On the double line, the official-in- charge should run the lorry on the proper road. The lorry should be taken along the line in the direction in which the trains will run; except when returning to the original starting station/Block Hut.

(4) *(a) Working in Station limits* – When a lorry is required to work within Station limits, the permission of the Station Master shall be obtained in writing before working the lorry and the lorry should be worked as per the approved special instructions.

(b) Protection in Station limits – When a lorry works in a station yard the Flagman must exhibit danger signals at such a distance on both sides as will ensure safety. When the lorry is required to remain stationary for more than 15 minutes, it must be protected by banner flags placed at an adequate distance supplemented by three detonators on both sides.

(c) When a lorry has to work on a section with a steep down gradient (gradients steeper than 1/100), the same should not only be controlled by hand brakes, but by a rope tied in the rear and held in tension by men following a lorry.

840 Working of Moped Trollies – These are light motor trollies, which can be lifted off the track normally by three men. They should be manned by at least three men including the Driver. These may be worked as per the rules pertaining to a motor trolley, for which the Railway Administration may issue special instructions, as necessary.

841 Rail Dolleys –

(1) Rail dolley is a device with two or more wheels, which in balanced condition, can be moved manually on one rail of track and can carry one rail/sleeper in suspended condition. When necessary, the suspended material can be dropped and rail dolley cleared off the track.

(2) *Manning of Rail Dolley* – Every rail dolley shall be manned by not less than 2 able bodied persons. The person- in-charge for the working of rail dolleys shall be a railway servant not lower in rank than a JE/P.Way.

(ACS – 3)

(3) Working of Rail Dolleys –

(a) The railway servant in-charge of rail dolleys must inspect the section in advance particularly in reference to heaping of ballast, girder bridges and any other special features which make it difficult to drop the material and remove the rail dolley in the event of an approaching train. He shall get the ballast heaps cleared and work the dolley(s) only when the visibility is clear for at least 1200 metre and the rails/sleepers can be dropped off safely without affecting the safety of trains and workers both.

(b) Rail dolley shall not be worked on sections having gradients steeper than1 in 200.

(c) Not more than 6 rail dolleys should be worked in a group in any one block section.

(d) Normally, not longer than 3 rail welded panels should be carried by rail dolleys. The rail dolleys must not be worked after sunset and before sunrise and in bad weather when the visibility is poor. Rail dolleys should not be worked in deep cuttings, steep grades, sharp curves and heavily built up areas where the visibility is not clear for 1200 metres. In such locations, the rail dolleys should be worked under block protection.

(e) In case, a rail dolley is to carry rails longer than 3 rail panel or it is required to move over x-overs in yard crossing more than one line in deep cuttings and curves then it should work under block protection.

(f) No traffic block or caution order is normally necessary for working of rail dolleys except as indicated in *Sub Para (3) (d) & (e)* above.

(g) Every rail dolley/group of rail dolley when on line shall exhibit a red flag.

(h) The rail dolley shall be protected by a flagman at a distance of 1200 metre from the rail dolley, on a double line in the direction from which trains may approach, and by two flagmen one on either direction on single line. The flagmen shall also carry three detonators for use in any emergency.

(i) Where necessary intermediate Flagman should be posted to relay signals.

(j) When a train is sighted, the Flagman should wave the red flag vigorously to warn the official-in-charge of the dolley of the train and at the same time place three detonators 10 m apart on the line to protect the rail dolley(s). The detonators should be removed only on receipt of hand signals from the official-in-charge by waving of a green signal to withdraw the danger signals from indicating that rail dolleys have been removed.

(k) The official-in-charge of the rail dolley shall keep a look out for approaching trains and will get the rail dolley(s) and materials cleared off the track as soon as an approaching train is sighted.

(l) While approaching level crossings, the official in-charge shall look out for road vehicles and ensure safe passage of rail dolleys.

(m) The official in-charge shall be fully responsible for the safe working of rail dolleys.

PART – C

Working of Material Trains & Track Machines

842 **The Rules for the Working of Material Trains** are outlined in **Appendix IX** of the *Indian Railway Code for the Engineering Department and* **Para 4.62** to **4.65** of *General Rules for Indian Railways (1976) and Subsidiary Rules thereto –*

When the quantity of material is such as could be conveniently trained out in stages, wagon - loads may be attached to goods trains by arrangement with the Operating Department.

843 **Material Train –** Material train means a departmental train intended solely or mainly for carriage of railway material when picked or put down for execution of works, either between stations or within station limits. The railway material may include stone boulders, ballast, sand, cinder, Moorum, rails, sleepers and fittings etc.

844 **Economical Working –** Material train should be expeditiously and economically worked. The ADEN should arrange to form a train of maximum capacity consistent with the haulage capacity of the engine and tonnage approved for the section. In consultation with the Operating Department, the running of goods trains should be suitably regulated so as to provide as long a working time for Material train as possible. Delays in working should be traced to their source and remedies applied as circumstances demand.

845 **Restrictions in Running –**

(1) Except with the permission of the ADEN or Divisional Engineer, a material train should not be permitted to work during periods of poor visibility due to fog, storm or any other cause.

(2) Except in an emergency such as, an accident or breach of the railway line, working of Material trains carrying labour should not be permitted between sunset and sunrise. If due to certain circumstances it is necessary to work Material Trains during night, permission to do so should be obtained from the Divisional Operating Manager.

846 **Brake-Vans and Shelter Wagons –**

(1) A Material train must be equipped with at least one brake-van in the rear. When running through between stations the engine should be marshalled at one end of the train, and the brake-van at the other end.

(2) Covered wagons to afford shelter to the labour may be coupled to the material train as required.

847 **Ordering of Material Trains –** Operating Department is the authority for ordering a material train. On receipt of requisition from the ADEN/DEN, the Divisional Operating Manager shall advise the staff concerned by letter, detailing the composition of train, the loading kilometrages, the sections over which the train will work, the date of commencement of work, the station at which the rake will be stabled and the engineering official who will be deputed to be in-charge of the train. The notice to be given by the Engineering department should not normally be less than a week.

848 **Issue of “Fit-to-Run” Certificate –** Before a material train is allowed to work, the complete rake should be examined by the carriage and wagon staff and a “fit-to-run” certificate issued to the Guard. The rake may also be examined by the carriage and wagon staff each time it arrives at the train examining station and whenever possible, once a week.

849 Official – in – charge of Material Train – Whenever a material train is worked, it shall be accompanied by a Guard. As the Guard is not qualified to carry out such duties as working of hoppers, distribution of ballast/materials, supervising loading and unloading, maintaining muster rolls and daily reports of labour and preparation of daily reports on material train working, a qualified engineering official (not be below the rank of JE/P.Way) should be deputed on the train to ensure working of material train to the programme specified by ADEN.

850 Equipment – Every material train Guard must have with him while on duty:

(1) A copy of General and Subsidiary Rules or such of them as related to his duties.

(2) An up-to-date copy of working time table with correction slips and appendices, relating to the section of the railway over which the material train is to be worked.

(3) A watch.

(4) Hand signal lamps/tri colour LED Flashing hand signal Lamp

(5) Two red flags and a green flag.

(6) A whistle.

(7) Not less than 10 detonators in a tin case.

(8) A carriage key.

(9) Padlocks as prescribed by special instructions.

(10) A set of clamp for point locking and/or other locking devices.

(11) A spare pair of glasses if he is required to wear glasses.

(12) First aid box.

(13) Wedge/Skid and chains.

(14) A tail lamp/LV Board.

(15) Portable telephone (on controlled sections), and any other equipment and stores prescribed by special instructions.

851 Testing of Brake Power –

(1) Before starting from a station, the Guard should ensure that the train is equipped with requisite brake power prescribed for the load.

(2) Each vehicle of material train whether or not provided with vacuum brake, must be provided with an efficient hand brake capable of being fastened down.

852 Working in Block Section –

(1) A material train shall be worked with the permission of the Station Master on either side and in accordance with the provisions and system of working in force on the section. Before a material Train enters a block section for work, the Station Master should advise the driver and the guard in writing of the time by which the train must clear the block and whether it is to proceed to the block station in advance or return to the same station.

(2) On double line, a material train must not push back to the Station in rear but should run through to the station in advance and return on proper running line except when otherwise directed.

Where provided, lever collars or other visual indicators must be used to remind Station Master that the material train is working in the block section.

(3) The guard/engineering official-in-charge shall ensure efficient and proper working and adhere to sanctioned time and occupation of block section. Materials should not be left fouling the track, signal wires and interlocking gears. If it is necessary for the train to leave the site of work before this is done, it should be ensured that sufficient labour is left to do so, in-charge of a competent railway servant and that the site is protected until the work is completed.

(4) When a Material train enters a block section to work under instructions of other than under the normal system of working, the Guard and the driver of the train shall ensure that the train is protected from the direction a train is approaching on double line and in both directions on a single line in accordance with General Rules.

If for any reason, it becomes necessary to detach the engine of a material train in the block section to run to the station in advance, the guard should ensure that the train is protected both in front and rear.

(5) On stopping a material train on a grade, the driver should give a long blast of the whistle to call the attention of the guard and thereafter three sharp blasts, the signal for application of hand brakes. The brakes must not be released until the Driver has signalled for this by giving two sharp blasts.

Before entering a section on which a ballast train is required to stand on a grade of 1 in 50 or steeper, the engine should be so attached that when the train is standing the engine is at the down-hill end of the train.

(6) A material train should not be divided outside station limits except in an emergency. Before the train is divided the Guard should put the hand brake in the brake-van hard on, and pin down the hand brakes of sufficient number of vehicles and if necessary, lock by means of safety chains or sprags a sufficient number of wheels, in each portion of the train. He should further ensure that the workers/labour are detrained before dividing the train. Vehicles should not be detached from a material train on a grade of 1 in 100 and steeper. The engine itself may be detached with the Guard's permission after he has ensured that hand brakes on each vehicle are properly applied and the wheels spragged against any movement.

(7) (a) JE/SSE/P.Way may impose suitable speed restriction along with deployment of lookout man for adjacent line during unloading of ballast or sleeper DMT.

(b) After unloading of ballast or sleepers, first train shall pass with restricted speed of 45 kmph or less, as imposed by JE/SSE/P.Way. Caution Order shall indicate the location where the material has been unloaded and also that the temporary engineering indicator boards are not displayed at site. (ACS – 6)

853 Pushing of Material Trains – On down gradient steeper than 1 in 100, pushing is not permitted. On gradient easier than 1 in 100 ascending or descending pushing may be permitted at a speed not exceeding 25 Kmph provided the brake-van occupied by Guard is the leading vehicle. The speed will be restricted to 10 Kmph, if the brake-van is not leading.

854 Procedure to be Followed while Pushing Back – When it is necessary for a Material train to push back into the station from which it started to work in the block section, the following procedure should be observed:

(1) No train must be allowed to push back without a written authority from the Station Master of the station from which it entered the section. Where line clear tickets are in use, the Station Master shall endorse the line clear ticket as follows "to push back to this station".

(2) The Station Master of a station where the train starts from and pushes back to, must advise the station in advance on the telephone or telegraph instrument and also the Controller on controlled sections that the train will push back to the station. He will then obtain the acceptance of the "Is line clear for a train stopping in the section"

signal on the block instruments or on the Morse instrument, where block instruments are not provided from the station in advance and then give the “train entering section” signal in the usual way.

(3) On the return of the train, the Guard will intimate that the whole of the train has returned to the station complete, from the section and sign in the trains register book to the effect and return the “authority to push back” to the Station Master which must be cancelled by the latter. The Station Master will then give “cancel last signal” signal on the block or on the Morse instrument, as the case may be, and endorse the remarks that “train pushed back” in the trains register book or the line clear enquiry book against the entry of the train.

(4) When it has been arranged for a train to push back from the section, it must always do so and not go through to the station in advance.

(5) Before starting, a green flag must be tied to a convenient fixture in front of the engine and also at the back of the rear brake-van to indicate to men working on the line that the train will push back.

(6) On the double line, when the train is required to be pushed back into a station, the train must come to a stand outside the advance starting signal and the Driver shall whistle, when, if a line is clear for its reception, it must be piloted into the station. If there is no advance starting signal, the train must be brought to a stand opposite the outer signal pertaining to the opposite direction and then be piloted into the station.

(7) On the single line, when a train is required to be pushed back into an interlocked station, it must come to a stand outside the outer signal and whistle, when, if a line is clear the home and the outer signals may be taken “off” for its reception. At a non-interlocked station, the train must also come to a stand outside the outer signal whence it must be piloted into the station on signals being lowered.

(8) Except in an emergency, material trains may push back during day-light only. If in case of an accident or for any other unavoidable reason, a train has to push back during the night, it must do so at a walking pace and the Guard or a competent railway servant must walk at least 600 metres in advance, exhibiting a danger signal until the train comes to a stand as detailed in *Sub-Para (6) & (7)* above.

855 Running on Ghat Section and Descending Grade –

(1) On Ghat sections, it may be necessary to attach an engine to bank the load in addition to the engine in front.

(2) When a Material train is descending a long and continuous steep grade, the brake levers of as many wagons as may be necessary to assist in controlling the speed, should be notched down by the Guard in consultation with the Driver.

856 Passage over Points – The Driver of a material train should stop the train short of all catch, loop or spring points which are facing for his train and which are not protected by signals. The Guard should ensure that these are correctly set and locked and then hand signal the Driver past the points.

857 Speed of Material Trains –

(1) When running between block stations with the engine leading, the speed of material train shall not exceed that prescribed for a goods train with a similar load.

(2) When the engine is pushing the train and when as in the case of emergencies the brake-van is not leading –

- (a) The speed must not exceed 10 Kmph.
- (b) The Guard must travel on the leading vehicle and exhibit hand signals to the Driver.
- (c) When passing over points, the Guard should take action as in **Para 856** above.

858 Stabling of a Material Train

(1) Material train shall not be stabled on running lines at a station, except in unavoidable circumstances.

(2) When a material train is stabled at a station, it shall be protected in the following manner and Station Master shall ensure that –

a) The vehicles of the material train have been properly secured and are not fouling any points and crossings,

b) All necessary points have been set against the line on which the material train is stabled and such points have been secured with clamps or bolts and cotters and padlocks and

c) The keys of such padlocks are kept in his personal custody until the material train is ready to leave the siding or line.

(3) The Guard shall not relinquish charge until he has satisfied himself that the material train has been protected as prescribed in this rule.

(4) When the train is ready to leave, the Guard must advise the Station Master in writing. The Station Master must then arrange for correct setting of the points.

(5) When a material train is stabled in an outlying siding, the Guard must ensure that it is inside the trap, clear of fouling marks and clear of running line. He must pin down sufficient number of brakes and if necessary, lock by means of safety chains or sprag the wheels.

859 Reporting Deficiencies and Damages – The Guard of the Material train should at once bring to the notice of the Train Examiner under advice to the Assistant Divisional Engineer, any deficiency or damage which may have escaped the attention of the train examining staff. The Guard will also keep a record of all damages caused to the vehicles during the work and report to the Assistant Divisional Engineer the circumstances in which they occurred.

In every case, the Assistant Divisional Engineer on receipt of such reports should arrange for the train-examining staff to attend to the damages and deficiencies expeditiously.

860 Warning to Workers on Material Trains –

(1) The Guard of a material train shall, before giving the signal to start, see that all the workers are on the train, and warn them to sit down.

(2) Before moving his trains, the Driver must sound the whistle, according to the prescribed code, as a warning to the labourers that the train is about to move.

(3) Before commencing any shunting with his train, the Guard must ensure personally that all labourers have been de-trained.

(4) In the event of it being necessary to part a Material train, the Guard must ensure personally that all labourers have been detrained before doing so.

861 Engine Crew's Hours of Duty – Drivers, Assistant Drivers employed on material train should be relieved according to their duty rosters. Only in exceptional and emergent cases such as breaches on the line, may the engine crew be kept on duty, for long hours, in which case, a special certificate should be given to the Engine Crew by the Engineering Official-in-charge.

PART – D

Loading and Unloading from Hopper Ballast Wagons

862 Staff Responsible – The staff at the ballast depots are responsible to ensure that the wagons are loaded to the correct level.

863 Working Trip –

(1) The train guard or engineering official-in- charge shall be responsible for working the train to the instructions issued by the ADEN. The JE/SSE/P.Way shall arrange for the inspection and clearing of track behind the train.

(2) A "working trip" is a trip when one or more wagons are to be unloaded between two stations. A "running trip" is a trip from one station to the other when no wagons have to be unloaded on the way. Before departing on a 'working trip' the JE/SSE/P.Way shall supply the material train guard/official-in-charge with a memo furnishing the kilometrages at which the wagons shall be unloaded and the quantity to be unloaded.

864 Operation of Hoppers – The hopper valves shall be operated according to the prescribed instructions under the direct supervision of the train guard or official-in-charge. As far as possible one hopper may be unloaded at a time moving at walking speed. The official-in-charge should walk on the side and instruct the labour as to when to open or close the hopper valves. The train should not be stopped, while ballast is being discharged; labour should not be moved from the platform without first stopping the train. For better control of operation of hopper valves, remote operated Electro-Mechanical gates should be used.

865 Training out Material and Daily Reports of Working –

(1) Training out of material and ballast should be done to a programme sanctioned by the Divisional or Assistant Engineer.

(2) The Guard/Engineering official-in-charge should adhere to the sanctioned programme and submit daily report on prescribed form **Annexure - 8/10** (material train journal) to the Assistant Engineer through the concerned JE/SSE/P.Way. Where the contract for the working of the material train provides for the employment of a minimum number of labourers and the contractor is paid for the actual labour so supplied for loading and unloading of ballast, permanent way or other materials the daily report should show the correct number of labourers of each class employed and the nature and approximate quantity of work done. Muster rolls should be maintained by the guard or engineering official-in-charge and checked and initialled frequently by the JE/SSE/P.Way concerned when the training out is done by departmental labour.

(3) In cases where the material is not loaded in bulk, the actual weight and number loaded should be given in the daily report.

(4) Sufficient number of copies of daily reports should be prepared by the guard/ engineering official-in-charge and submitted to the concerned officers e.g., engineering, operating, mechanical etc.

(5) The number of wagons on the train with their capacity and painted numbers should be indicated on the form of daily report. Particulars of detention to the train other than for Engineering work should also be indicated.

(6) Before forwarding the daily reports of material train working to the Assistant Engineer, the JE/SSE/P.Way may add relevant remarks as considered necessary. The Assistant Engineer should scrutinise the daily reports and take such action as considered necessary to avoid or minimise detentions in the working of the material train, before forwarding the same to the Divisional Engineer for allocation, initials and record.

866 Charges for Material Train Working – For purposes of debiting the charges on account of material train working to the heads of revenue working expenses concerned a monthly or fortnightly "material train return" in standard proforma will be prepared by Operating Department and sent to the Divisional Engineer for completion and submission to the Accounts Department, for necessary action. On this return, the hire charges for wagons and engine will be separately shown.

867 Register of Engineering Vehicles –

(1) When Engineering wagons are not in use, these should be stabled in the siding allotted for this purpose in specific station yards.

(2) The DEN and ADEN should maintain subdivision-wise a complete inventory in the form of a register of all closed wagons, open wagons, hoppers, etc., on the division. The register should contain:

- Vehicle numbers;
- Type of vehicle;
- Capacity;
- Condition of vehicle;
- Locations and particulars of periodical overhaul, when carried out and due.

The register should be kept current to facilitate issue of instructions when ordering a material train.

(3) A monthly return of engineering vehicles on the sub-division should be submitted by the ADEN to the Divisional Engineer with complete particulars of each vehicle for record in his office. It should be the ADEN's responsibility to keep track of all engineering vehicles allotted to his sub-division and see that those that are sent to workshops for periodical overhaul are returned expeditiously.

868 Working of Track Maintenance Machines –

(1) All 'On Track' machines shall be worked only under traffic block with the permission of the concerned Station Masters and in accordance with the special instructions issued in this regard.

(2) (a) Each machine shall be in direct charge of a nominated track machine operator. The operator shall be responsible for the working of the machine under his charge. He shall be fully conversant with the rules of working of trains and of protection in case of emergency. He shall also ensure that the other staff deployed on the machine are fully conversant with the protection rules. He shall hold a valid certificate of competency for driving and working of the machine.

(b) The track machine shall work under the direct supervision of an engineering official not below the rank of JE/SSE/P.Way who will be responsible for taking the traffic block, for protection of the line while the work is in progress and clearing of the block after completion of the work when the last machine clears the block section and certifying that the track is fit for train movement.

(c) When the track machine is required to move from one block station to another block station, the operator shall run the machine with the proper authority to proceed as defined in **Para 1.02 (6)** of *General Rules***.**

(3) Each unit shall carry all safety equipment as specified under *IRTMM***.**

(4) When more than one track machine is running in a block section, there should be a minimum distance of 200 metres between two units.

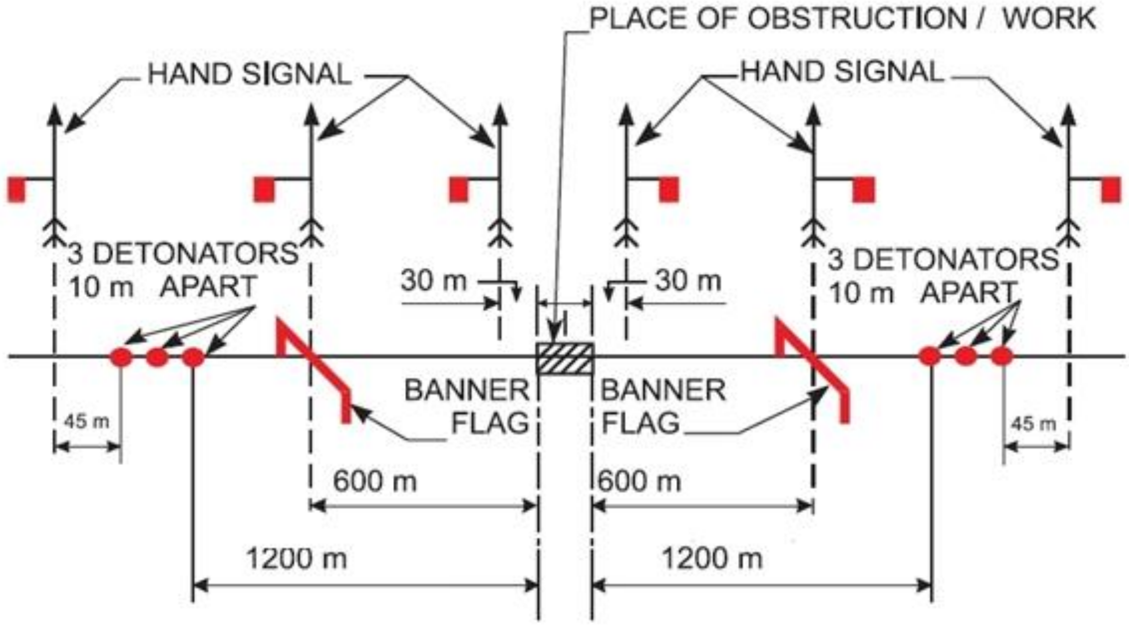
(5) While working on double/multiple lines, the engineering officials supervising the work of track machine shall ensure that no part of the machine fouls the adjacent track. In case infringement to adjacent track is inherent to the machine working which can be cleared at a short notice, the work should be carried out by protecting the infringed line by Engineering signals by JE/SSE/P.Way as envisaged in **Para 806**.

(6) Each unit will run within the maximum permissible speed sanctioned for that type of machine on that section.

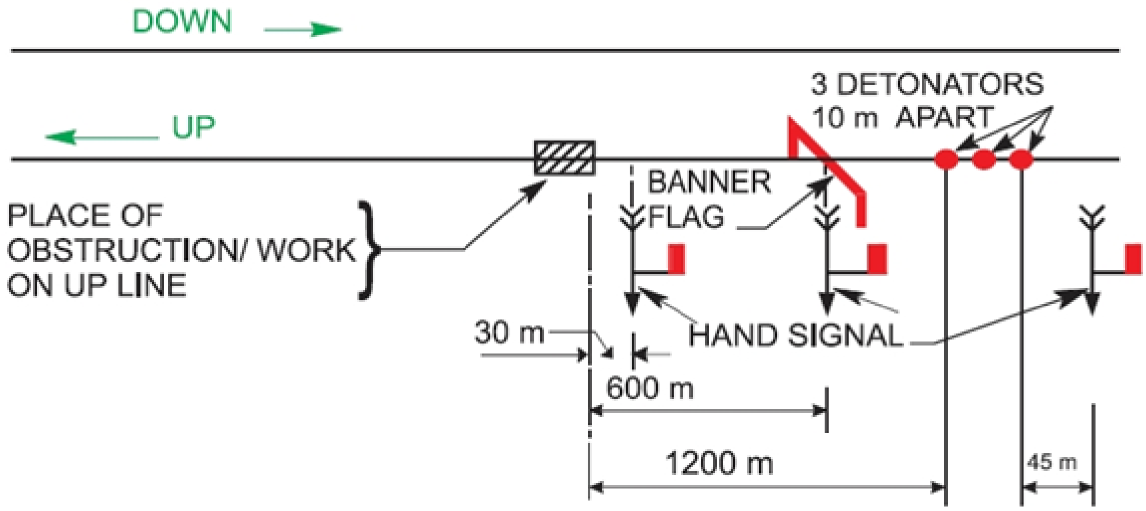
(7) All track machine shall work as per provision given in **Para 4.65** of *General Rules for Indian Railways (1976)* supplemented by Subsidiary Rules of Railways. For detailed working of track machines provisions in IRTMM may be referred.

Annexure - 8/1 – (*Para 806(1)*)

WORKS OF SHORT DURATION – PROTECTION OF LINE IN CASE OF STOP DEAD RESTRICTION



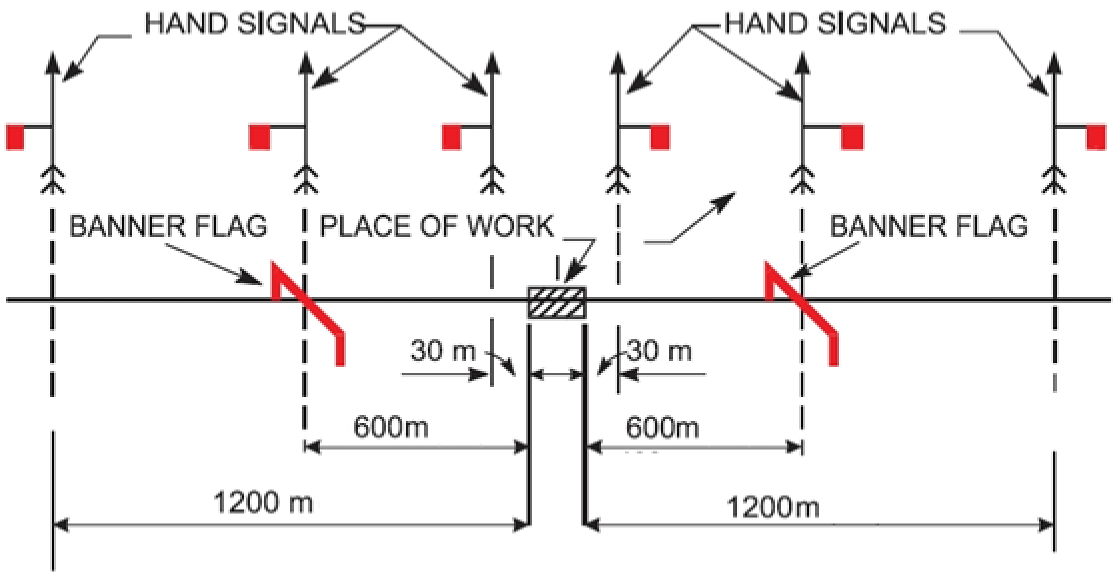
SINGLE LINE



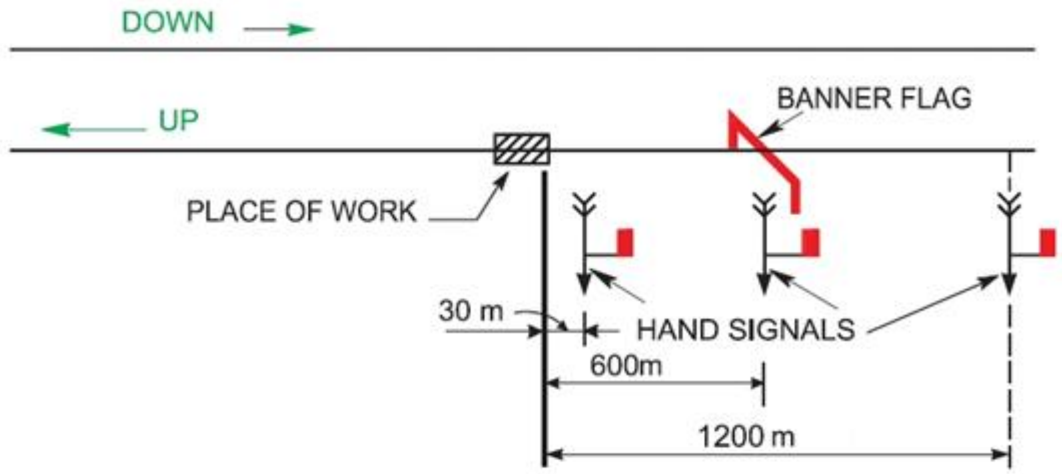
DOUBLE LINE

Annexure - 8/2 – (*Para 806(2))*

WORKS OF SHORT DURATION – PROTECTION OF LINE IN CASE OF REDUECD SPEED



SINGLE LINE



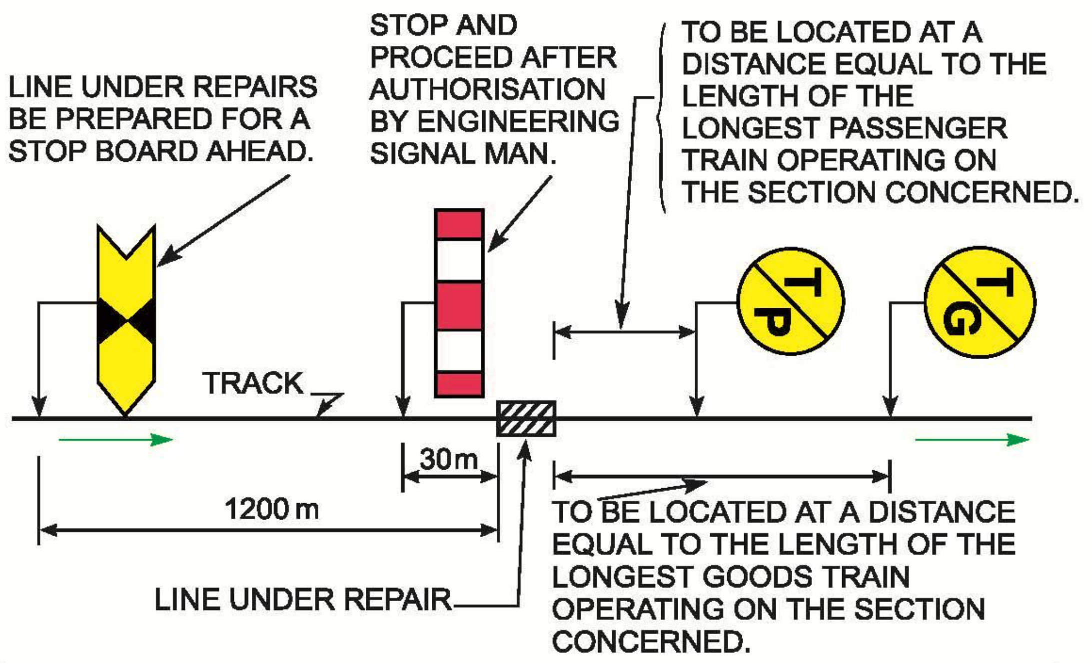
DOUBLE LINE

Note – *Intermediate Flagman will keep Banner Flag until the speed of the train has been reduced, after which the Banner Flag will be removed and train hand-signalled forward.*

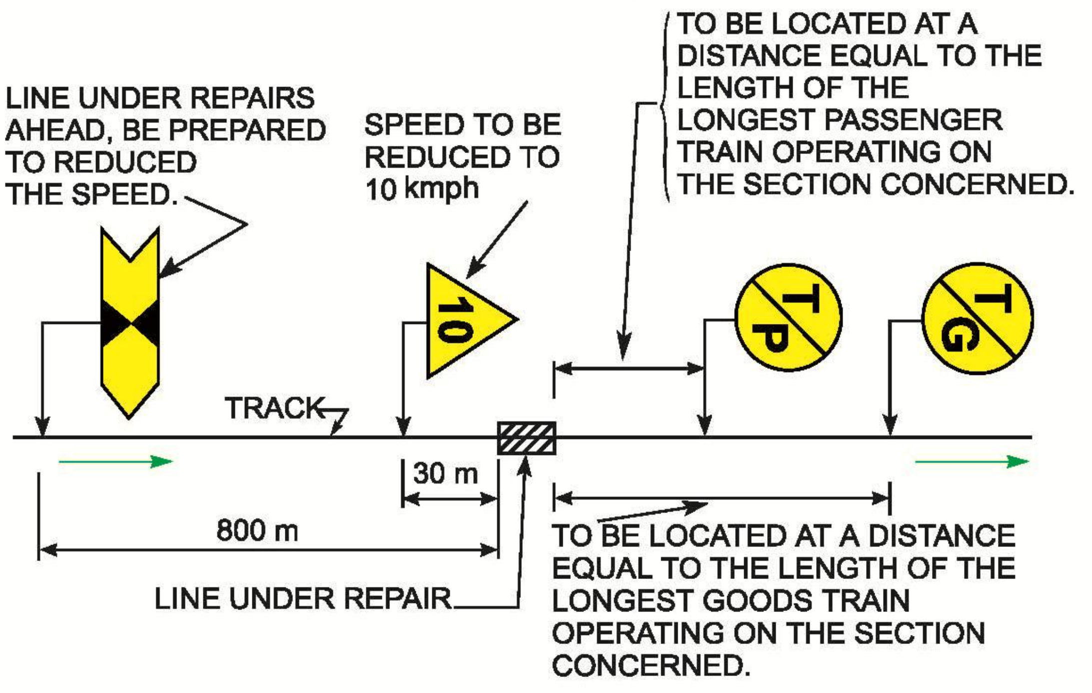
Annexure - 8/3 *(Para 807, 808, 814)*

RETRO REFLECTIVE TYPE BOARDS - TO BE PROVIDED IN NEW CONSTRUCTION AND DURING REPLACEMENT OF EXISTING BOARDS

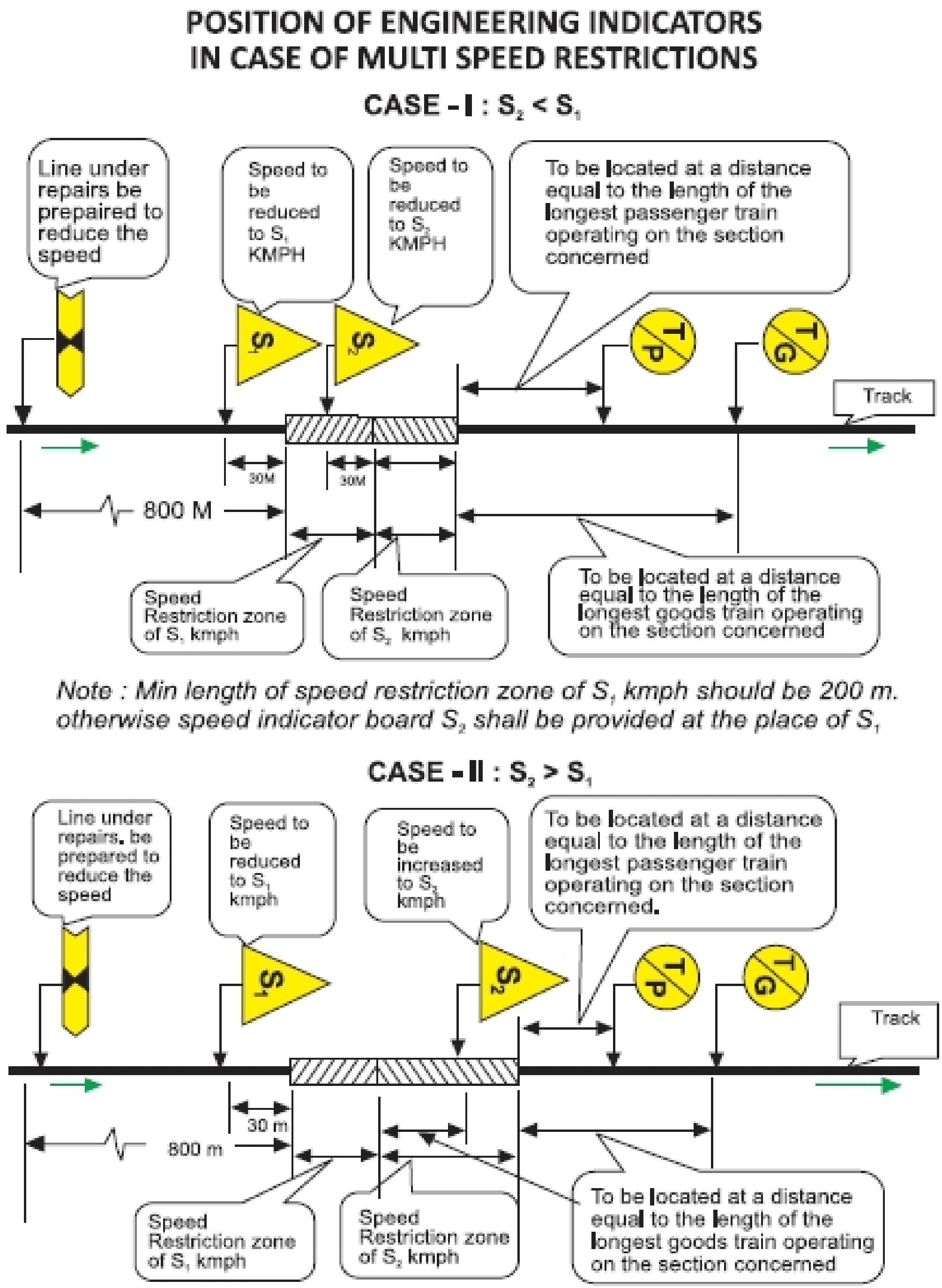
FOR STOP - DEAD RESTRICTION



FOR REDUCED SPEED

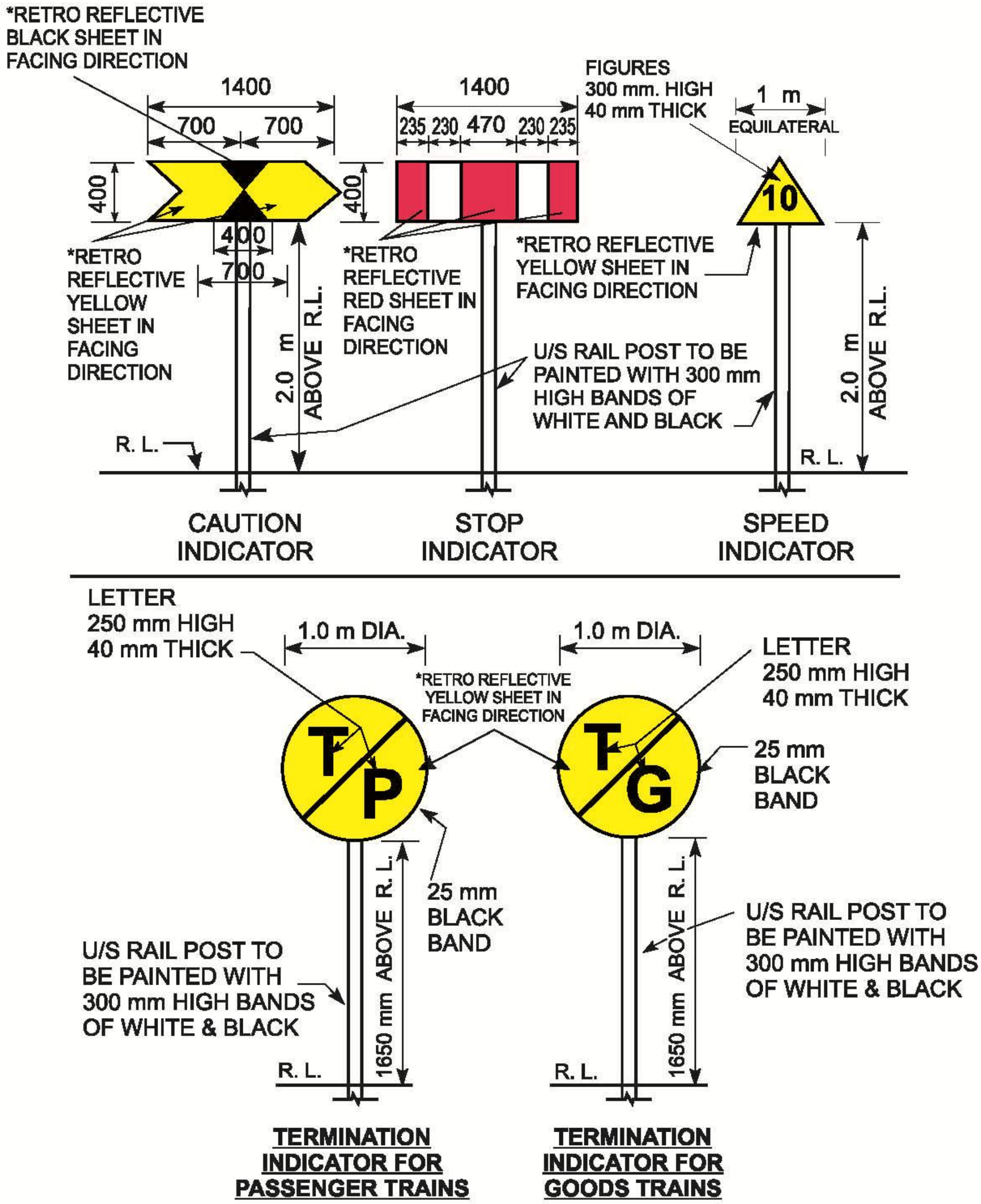


RETRO REFLECTIVE TYPE BOARDS - TO BE PROVIDED IN NEW CONSTRUCTION AND DURING REPLACEMENT OF EXISTING BOARDS



Annexure - 8/4 *(Para 808, 814)*

ENGINEERING INDICATORS FOR TEMPORARY RESTRICTIOINS



Annexure - 8/5 (*Para 819(4)*)

COMPETENCY CERTIFICATE

Certified that shri.. P.Way supervisor of M/s .... has been examined regarding P.Way working on .... work. His knowledge has been found satisfactory and he is capable of supervising the work safely.

ADEN

Annexure - 8/6 (*Para 831*)

INDEMNITY BOND IN CONNECTION WITH THE PERMISSION GRANTED TO TRAVEL ON A RAILWAY

.........................Trolley/Motor Trolley

In consideration of my being granted permission to travel between .... and .... on .... Railway .... Trolley/Motor Trolley, I .... hereby undertake and agree that the Railway shall be free from all responsibility or liability for any delay or detention or for any injury or loss to me or to any property of whatsoever kind accompanying me occasioned during the journey for which the permission is granted or whilst I am or the said property is within Railway limits.

I further undertake that I shall not interfere with or obstruct .... on his duties and shall obey all reasonable directions he shall give me to be subject to the bye-laws and other general regulations of the Railway.

I further undertake to indemnify and keep indemnified and save harm less the Railway Administration for and against any loss or damage done to the property of the Railway through any act or omission on my part or on the part of my agent or servants while so travelling on the Trolley/Motor Trolley.

Dated ....
Witness –

Name ....
Designation…….. ……

1. ....

Address ....

2. ....
.... (To be executed on stamp paper)

Annexure - 8/7 (*Para 832)*

INDEMNITY BOND IN CONNECTION WITH USING TROLLEY IN PRIVATE SIDING BY NON-RAILWAY MEN

THIS INDENTURE made the .... day of .... between..of the one part and the President of India as owner of and administering the...Railway(hereinafter called "the Administration")of the other part WHEREAS by an Agreement dated the..day of........................... and made between the Administration of the one part and the said..................................of the other part, the President of India agreed to allow the said.. to use and work a private trolley the railway line of the said................ Railway between ....and whereas prior to the execution of the agreement the said .... agreed to execute these presented.

NOW THIS INDENTURE WITNESSETH AS FOLLOWS:

The said ....shall henceforth at all times perform and observe the stipulations, provisions and conditions on his part to be performed and observed and contained in the aforesaid agreement.

The said .... shall observe and perform the bye-laws, rules and regulations of the......................... ....Railways for the time-being in force.

The said...shall not in any way interfere with or hamper the working of the ....Railway.

The said..shall from time-to-time and at all times hereafter indemnify and keep indemnified the Administration from and against all actions, claims, demands, costs, losses, damages and expenses including claims by 3rd parties Workmen's Compensation and Employees' liability which may be brought against or made upon the Administration or which the Administration may, pay, incur, sustain or be put to by reason of any loss of life or injury or damage to any person or property caused by or arising out of or from the user and for working of a private trolley by the said..on the said railway line and the user of permanent way in pursuance of the said agreement.

IN WITNESS where of the said ....has here into set his hand and seal the...day and…………………year first herein/above written.

Signed, Sealed and Delivered by the said .... In the presence of:

Annexure – 8/8 (*Para 837(4)*)

Trolley/Motor Trolley/Lorry Notice

(Working without line clear)

Notice No. .... Station..............................

Dated ....

To,

The Station Master/Signalman .... Station.

Trolley/Motor Trolley/Lorry No.. is required to work between .... and .... It will leave .... station at .... hours } this day for Kilometre .... at .... hours

.... Station.

Kilometre ....

....

Official-in-charge

To,

The Official-in-charge

Daily and extra trains due to arrive at or pass this station upto .... hours have actually done so except.

No .... minutes late

....

....

The following extra trains, special trains and light engines will enter .... section as shown.

....

....

I have exchanged advice with .... station/block post and shall issue caution orders to all Drivers until I receive advice of removal of the trolley/motor trolley/lorry.

....

Station Master/Signalman

Removal Report

Reference trolley/motor trolley/lorry Notice No. .... dated .... trolley/motor trolley/lorry No. .... arrived at ....

.... at .... hours.

was removed from the track at kilometre.

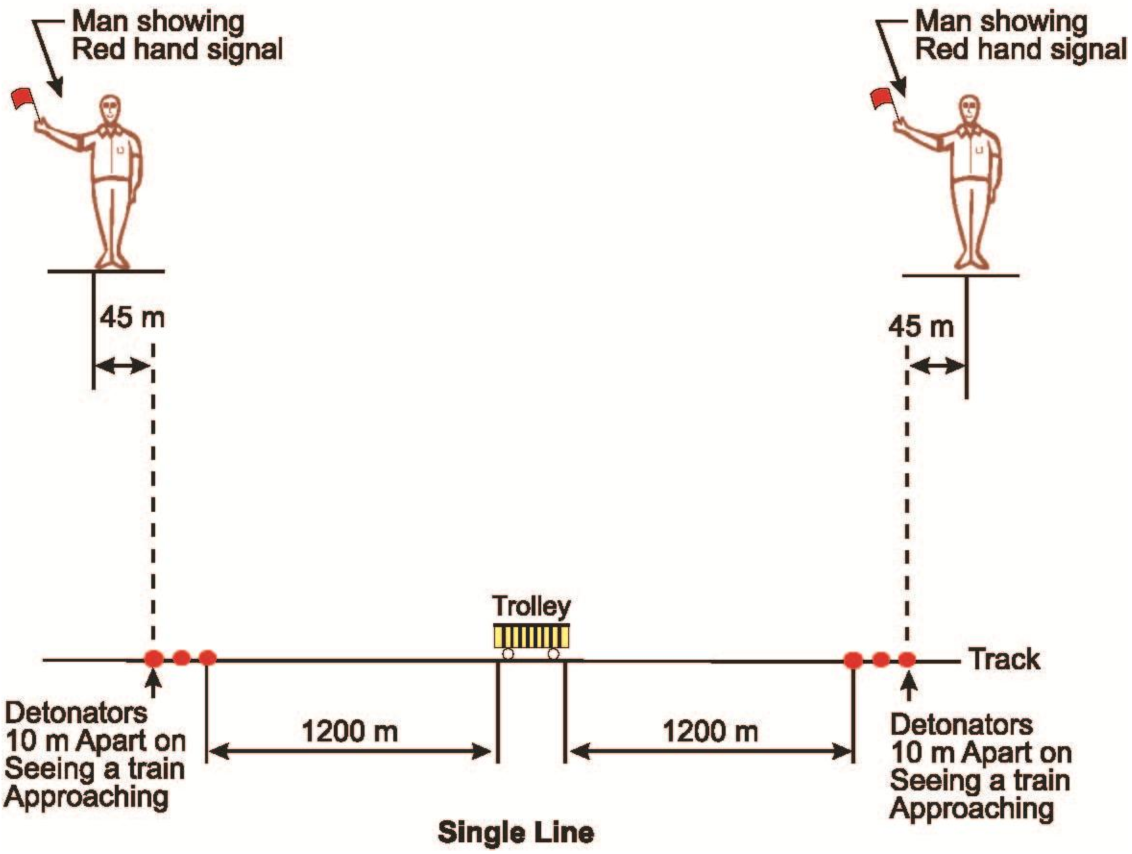
Removal report received at .... hours.

Station Master/Signalman, ... Station.

Official-in-charge.

Annexure – 8/9 (*Para 837(5)*)

PROTECTION OF TROLLEY ON LINE



Annexure - 8/10 (*Para 865)*

DAILY REPORT OF MATERIAL TRAIN WORKING

Material Train Report of..train, ordered vide Divisional Engineer’s/ Assistant Engineer’s No.. working from kilometre... to kilometre .... Engine No............................ Class..................... composition of train .... labour .... Mates .... Men .... Women.

Name of the Contractor...

Station		Time		Hours occupied	Trip No.	Work done	Trains crossed	Allocation	
From	To	From	To					Name of work	Head of Account

At		Trip No.	Contents			At		Trip No.	Contents		
Kilometre	T. P.		Wagon	Descrip-tion of material	Quantity	Kilo-metre	T. P.		Wagon	Descrip-tion of material	Quan-tity

Contractor or his authorised agent	SSE/JE No. .... Section	Material Train Guard/ Official.	Assistant Engineer. Sub-Division	Divisional Engineer. Division
.... 20	.... 20	.... 20......	.... 20......	.... 20......

Note – On reverse of this form the class, capacity and number of each wagon should be shown; also, particulars of detentions to train other than for Engineering Work.

CHAPTER – 9

LEVEL CROSSINGS AND GATEMAN

901 **General Location –** As far as possible, new Level Crossings may not be provided in the interest of safety of road users and public on any line. However, in case of new line projects sanctioned on socio-economic considerations with Rate of return (RoR) less than 10%, provision of manned Interlocked level crossing may be considered with the approval of Railway Board. The Level Crossing would be located outside the outermost facing points. Level crossing at cuttings or near cuttings should be avoided as far as possible.

For Level Crossings already located within busy station yards affecting Railway operations and causing heavy detention to the road traffic, efforts should be made to replace them by Road Over/Under Bridges as per extant rules or shift them outside the outer most facing points, especially during planning of gauge conversions, yard re-modeling and doubling works.

902 **Classification of Level Crossings –**

(1) The classification of level crossings, based on the volume of rail and road traffic, shall be as under:

Class of LC	Criteria
Special…….for roads	TVUs greater than 50,000
‘A’ class……for roads	TVUs from 50,000 & up to 30,000; or Line capacity utilization 80% (on single line) and number of road vehicles greater than 1000
‘B’ class…….for roads	TVUs less than 30,000 and up to 10,000 and number of road vehicles greater than 750 ‘B’ Class is further subdivided as following – B1 class… TVUs less than 30,000 and up to 25,000 B2 class… TVUs less than 25,000 and up to 10,000
‘C’ class…… for roads	All other level crossings for road, not covered in above classes

(ACS – 6)

(2) Level crossings over colliery, factory and other similar sidings where Railway traffic is light may, however, be dealt with according to local conditions, subject to the approval of the Commissioner of Railway Safety being obtained in each case to the measures adopted for the safe working of trains.

903 **Categories of Roads –** For the purpose of this standard, Roads shall be categorized as under –

(a) Class I roads –

(i) National Highways,

(ii) State Highways,

(iii) Important roads with in municipal towns, and

(iv) Roads in and around towns where road and rail traffic is heavy.

(b) Class II roads –

(i) Major and other District roads,

(ii) Unimportant (Other than important) roads within municipal towns,

(iii) Roads within Non-Municipal towns including those within shunting limits of railway stations, and

(iv) Other surfaced roads.

(c) *Class III roads –*

(i) Earth roads, and

(ii) Cart tracks.

904 Standards for Different Classes of Level Crossings – The standards to be followed (within the Railway limits) for the various Parameters in respect of different classes of level crossings will be as shown in **Annexure - 9/1**. These standards are applicable to all new constructions and also in the case of up-gradation of the existing level crossings. The existing level crossings which are of a lower standard than those prescribed in **Annexure - 9/1** need not be altered or modified merely to suit these standards.

905 Gates and Locking Arrangements –

(1) *Gates –*

(a) The gates shall be in the form of lifting barriers or swing gates of approved design. In the event of any damage, Chains or sliding boom may be used as a temporary measure.

(b) At new manned level crossings, lifting barriers should normally be provided which are coupled so as to operate simultaneously. Chains or swing gates at existing manned level crossings should be replaced by lifting barriers on a programmed basis, giving priority to the important and busy level crossings.

(2) Locking arrangements –

(a) Lifting barriers, swing gates or chains when closed against road traffic shall be securely locked.

When the locking arrangement is of the hasp and staple type with padlocks, two spare chains with loops at both ends should be provided for locking the gates when the locking arrangement goes out of order.

(b) Stops should be provided to prevent level crossing gates from swinging towards the track and causing infringement. Catches should be provided to secure gates when in the open position to avoid obstruction to road traffic.

(c) In the case of all manned level crossings, two long spare chains with loops at both ends should be kept as reserve for use as an alternate to the barrier/ gate, in case of damage to them. Two discs painted red with the words “stop” with arrangements for fixing them on the ground should also form part of the spare equipment. Separate rail posts should be erected near the gate, so that the chains can be fixed on them **(Annexure - 9/2).**

906 Skew Level Crossings –

(1) All roads should preferably cross the railway line at right angles. In special cases, when modification is required to suit the road approaches the angle of crossing should not be less than 45°.

(2) At all level crossings the gate posts shall be fixed square to the road.

907 Normal Position of Gates –

(1) *General –* Subject to such Special Instructions in that behalf as are permitted by **GR 16.03**, all gates at level crossings shall be kept constantly closed and securely fastened across the through fare on both sides of the railway and shall only be opened when it is necessary and safe to open them for the passage of road traffic; provided that any Railway Administration may from time to time issue special instructions for any particular level crossing or class of level crossing and may by such special instructions permit the gates at any level crossing or class of level crossings to be

normally kept open to road traffic and may therein prescribe the conditions under which gates are to be kept closed against road traffic for the passage of a train or trains or for the purposes of any other railway operation.

(2) Based upon classification of level crossings over which trains are required to pass, the normal position of gates may be as under:

(a) *Interlocked level crossings* – All interlocked level crossings shall be kept 'Normally Open to Road Traffic' and may only be closed against the road traffic for the passage of trains or for any other Railway operation by taking off the signals.

(b) *Non-Interlocked Level crossings* – The gates must normally be kept closed and securely fastened against road traffic and may only be opened for the passage of road traffic when it is necessary and safe to do so. The Railway Administration may under special instructions permit gates of level crossings not protected by signals to be normally kept open to road traffic prescribing the conditions under which they may be kept closed against road traffic for passage of trains or any other railway operation.

(c) The normal position of gates at level crossings within station limits shall be as *Sub-Para (a) and (b)* above, fixed station signals not being regarded as affording any protection unless the gates are interlocked with signals.

(d) *Level crossings having heavy seasonal traffic* – In case of level crossings having heavy seasonal road traffic with normal position of gates closed to road traffic, the Railway Administration may permit gates of such level crossings, to be kept open to the road traffic during the busy season, when road traffic is heavy, by issuing special instructions and prescribing the conditions, under which they may be kept closed to road traffic for passage of trains or any other railway operation. The special instructions should be incorporated in the working rules for the gates and stations concerned.

(3) Gateman shall at all level crossings be prepared, wherever level crossings be open to road traffic, to show a danger signal to any approaching train and for this purpose invariably keep a hand signal lit during night to show Red throughout the period the level crossing is open to road traffic.

908 Signals for road users –

(1) Type of signals for road users – Preferably, electric signals should be provided at gates to give correct indication to road users. As an alternative, Gate lamp along with blinders may be mounted preferably in rectangular sockets over gates so as to give correct indication to road users vide item 6 of **Annexure - 9/1.** The lamp should be lighted by the Gateman at sunset and remain lighted till sunrise.

(2) Drivers of trains shall get no light indication from the road signal/gate lamp, except in case of level crossings on non-important lines like sidings where normal position of level crossings may be kept closed for railway

909 Traffic and Engineering Gates –

(1) *Traffic Gates* –

(a) The manning and operation of the gates at level crossings located within the outermost stop signals shall be under the control of Operating Department. The level crossings and structures pertaining thereto shall be maintained by the engineering department.

(b) When protected by signals the equipment shall be governed by the signals of the station/block hut and the operation as per the station working rules.

(2) *Engineering Gates –*

(a) Level crossings beyond the outer most stop signals shall be under the control of the SSE/P.Way (In-charge) both as regards to their operation and maintenance.

(b) Where the level crossing is protected by Signals, fixed signals shall be provided in each direction in accordance with the relevant General Rules (**GR 3.34** New Rules) and approved special instructions.

(3) The maintenance of signals, interlocking, lifting barriers at interlocked gates and communication equipment will rest with the Signal Department in the case of all level crossing gates, whether located within or outside the outermost stop signals.

(4) The gate working instructions in English, local language and Hindi (wherever required) for manned gate including the signaling diagram for interlocked gate shall be incorporated in Station working Rules. A copy of gate working rules, for both interlocked and non-interlocked gates, shall also be kept at gate lodge.

910 Equipment at Level Crossings –

(1) The equipment for a level Crossing shall be as follows; in addition to such others as may be prescribed by special instructions –

(a) Two hand signal rechargeable LED lamp with tri-colour light/K Oil H S lamp, tri-color provided with bright reflectors

(b) 1 hand signal flag, green

(c) 2 hand signal flags, red

(d) 1 staff suitable for exhibition of red lamp or red flag

(e) 2 long spare chains with “stop” marked disc attachment at the centre to cover the full width of the gate, for use in case the gates/ barriers are damaged (**Annexure - 9/2**).

(f) 2 spare small chains and padlocks for locking gates, in case locking arrangements of gates become defective.

(g) 10 nos. detonators in tin case.

(h) 1 tin case for flags.

(i) 2 nos. Banner flags.

(j) 1 canister for muster sheet. (For Engineering gates only)

(k) 1 can for oil (Only at gates where K oil hand lamps are still in use)

(l) 1 tommy bar.

(m) 1 water pot or bucket.

(n) 1 mortar pan.

(o) 1 phowrah.

(p) 1 rammer.

(q) 1 pick-axe.

(r) 1 tool list (with columns drawn for checking of tools).

(s) 1 book of safety rules in Hindi, Regional language and English(This is already part of gate working instructions)

(t) Duty roster.

(u) Complaint book for road users.

(v) Inspection register.

(w) Level crossing working instructions containing safety rules

(x) Two gate lamps (Electric/ Kerosene type).

(y) Gatemen working on double line/multiple lines, ghat sections, suburban and automatic block territories shall be provided with three warning signals as prescribed in **Para 817.** Gatemen working on single line sections shall be supplied with two warning signal. Gates provided with rechargeable lamps with flashing red light, will serve the above purpose.

(z) Diagram indicating the method of protection to be adopted, in case of obstruction in the level crossing **(Annexure - 9/7)**

(z)(i) Wall clocks to enable the gateman to correctly record the time of exchange of private number, expected and actual time of passage of train, time for opening and closing of level crossing etc.

(z)(ii) Whistle thunderer – 1 No.

(z)(iii) Jumper and Gloves (for electrified section) – 02 sets.

***Note** – In case of level crossings in multiple lines, the hand signal flags/lamps, detonators and banner flags shall be increased suitably.*

(2) In place of physical private number books, it is preferable to provide automatic Private Number generating device, which generates Private Number only after closure of LC gates and thus enhances safety.

(3) There should be sufficient supply of kerosene oil, wicks and matches at the gate-lodge provided with HS lamps/ gate lamps. The Gateman should always keep their hand signal lamps trimmed and ready for lighting and use at a moment’s notice. During night, one of the hand signal lamps should be kept lit through-out to show danger stop signal to an approaching train. When the level crossing is closed to road traffic, the hand signal lamps should be kept lit dimly only.

(4) At every level crossing there should be distinct indication at 600 meters and1200 meters on Broad Gauge on either side to guide the Gateman for placing the detonators in case of obstruction at the level crossing. Indicator posts should be provided with one dot and three dots at these distances to indicate the number of detonators to be placed. Arrangements for exhibiting the danger signal at a distance of 5 meters during emergency should be made at each level crossing.

(5) *Height gauges on electrified sections* **–**

(a) Adequate arrangements shall be made to erect standard height gauges on either side of the overhead equipment or other equipment at every level crossing so as to ensure that all vehicles and moving structures passing under the height gauge also pass under the overhead equipment or other equipment with adequate clearance.

(b) The adequate clearance referred to in *Sub-rule Para (a)* shall be sanctioned under approved special instructions.

(c) Height gauges should be located at a minimum distance of 8 meter from gate posts. In exceptional circumstances where site conditions do not permit, Principal Chief Engineer can give exemption in these standards subject to a minimum of 8 meter distance from the centre line of the track. Road surface up to this point may be at the same level as the road surface inside the gate posts.

(d) Vehicles and moving structures, which cannot pass under the height gauge without striking or touching it, shall not be permitted to pass the overhead equipment or other equipment except in accordance with special instructions.

911 Location of Gate-Lodge –

(1) Gate-lodge shall be so located that a clear and unobstructed view is obtained of all approaching trains and road vehicles, care being taken that allowance is made for all

future extensions, e.g., doubling of line or widening of roadway.

(2) Where the level crossing is on a curve, the gate-lodge should be built on the outside of the curve.

912 Appointment of Gatemen, Rosters and Medical Fitness Certificates –

(1) Before appointment, the SSE/P.Way (In-charge) should ensure that competent track maintainers elected as gate men have been certified fit in class A3 by the Medical Department and that they are examined thereafter at periods stipulated by the rules in force. In all level crossings, literate Gateman capable of exchanging private numbers should be posted.

(2) The selected gatemen will be given initial and periodical training in Divisional training Centre and competency certificate shall be issued as specified in **Chapter 14**.

(3) The hours of duty for the Gateman should be laid down and must confirm to the regulations in force. The rosters detailing the hours of duty and rest for each Gateman shall be maintained at the gate-lodge. The roster should indicate clearly as to which Gateman is required to be on duty at any particular time. No Gateman shall change his hours of duty without the order of the SSE/P.Way (In-charge).

(4) Full particulars regarding the periodical medical examination and vision test of each Gateman shall be maintained at the gate- lodge.

(5) When handing or taking over charge, the Gateman and their relievers should jointly check all the equipment and test all the gears to see that they are in order.

(6) Every Gateman shall be fully conversant with the use of hand signals, detonators and protection rules.

913 Maintenance of Level Crossing, Examination of Gate Equipment and Gateman in Rules –

(1) *By SSE/P.Way (In-charge)* –

(a) Obstruction of view – All trees, bushes or undergrowth that interfere or tend to interfere with the view from the Railway or road way when approaching level crossings, should be cut down taking care to comply with the procedure laid down in ***Para 648***.

(b) Inspection and Maintenance –

(i) Level crossings laid with PSC sleepers should be overhauled with each cycle of machine packing or more frequently as warranted by condition and in no case shall opening be delayed by more than two years. In all cases, rails and fastenings in contact with the road shall be provided with galvanized fittings. Alternatively, non-galvanized fittings should be thoroughly cleaned with wire brush and a coat of coal tar/anti-corrosive paint applied. Flange way clearances, cross level, gauge and alignment should be checked and corrected as necessary, and the track packed thoroughly before reopening the level crossing for road traffic.

(ii) The painting of gates and discs should be done at regular intervals.

(iii) The SSE/P.Way (In-charge) should keep a manuscript register of repairs for all level crossings on his section. This register should show the date of opening, the condition of sleepers with their age and time, the date and type of each sleeper changed and other requisite particulars.

(iv) The SSE/P.Way(In-charge) will be responsible for the proper upkeep and maintenance of 'Whistle Boards' and 'STOP' Boards provided on the approaches to level crossings.

(v) Check rails of level crossing are required to be removed for tamping operations, overhauling of level crossings, destressing of LWR or track renewals etc. Check rails should be re-fixed as quickly as possible and preferably before leaving site.

Should a situation arise where check rails cannot be re-fixed for any reason and trains have to be passed, a speed restriction of 30 Kmph should be imposed besides ensuring that road traffic is diverted till the check rails are put in place. In case such diversion is not possible, temporary arrangements should be made for passage of road traffic till the check rails are put in place. However, in both these cases, the check rails should necessarily be provided latest by close of next day. In such cases, a stationary watchman shall be posted to ensure safety.

(c) Checking equipment and examination of Gateman in rules –

(i) The equipment with the Gateman shall be checked by JE/SSE/P.Way once in a month by rotation.

(ii) The JE/SSE/P.Way shall ensure that the Gatemen have correct knowledge of rules by examining them periodically during his routine inspection and on appointment, promotion or transfer. He should not only educate them in rules, but also conduct practical demonstration of protection of level crossing in case of emergency.

(d) Surprise day/night inspection of level crossing should be carried out to ensure presence and alertness of Gateman.

(2) *By ADEN* – The ADEN should inspect the equipment at every manned level crossing on the sub-division once in six months, and examine the Gateman in rules during his inspection.

The ADEN should scrutinize the manuscript register of level crossings maintained by the SSE/P.Way (In-charge) and inspect as many level crossings as possible, when they are completely opened out during the year.

914 Level Crossing Registers – In the office of the DEN, ADEN and SSE/P.Way(In-charge) complete particulars of level crossings in serial order should be maintained in a register as shown in **Annexure - 9/3**.

Whenever additions and alterations or improvement to level crossings are made, the level crossing registers should be amended and where necessary a copy of the new or revised working instructions with the revised signal and interlocking diagram pasted at the gate-lodge.

915 Level Crossing indicators – (*Back to **Para 815***) At the approaches of all level crossings, bilingual whistle boards as per design **(Annexure - 9/4)** should be erected at 600 metres along the track from the level crossing to enjoin the Drivers of approaching trains to give audible warning of the approach of a train to the road users.

916 Provision of Speed Breakers on the Approaches of Level Crossing – Provision of rumble strips on approaches of level crossings as per the standard design is the responsibility of Road authorities. Matter may be pursued with all State Governments/Road authorities to ensure that rumble strips are provided on all level crossings as per standard design over the total width of the road i.e. edge of the berm to edge of berm with proper road warning signs as per the standard design. However, it is incumbent upon Railways to provide speed breakers as per the standard design on level crossings irrespective of whether the approach road is metalled or un-metalled, as a temporary safety measure, till such time these are replaced with rumble strips of proper design by the Road authorities. While providing speed breakers, following guidelines may be observed:

(1) One speed breaker should be provided on either approach of level crossings at a distance of about 20 m from the gate post of the level crossing, covering full

width of the road including berms as per **Annexure - 9/5.** This may require construction of speed breaker by railway outside railway boundary. For roads with central median/one-way roads, speed breaker is to be provided on the entry side of the road only. For safety reasons, the paint marking should be provided and their maintenance ensured.

(2) Standard warning signs for speed breakers as per **Annexure - 9/6** should be invariably provided at a prescribed distance as indicated in item 19 of **Annexure - 9/1.**

(3) Speed breakers should be constructed with suitable material depending on the type of road and traffic. On berms and un-metalled roads, the speed breakers should be supported on proper base of compacted road metal.

917 Census of Traffic at Level Crossings –

(1) Periodical census of traffic at all level crossings shall be taken once every three years. This shall be carried out for 7 days and total Train Vehicle Units (TVUs)/Day (Train Units × Road Vehicle Units) are worked out. Train, road vehicle, bullock carts and tongas being considered as one unit, cycle rickshaw/auto rickshaw being considered as half unit and motorized two wheelers being considered as 0.25 unit. The census shall be carried out by a multi-disciplinary inspectorial team consisting of representative of Engineering, S&T and Traffic Departments. The mechanism shall be setup by the Divisional Railway Manager to ensure that the representatives are present for the census by laying down advance timetable for carrying out of census of level crossings.

(2) In the case of manned level crossings, the periodical census should be substituted by a census-cum-job analysis so as to avail of the opportunity of checking up the adequacy of men on consideration of Hours of Employment Regulations.

918 Track Structure at Level Crossings (*Back to **Para 318**, **715***)

(1) Rail joints should be avoided in check rails and on the running rails, within the level crossings and three metres on either side from the end of level crossing.

(2) In the case of SWR, the short-welded panel may be continued through the level crossing, avoiding fish plated joint on the level crossing and within six metres from the end of level crossing.

(3) The level crossing should not fall within the breathing length of LWR.

(4) Concrete sleepers to relevant RDSO drawings along with fittings should be provided at LC Gate.

919 Level Crossings on National Highways/State Highways and Other Important Roads.

(1) In case of National Highway/State Highways or their by passes and important city roads, no new Level Crossing to be provided and only grade separators to be provided.

(2) In case of the important roads, it is preferable to provide grade separators. However, depending upon the traffic density envisaged, manned level crossings can also be considered.

(3) Relaxation of the above (1) will require Board's prior approval.

920 Elimination of Level Crossing – A detailed review/survey of the existing level crossings should be carried out with a view to eliminate them by-

(a) Construction of Subways, along with adequate drainage arrangements.

(b) Construction of roads along railway boundary to divert road traffic to the nearest level crossing/grade separator – The roads for closure of LC gates can be diverted through existing water way bridges if the water way remaining after treating one span as closed is sufficient to cater to the requirement of design discharge.

(c) Closure of low TVU gates,

(d) Construction of ROB/RUB as per **Para 921** below.

(e) During execution of Gauge conversion & doubling works, etc.

921 Criteria for Replacement of Existing Level Crossings (other than those provided on deposit terms) with Road Over/Under Bridges on Cost Sharing Basis –

(1) Minimum Train Vehicle Units (TVU) on a Level Crossing should be 1 lakh per day to become eligible for replacement with Road Over/Under Bridges on 'Cost Sharing' basis. However, this could be relaxed in the following cases :

(a) Suburban sections having high frequency of train services; and

(b) Near stations where detentions to road traffic are very high on account of either shunting operations or multi-directional receipt/dispatch of trains or stabling of trains etc.

(2) Preference should be given to the Level Crossings located on trunk routes vis-à-vis those located on branch lines. In any case, minimum number of times the level crossing is required to be closed against the road traffic should at least be 12 times per day.

(3) Subject to (1) and (2) above, priority should generally be accorded by the concerned State Government giving preference to Level crossings on National/State Highways.

(4) In case of Road Over/Under Bridges constructed in replacement of busy level crossings situated in Municipal/Corporation/ Metropolitan areas where Light Vehicular traffic is considerable and where the Railways are satisfied that closure of the level crossings would cause hardship, additional provision may be made for construction of the subway or a light Over Bridge with ramps for the use of light vehicular traffic at the time of framing the proposal for the construction of Road Over/Under Bridges. The proposals for providing the ramps/sub-way should be examined critically and should be provided for, only in the case of genuine hardships and not as a matter of course. The cost of these ramps/subway will be shared equally with the Sponsoring Authority on 50:50 basis.

(5) Closure of the Level Crossings should be ensured before commissioning of the Road Over/Under Bridges. All such cases where State/Local Authorities do not agree to abide by this should be reported to the Railway Board promptly.

(6) Railways may, based on specific request of concerned Road authorities, consider sharing cost of constructing new FOUR lane Road Over Bridge in lieu of level crossings having minimum TVU of 3 Lakh per day comprising not less than 6000 Road vehicle units. The cost sharing of FOUR lane Road over bridge should be resorted to only if the concerned Road authorities have converted the approach road into four lane or are simultaneously doing four laning of approach portion.

Annexure - 9/1 (*Para 904, 908, 916*)

Government of India – Railway Department (Railway Board)
Classification and Standard Specification for Level Crossings
(Within Railway Limits)

Note – *(1) The revised specification applies only when any level crossings constructed or old one altered.*
Wherever the new standards differ from the old standards, the old standards have been given below the new standards for reference. In other cases, the old standards and new standards are the same.

Item	Details	Dimensions and Details for various classes of crossings.				Remark
		Special	'A' Class	'B' Class	'C' Class	
1	2	3	4	5	6	7
1.	Minimum width of gates at right angles to the centre line of the road.	The Minimum width of gates will be governed by the class of roads on which the level crossing is situated and will be as under – Across Class I roads – 9 metres or X + 2.5 m, whichever is more. Across Class II roads – 7.5 metres or X + 2 m, whichever is more. Across Class III roads – 5 metres or X + 1.25 m, whichever is more.				Where, X = width of carriage way. In the case of skew crossing the length of the check rail must be increased in accordance with the formula: $X = \frac{L}{\sin A}$ Where, X = Required length, L = Minimum length measured at right angles to the centre line of the road, A = Angle between the centre line of the Road and Railway.
	Old Standards	7.5 metres (24')	5.5 metres (18')	5.5 metres (18')	5.5 metres (18')	
2.	Minimum length of check rail (for a square crossing)	2 metres more than width of gate.				(ACS – 6)
3.	Angle of crossing between gates.	Not less than 45° between centre line of road and Railway.				(ACS – 6)

Item	Details	Dimensions and Details for various classes of crossings.				Remarks
		Special	'A' Class	'B' Class	'C' Class	
1	2	3	4	5	6	7
4.	Provision of Wicket gates for foot passengers.	To be Provided except where foot over bridges are provided.	To be Provided except where foot over bridges are provided.	To be Provided except where foot over bridges are provided.	To be provided on need basis after assessing the requirement by a committee constituted by the railway.	Design of Wicket gate should be such that trespassing by cattle is prevented.
5.	Position of gates (Lifting barrier/ Swing gates) when open to road traffic.	Across or towards the line.	Away from or towards but not across the line.	Away from or towards but not across the line.	Away from or towards but not across the line if gates are provided.	At new manned level crossing lifting barriers should normally be provided as close to gate posts as feasible, which should be coupled, so as to operate simultaneously Chain and Swing gates at existing manned level crossings should be replaced by lifting barriers on a programmed basis, giving priority to the important and busy level crossings. Where, lifting barriers are provided, the booms will be in vertical position.

Item	Details	Dimensions and Details for various classes of crossings.				Remarks
		Special	'A' Class	'B' Class	'C' Class	
1	2	3	4	5	6	7
6.	Provision of lights on gates at night. (a) Light as observed by road users.	Across or towards the line.	Red when either gate is closed to the Road, white when both gates open to the Road.	Red when either gate is closed to the Road, white when both gates open to the Road.	Red when either gate is closed to the Road, white when both gates open to the Road. But provision of gate lamps is not obligatory and should normally be provided at only those level crossings where there is motor traffic. Where there is no motor traffic, the gate should be painted white and red disc provided. If posts and chains are provided the posts should be painted white with red disc provided on the chains at the centre and reflectors, luminous paint or scotchlite tape may be provided on the red disc as an alternative to lamps.	At all important level crossing gates where electric power supply is available flashing lights to give indication to the road users about lowering or raising of lifting barriers should be provided. An economical arrangement would be to fit the gate lamp in both directions along the track. If local conditions make it expedient to fit the lamp in the centre of the gate, a suitable rod operated cowl must be provided.

Item	Details	Dimensions and Details for various classes of crossings.				Remarks
		Special	'A' Class	'B' Class	'C' Class	
1	2	3	4	5	6	7
	(b) Light as observed by Drivers of approaching trains.	Away from or towards but not across the	Nil	Nil	Nil	
7.1	Minimum distance of gate posts from centre line of track.	3.5 metres	3.5 metres	3.5 metres	3.5 metres	(ACS – 3)
7.2	Distance of Gate post from centre line of track.	Minimum distance + 30 cm (Tolerance)				If it is not feasible to keep post within the minimum distance + 30 cm, it can be increased with specific approval of PCE.
8.	Minimum distance of gate lodge from – (a) Centre line of nearest Track.	6 metres				If the line of approach road is on a curve at or near a level crossing, the gate lodge must be built on the outside of curve. (ACS – 6)
	(b) Edge of Road Metalling	6 metres				
	Old Standards –	6 metres	4.5 metres	4.5 metres	3 metres	

Item	Details	Dimensions and Details for various classes of crossings.				Remarks
		Special	'A' Class	'B' Class	'C' Class	
1	2	3	4	5	6	7
9.	Interlocking and communication devices to be provided – (a) Normal position of gate.	Open to road traffic	Open to road traffic	Closed to road traffic. Can be kept open to road traffic provided either gates are interlocked with signals and provided telephone communication with adjacent stations/ cabins or when the following Conditions are satisfied: LC. should not be located in a Suburban Section. L.C. should not be in Automatic Block Signalling or Automatic permissible block signalling territories. Should have a telephone Connection with the nearest station with exchange of private numbers. Visibility at the level crossing should be good.	Closed to road traffic. Can be kept open to road traffic provided either gates are interlocked with signals and provided telephone communication with adjacent stations/ cabins or when the following Conditions are satisfied: LC. should not be located in a Suburban Section. L.C. should not be in Automatic Block Signalling or Automatic permissible block signalling territories. Should have a telephone Connection with the nearest station with exchange of private numbers. Visibility at the level crossing should be good.	

Item	Details	Dimensions and Details for various classes of crossings.				Remarks
		Special	‘A’ Class	‘B’ Class	‘C’ Class	
1	2	3	4	5	6	7
	(b) Interlocking of gates with signals – (i) If within station limits.	Should be interlocked with station signals.	Should be interlocked with station signals.	Should be interlocked with station signals irrespective of the location of gate i.e., Suburban, non-Suburban sections (where operated from cabins) or Automatic Signalling territories.	Should be interlocked with signals. (i) Within station limits where operated from cabins, (ii) In Automatic Signalling territories.	(i) The level crossing inside station limits should be beyond the limits up to which shunting is normally carried out or at an adequate distance of at least 250 metres ahead of the starters and trailing points of the station where Advanced Starters/Shunting Limit Boards are not provided. (ii) In case of level Crossings falling on Suburban Sections they may be considered for upgradation to 'B' class in the event of their not qualifying for upgradation to "Special" or 'A' class and when so upgraded to 'B' class the facilities as indicated in column 5 should be provided. Apart from above, Interlocking of level crossing gates can be considered by the Competent Authority as per the instruction issued from time to time.

Item	Details	Dimensions and Details for various classes of crossings.				Remarks
		Special	'A' Class	'B' Class	'C' Class	
1	2	3	4	5	6	7
	(ii) If outside station limits.	Should be interlocked with station signals.	Should be interlocked with station signals.	Should be interlocked with Gate signals irrespective of the location of gate i.e., Suburban, non-Suburban sections (Where operated from cabins) or Automatic Signalling territories.	To be interlocked in Automatic Signalling territories.	(i) In the case of level crossings protected by signals where the sighting of the signal by an engine Driver is inadequate a warning board should be placed at not less than the emergency braking distance in rear of the gate stop signal. The board should be vertical 2000 mm by 450 mm with alternate black and yellow strips 125 mm wide painted on it at an angle of 45°. The top of the board should be 4 m above Rail level. The board need not be lit at night but should as far as possible be provided with scotchlite or other effective light reflectors. (ii) Where level crossing is situated outside the station limit but in close proximity thereof, the clear distance between the level crossing and an outer signal should not be less than a full train length. Apart from above, Interlocking of level crossing gates can be considered by the Competent Authority as per the instruction issued from time to time. (ACS – 6)

Item	Details	Dimensions and Details for various classes of crossings.				Remarks
		Special	'A' Class	'B' Class	'C' Class	
1	2	3	4	5	6	7
	(c) Telephone communication for Gate lodge. (i) Within station limits.	Tele-communication with ASM's Office to be provided.	Tele-communication with ASM's Office to be provided.	Tele-communication with ASM's Office to be provided.	Tele-communication with ASM's Office to be provided.	In cases where communication with ASM is stipulated, the connection may be given too the Switchman in the Cabin as per the local condition.
	(ii) Outside station limits.	Tele-communication with ASM's Office of adjoining station should be provided.	Tele-communication with ASM's Office of adjoining station should be provided.	Tele-communication with ASM's Office of adjoining station should be provided.	Tele-communication with ASM's Office of adjoining station should be provided.	
	(d) Warning bell operated by approaching train.	Provision of warning bell or hooter operated by approaching train at Interlocked LC Gates in suburban section and non-suburban sections be provided on sections having Automatic Signalling.				(Ref.: RB's letter No. 2011/SIG/WP/LC/IR/1 dated 20.02.2013) (ACS – 6)
10.	Minimum no. of Gate Keepers.	Three	Two	Two	Two (One if the gate is closed and locked at night in accordance with the provision of GR 16.03).	

Item	Details	Dimensions and Details for various classes of crossings.				Remarks
		Special	'A' Class	'B' Class	'C' Class	
1	2	3	4	5	6	7
11.	Fencing on lines which are not fenced throughout their length.	Minimum length of 15 m from each gate post parallel to track.	Minimum length of 15 m from each gate post parallel to track.	Minimum length of 15 m from each gate post parallel to track.	Minimum length of 15 m for level crossing outside station limits and level crossing within station limits provided with gates/chains.	
12.	Width of metalling – (a) Between Gates	Same as that of width of gates.	Same as that of width of gates.	Same as that of width of gates.	Same as that of width of gates or the width between gate posts where gate leaves are not provided.	
	(b) Outside of Gates.	Minimum width of metalling immediately outside gates (but tapering off to the existing carriage way width within a distance of 30 m from the gate) shall be as follows depending on the class of road over which the L.C. is situated:				
		Class-I road: 7 m or the width of existing carriage way whichever is greater.	Class-II road: 5.5 m or the width of existing carriage way whichever is greater.	Class-III road: 3.78 m or the width of existing carriage way whichever is greater.		
	Old Standards:	Same width as metalling outside the Railway Boundary				

<table>
<tr><th rowspan="2">Item</th><th rowspan="2">Details</th><th colspan="4">Dimensions and Details for various classes of crossings.</th><th rowspan="2">Remarks</th></tr>
<tr><th>Special</th><th>‘A’ Class</th><th>‘B’ Class</th><th>‘C’ Class</th></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td rowspan="2">13.</td><td>(a) Type of pavement between Gates.</td><td colspan="4">The Road surface within the Gates should not be inferior to the approach road in its load carrying capacity. However, frequent opening of road surface within the Gates for track maintenance should be kept in mind while selecting the type of road surface.</td><td rowspan="2">If the surface outside is cement concrete, black top surface may be provided.
For class I and II roads, it is desirable to have black topped surface for a distance of at least 30 m beyond each gate.</td></tr>
<tr><td>(b) Outside gates.</td><td colspan="4">Same standard as that of the road surface outside the Railway Boundary.</td></tr>
<tr><td rowspan="4">14.</td><td rowspan="3">Minimum width of road formation outside the gates for a distance of 30 m beyond the gate.</td><td colspan="4">Depending on the class of road over which level crossing is situated the minimum width of road formation will be as under –</td><td rowspan="4"></td></tr>
<tr><td>Class-I road:
C + 5 m</td><td>Class-II road:
C + 5 m</td><td colspan="2">Class-III road:
C + 5 m</td></tr>
<tr><td colspan="4">Note – C = width of metalling just outside the gate.</td></tr>
<tr><td>Old Standards:</td><td>Same as rest of the road outside Railway Boundary.</td><td>4 metres wider than metalling.</td><td>3 metres wider than metalling.</td><td>2 metres wider than metalling.</td></tr>
<tr><td rowspan="4">15.</td><td>Level length and gradients:
(a) Between gates</td><td>Level</td><td>Level</td><td>Level</td><td>Level</td><td rowspan="4">Vertical curves should be provided at change of gradient within Railway Boundary according to Indian Road Congress Standard, beyond the level portion.</td></tr>
<tr><td rowspan="2">(b) Outside gates</td><td colspan="4">Depending upon the class of road over which the level crossing is situated the level length and gradient will be as follows:</td></tr>
<tr><td>Class-I roads:</td><td>Class-II roads:</td><td colspan="2">Clas-III roads:</td></tr>
<tr><td>Level upto</td><td>15 metres beyond.</td><td>8 metres beyond.</td><td colspan="2">8 metres beyond.</td></tr>
</table>

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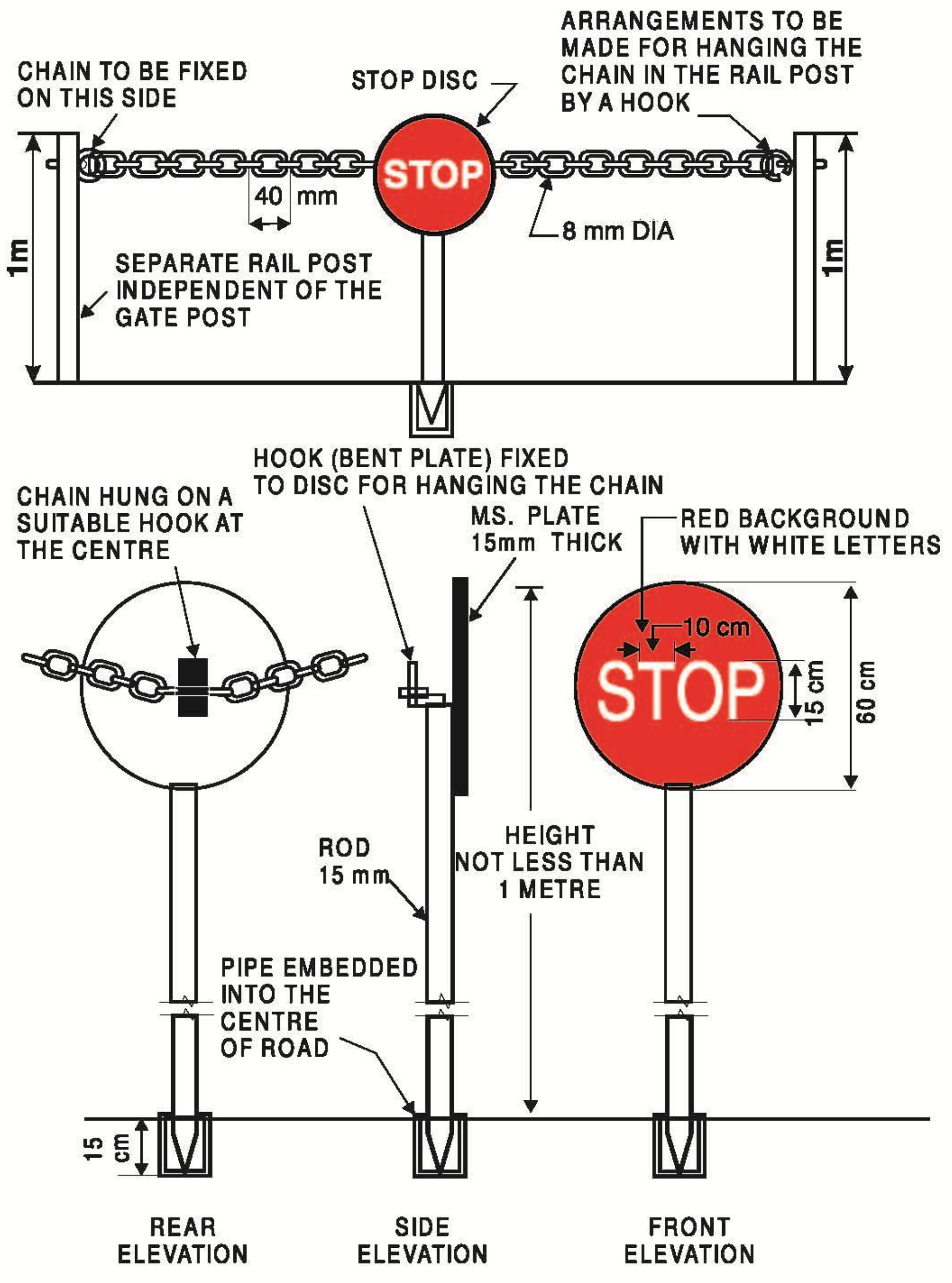
<tr><td rowspan="3"></td><td>Not Steeper than</td><td colspan="2">1 in 40 beyond.</td><td colspan="2">1 in 30 beyond.</td><td>1 in 20 beyond.</td><td>1 in 15 beyond.</td><td rowspan="3"></td></tr>
<tr><td>Old Standards:</td><td colspan="2">8 metres beyond.</td><td colspan="2">6 metres beyond.</td><td>6 metres beyond.</td><td>6 metres beyond.</td></tr>
<tr><td>Not Steeper than</td><td colspan="2">1 in 40 beyond.</td><td colspan="2">1 in 30 beyond.</td><td>1 in 30 beyond.</td><td>1 in 20 beyond.</td></tr>
<tr><td rowspan="2">16.</td><td>Minimum radius of centre line of road on curved approaches.</td><td colspan="6">In the case of Level crossings situated on National or State Highways, the following minimum radius may be adopted;
(a) Plain or rolling country: 250 metres.
(b) Hilly country: 90 metres. In difficult terrain, the radius may he reduced with the concurrence of road authorities.
The aim should be to provide the greatest possible radius.
In the case of other roads the best possible radius, having regard to safety of Road traffic may be adopted.</td><td rowspan="2"></td></tr>
<tr><td>Old Standards:</td><td colspan="2">60 m (200 ft)</td><td colspan="2">45 m (150 ft)</td><td>30 m (100 ft)</td><td>21 m (70 ft)</td></tr>
<tr><td rowspan="5">17</td><td rowspan="4">Minimum desirable straight length of Road outside the Gate.</td><td colspan="6">Depending upon the class of road over which the level crossing is situated the following minimum and desirable length may be adopted:</td><td rowspan="5"></td></tr>
<tr><td colspan="2">Class-I</td><td colspan="2">Class-II</td><td colspan="2">Class-III</td></tr>
<tr><td>Desirable</td><td>Minimum</td><td>Desirable</td><td>Minimum</td><td>Desirable</td><td>Minimum</td></tr>
<tr><td>30 m</td><td>15 m</td><td>22.5m</td><td>9 m</td><td>15 m</td><td>4.5 m</td></tr>
<tr><td>Old Standards:</td><td colspan="2">12 m.</td><td colspan="2">9 m.</td><td>6 m.</td><td>3 m.</td></tr>
</table>

<table>
<tr><th rowspan="2">Item</th><th rowspan="2">Details</th><th colspan="6">Dimensions and Details for various classes of crossings.</th><th rowspan="2">Remarks</th></tr>
<tr><th colspan="2">Special</th><th colspan="2">‘A’ Class</th><th>‘B’ Class</th><th>‘C’ Class</th></tr>
<tr><td>1</td><td>2</td><td colspan="2">3</td><td colspan="2">4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td rowspan="4">18.</td><td rowspan="4">Minimum sight distance of level crossing gate from road in the vicinity of level crossing.</td><td colspan="6">Depending upon the class of road over which the level crossing is situated the following minimum and desirable length may be adopted:</td><td rowspan="4"></td></tr>
<tr><td colspan="2">Class-I</td><td colspan="2">Class-II</td><td colspan="2">Class-III</td></tr>
<tr><td>Plain or rolling country</td><td>Hill country</td><td>Plain or rolling country</td><td>Hill country</td><td>Plain or rolling country</td><td>Hill country</td></tr>
<tr><td>120 m</td><td>60 m</td><td>60 to 90 m</td><td>40 to 50 m</td><td>40 m</td><td>30 m</td></tr>
<tr><td rowspan="4">19.</td><td rowspan="4">Warning to Road traffic of proximity of level crossing:</td><td colspan="6">Distance of Road sign posts from level crossing:</td><td rowspan="4">Road sign confirming to the standard prescribed must be erected by the Road Authority in advance of the level crossings at the specified distances.</td></tr>
<tr><td colspan="2">Class-I</td><td colspan="2">Class-II</td><td colspan="2">Class-III</td></tr>
<tr><td>Plain or rolling country</td><td>Hill country</td><td>Plain or rolling country</td><td>Hill country</td><td>Plain or rolling country</td><td>Hill country</td></tr>
<tr><td>120 m</td><td>60 m</td><td>60 to 90 m</td><td>40 to 50 m</td><td>40 m</td><td>30 m</td></tr>
<tr><td>20.</td><td>Vertical clearance between the underside of the top member of the height guage and the road surface.</td><td colspan="6">4.76 m to 4.78m</td><td>(ACS – 6)</td></tr>
<tr><td>21.</td><td>Clearance between the road surface and the boom of lifting barrier when the gate is closed to Road Traffic.</td><td colspan="6">0.8 m to 1 m</td><td>As per Para 14.2.1 (h) of IRSEM.
(ACS – 6)</td></tr>
</table>

Annexure - 9/2 (*Para 905, 910)*



DETAILS OF STOP DISC TO BE PROVIDED ALONG WITH SAFETY CHAIN AT MANNED LEVEL CROSSINGS

.... RAILWAY

LEVEL CROSSING REGISTER

Division .... Sub Division .... SSE/P.Way Section ....

General Details of Level Crossings

Level Crossing No. .... Kilometrage .... Between Stations......................... Inside station Limits of Station ....

Class of Level Crossing .... No. of Gate keepers ....

Roster Classification ....

Type of Barrier: Movable/lifting/gates/chains/... whether located in suburban/A.P.B. territory/Automatic block signalling ....

Whether interlocked or not .... Whether Provided with telephone ....

1. **Particulars of Road Across which the Level Crossing is Situated –**

   a) Name of Road ... ...

   b) Road connecting village/town ... ...

   c) Class of Road (whether Class I, II, III) ... ...

   d) Road authority in-charge of maintenance of road (National Highway/State Highway/Municipality /Panchayat/P.W.D./Others.) ....

   e) Civil District where located ... ...

   f) State in which located ... ...

   g) Type of road surface (Kutcha/Moorum/Water Bound Macadam/Bituminous surface/concrete etc.) ....

2. Width of gates at right angles to centre line of road ....
3. Length of check rails/check flats ... ...
4. Angle of crossing of road way, if skew ... ...
5. Whether wicket gates or stiles have been provided for pedestrians. ....
6. Position of gates when open to Road traffic Across/ Away from tracks. ....
7. a) Whether lamps have been provided on the gate on both sides for the road users. ....

   b) In the absence of lamps, whether the gate has been painted white and red disc provided. ....

   c) Whether reflectors have been provided on the stop disc on both sides of the gate. ....

8. Whether the red light meant for road users has been blanked off towards the approaching train except for special class level crossing where gates are closed across the track.	....
9. Distance of gate posts from centre line of track ...	....
10. a) Whether gate-lodge/bunk has been provided ...	....
b) Distance of gate-lodge from centre line of nearest track.	....
c) Distance of gate-lodge from edge of metalling ...	....
d) If on a curve, whether gate-lodge is located on outside of the curves.	....
e) Whether quarters have been provided for Gateman ? If so, How many.	....
11. Type of fencing and length	Left side .... Right side ....
	Prior................. Prior.....................
	After................. After.....................
12. Interlocking and Communication Devices Provided –	
a) Normal position of gate (whether closed to road traffic or open to road traffic).	....
b) Whether barriers/gates are interlocked with separate signals or with the station signals.	....
c) Distance of gate signals and warning boards from level crossing.	Up Direction ....
	Dn Direction ....
d) Whether there is a telephone (Magneto), connection and facility for exchange of private nos. and the station to which connected.	....
e) Whether there is warning bell-operated by approaching train.	....
f) Whether the gate/barriers can be operated simultaneously.	....
13. Details of Road and Approaches –	
a) Width of road-way at right angle to centre line of Road outside gate.	....
b) Width of metalling between gates	....
c) Width of metalling outside gates	....
d) Minimum width of road formation outside gates for a distance of 30 m beyond gate.	....
e) Whether it is level between gates	....

f) Level length outside the gates. Details of gradient on approaches — L H side .... R H side ....

g) Length of straight outside gates. — L H side .... R H side ....

h) Whether rumble strip has been provided. ....

14. Visibility, Road, Signs, Whistle Boards etc. –

a) Has Whistle boards (W/L) been provided on the approach of Level Crossing. If so distance of whistle boards from the Level Crossing. — Up Direction .... Down Direction ....

b) Distance of clear view of approaching trains from Level Crossing (gate lodge) — Up Direction .... Down Direction ....

c) Whether warning boards for road users have been provided. If so, the type and the distance at which it is provided. — L H side .... R H side ....

15. a) Dates of taking last Census (for seven days) ... .

b) No. of trains per day ... ...

c) No. of Trains/Vehicle Units per day ... ...

d) Whether there is motor traffic and No. of motor vehicles per day.

16. Track structure at Level Crossing –

a) Type of Track - Free rail/SWR/LWR/CWR. .... kg Rails on .... sleepers. ....

b) Date of last overhauling ... ...

c) Date of painting gate ... ...

17. Safety Items –

a) Whether locking arrangements have been provided for both gates. ....

b) Whether stops have been provided to prevent gates from swinging towards track.

c) Whether spare chains have been provided for emergencies. ....

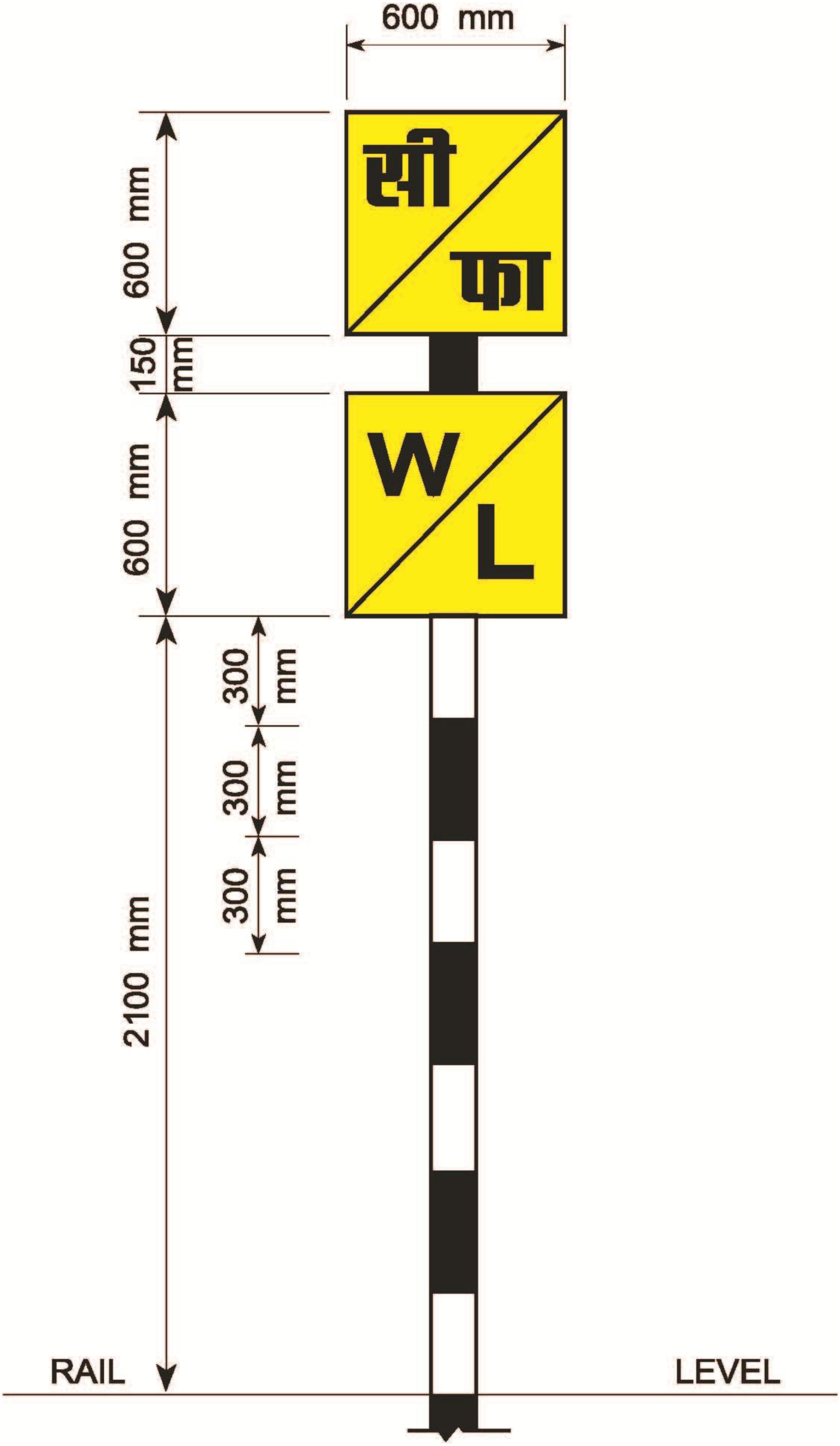
d) Whether working instructions of level crossing in English and Local language are available at the gate. ....

e) Whether distinct indications are provided for guiding the gateman to place the detonators and also the staff/lamp near the gate, to warn the approaching train in case of emergency. ....

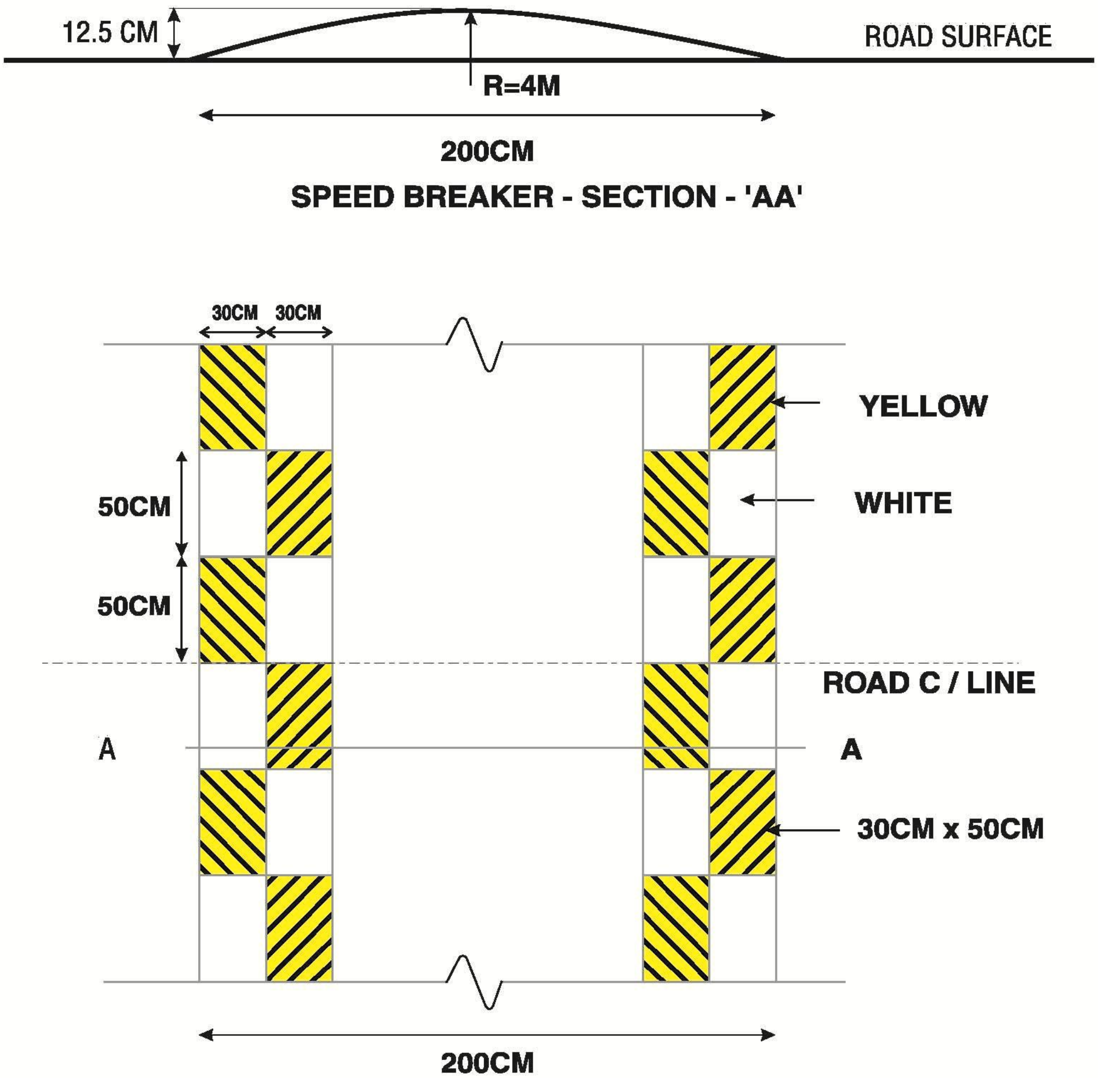
f) Whether height gauge have been provided on both sides of level crossing, in the case of electrical territory. ....

g) Whether protection diagram has been exhibited at gate. ....

Annexure - 9/4 (*Para 915)*

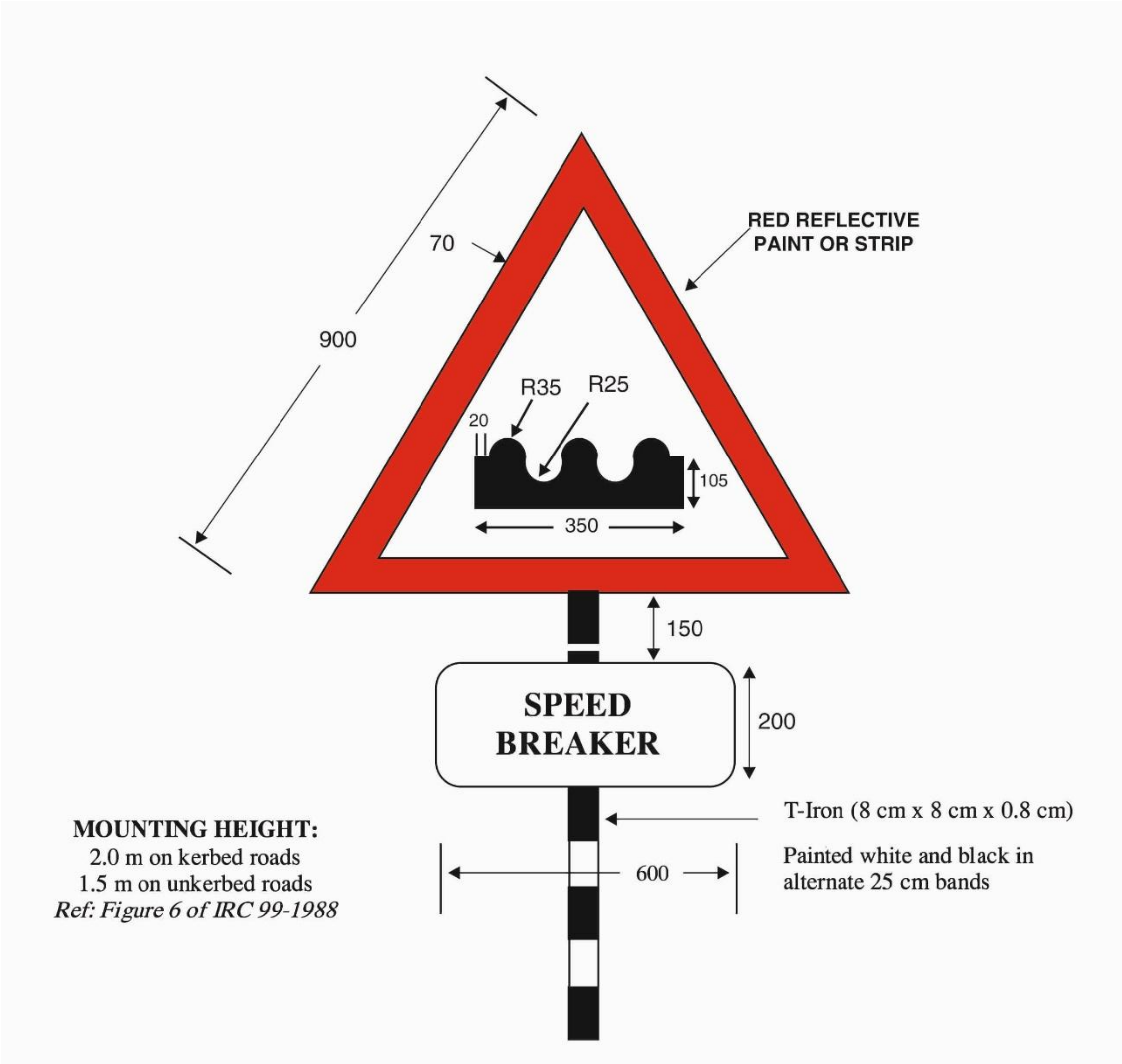


DETAILS OF WHISTLE BOARD ON THE APPROACH OF A LEVEL CROSSING



Note – The hump should extend to the full roadway width. Approach base course material should be extended over the shoulders for placing the humps over these.

WARNING SIGN

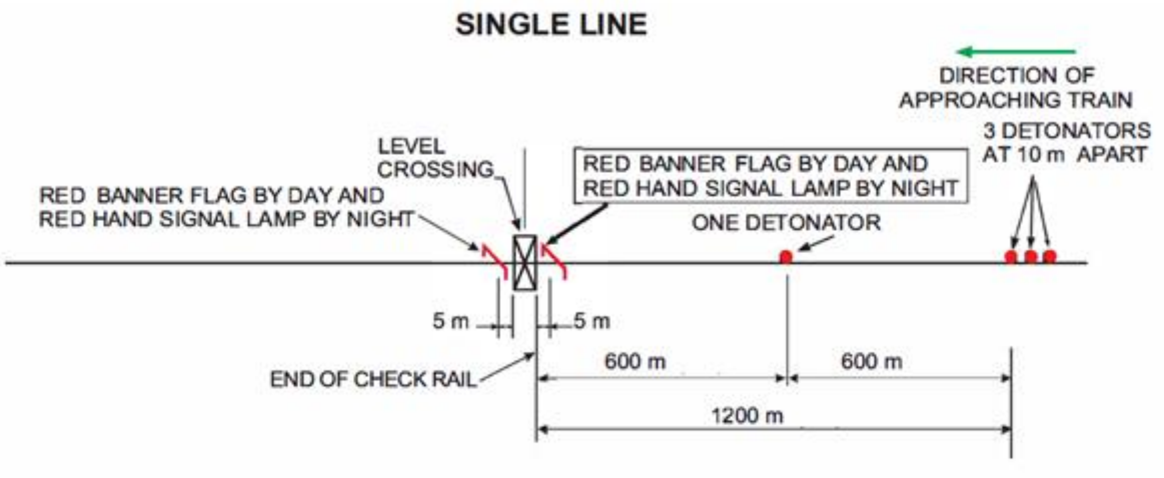


Location: To be placed on rod formation that no part of the sign board comes in contact of the vehicles

(Dimensions in mm)

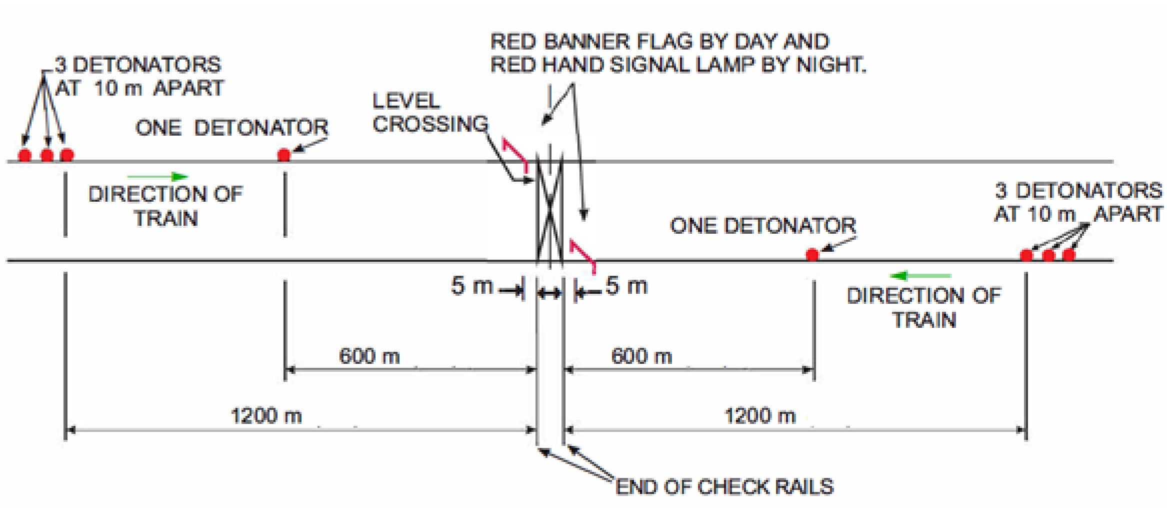
PROTECTION DIAGRAM FOR LEVEL CROSSINGS

SINGLE LINE



Note – Protection for the direction opposite to that of approaching train to be repeated on the other side also.

DOUBLE LINE



CHAPTER – 10

PATROLLING OF THE RAILWAY LINE

1001 Types of Patrolling – The following types of patrolling are in vogue

(1) Keyman's daily patrol.

(2) Gang patrol during abnormal rainfall or storm.

(3) Monsoon Patrolling.

(4) Hot/Cold weather patrolling for long welded rails/continuous welded rails

(5) Watchmen at vulnerable locations

(6) Security patrolling during civil disturbances and special occasions.

1002 Keyman's Daily Patrol – Every portion of the permanent way shall be inspected daily on foot by the keyman of the beat in which the portion of the track falls. Provided that, the interval between such inspections may, under special instructions, issued by Chief Engineer be increased to once in two days in the case of specified section of lines with light and infrequent traffic. The Keyman shall preferably be provided with a GPS tracking device, to monitor his movements so as to ensure effective patrolling.

1003 Gang Patrol during Abnormal Rainfall or Storm – In the event of abnormal rainfall or storm during day or night, the Mate should, on his own initiative, organize patrolling over the length affected, independently of other patrolling, if any, being done. This patrol should, in case of heavy rainfall, confine its inspection to known points of danger, such as cutting or culverts likely to scour, banks affected by tanks likely to breach and bridge approaches. In case of high winds, the Patrolman should inspect the length of track likely to be fouled by falling of tree etc.

Arrangements exist with the Meteorological Department of the Government of India for sending electronic communication regarding warning, wherever storms, gales or heavy rainfall is expected. On receipt of such information from the Control, the JE/SSE/P.Way will arrange to advise monsoon patrolmen, watchmen and Gangmates to be extra vigilant and be prepared to introduce patrolling, as necessary (for detailed instructions regarding weather warning and action to be taken **Para 1129** may be referred to). The beat length of gang Patrolling shall be similar to the monsoon patrolling.

1004 Monsoon Patrolling – (*Back to **Para 1005***) During the monsoon, certain section of the railway line, as may be specified, shall be patrolled to detect damage by flood, such as breaches, settlements, slips and scours and immediate action be taken to protect trains, when so warranted.

(1) *Commencement and Termination* – The sections, which are normally to be patrolled during monsoon will be identified and notified by the Divisional Engineer. For every such section, the Divisional Engineer shall prescribe the period of year, when normal monsoon patrolling is to be done; patrolling should be started on these notified sections on the dates specified. If the local conditions warrant, the JE/SSE/P.Way of the section concerned may introduce or continue monsoon patrolling outside the stipulated dates, duly advising all concerned.

(2) *Preparation of Patrol Charts* –

(a) The Divisional Engineer will issue patrol charts for each of the sections where monsoon patrolling is required to be done, taking into consideration the train timings of the timetable in force during this period. The principles governing the preparation of patrol charts shall be:

(i) Ordinarily patrolling will be carried out by a single Patrolman, but in regions where danger from wild animals, dacoits and other risks exist, as in ghat sections, suburban section or other specified sections, patrolling in pairs may be introduced with the approval of Sr DEN Co.

(ii) All trains carrying passengers between sunset and sunrise get the maximum protection possible.

(iii) As far as possible, each block section will be treated as a unit and the length will be divided into equal beats. The length of each patrol beat should not normally exceed 5 km where the block section is more than 10 km an intermediate flag station, if any, or any other suitable point may be fixed as intermediate station, to keep the length of beat at about 5 km.

(iv) The walking speed of a Patrolman may be taken as 3 Kmph.

(v) The maximum distance covered by a Patrolman should not normally exceed 20 km in a day.

(vi) A period of at least half an hour rest is desirable between consecutive beats.

(vii) For giving better protection to passenger trains between sun-set and sun-rise, it would be advantageous to plot the scheduled paths of all passenger trains and then plot the patrol movement in such a way, so as to minimize the time interval between patrolling of the beat and passage of train.

(viii) Patrol charts should show all vulnerable locations where stationary watchmen are posted.

(b) Sample patrol charts are appended for guidance, as **Annexure - 10/1, 10/2, 10/3.**

(3) *Distribution of Patrol Charts* –

Before commencement of the monsoon, requisite number of copies of patrol charts should be supplied by the Divisional Engineer to the Assistant Divisional Engineers, SSE/P.Way (In-charge), the Divisional Operating Manager (for distribution to the Control staff), Station Masters and Loco Inspectors of running rooms. The Loco inspectors will acquaint Loco pilot of passenger trains, when they may expect to pass patrolmen, if running to time. By inviting Loco pilots to lookout for patrolling, an immediate and practical means of supervising the Patrolmen is introduced. The task of dispatching Patrolmen at the right time and signing their patrol book when they arrive at or depart from a station devolves upon the Station Master/Block Hut-in-charge.

(4) *Patrol Books and Systematic Patrolling* –

A patrol book containing sufficient number of pages should be supplied to each patrolman with a tin case. The books shall be serially numbered to correspond with the number of patrol beat on each section. The first page of the book shall contain the name of Patrolman, kilometerage of patrolling section and its number. The remaining pages will contain columns for date, station, time of arrival and departure and signature of Station Master.

Patrolmen shall be on duty at the time specified in the patrol chart.

The Patrolman whose beat commences/terminates at a station shall present the patrol-book in his possession to the Station Master/Block hut In-charge who will enter therein the time of arrival and departure and sign the book. The Station Master/Block hut-in-charge will also record the time of arrival and departure in his diary/train register book. The Patrolman shall then patrol his length at the end of which, he will exchange his patrol book with that of the next Patrolman and retrace his beat. The intermediate patrolman shall do likewise. In this way each patrol-book will be conveyed from one station to the other and back again. Owing to close proximity of stations, patrol books may be passed through one or more intermediate stations, before it is returned to the original station.

If a Patrolman on arrival at the end of his beat does not find the next Patrolman to take over the book, he must proceed ahead, until he meets him. The Patrolman should report the absence of any Patrolman from his beat to the Mate the next day.

Station Masters will see that the Patrolmen come on duty sober and fully equipped, their lamps are trimmed and filled with oil or the batteries are fully charged (in case of rechargeable lamps) and they leave for their patrol duty in time.

If a Patrolman who is due to arrive at a station does not turn up in time or does not turn up at all, the Station Master/Block hut-in-charge will advise Station Master/Block hut-in-charge at the other end of the block section about the absence of the Patrolman and both Station Masters/Block hut-in-charges will issue caution orders to all trains entering the section until the Patrolman from the other end of the "patrol-section" arrives at the station and reports that all is well.

The Patrolman shall preferably be provided with a GPS tracking device, to monitor his movements so as to ensure effective patrolling.

(5) *Equipment of Monsoon Patrolmen* –

(a) Each Patrolman shall be provided with the following equipment and such other, as may be prescribed by special instructions:

(i) One staff (preferably foldable).

(ii) Number plate 15 cm Square (to be numbered consecutively from the beginning of each SSE/P.Way (In-charge) length in white letters on black background).

(iii) 10 detonators in a tin case.

(iv) Warning signals (a red flashing rechargeable LED torch/hand signal lamp at night or red flag during day as per **Para 3.65** of *GR*). Three warning signals on double/multiple lines, Ghat sections, suburban and automatic block territories and two warning signals on single line sections

(v) Protective clothing according to local dress regulations including industrial safety shoe / Gum boots, Safety jacket, Rain coat, Helmet with Head light.

(vi) One match box.

(vii) Two red flags and one green flag (day patrol only).

(viii) Patrol book in a tin case.

(ix) One three cell electric torch.

(x) Whistle thunderer.

(xi) One haversack.

(b) Where patrolling is undertaken in pairs or stationary patrol consists of two men, the equipment need not be duplicated but the additional Patrolman will be provided with an extra rechargeable LED torch/hand signal lamp, whistle thunderer, protective clothing and one spanner, hammer and light crowbar for emergency use.

(6) *Selection of Patrolman* **–** **(***Back to* ***Para 1124*****)**

Literate, Intelligent, experienced and trustworthy track maintainer should be selected from the Permanent Gangs by JE/SSE/P.Way to work as Patrolmen and Watchmen. Twice the number required should be selected to serve as relief, in case of illness, to provide for rest giver Patrolman etc. The track maintainer selected from each gang should be sent to the Divisional Medical Officer for vision test and shall not be employed as patrolmen unless they have passed the requisite medical test.

(7) *Certificate to be submitted by SSE/P.Way (In-charge)* –

The SSE/P.Way (In-charge) shall submit a certificate to the DEN through ADEN, a month in advance before the commencement of the monsoon that he has made all arrangements for monsoon patrolling and for watching vulnerable locations/bridges and that the patrolmen and the watchmen have been made conversant with their duties, rules for the protections of the line and vulnerable locations in their beats. He will also submit to the ADEN a list of names of patrolmen and watchmen with their duties/locations assigned during the patrolling season.

(8) *Action When Damage is observed* – (*Back to* **Para** ***117 (1) (c), 117(4)(a), 1006***)

In the event of any portion of the line being breached or otherwise rendered unsafe for traffic the following procedure shall be observed

(a) In the case where two patrolmen are employed –

(i) Protecting the line –

(a) The danger signal must be exhibited in both the directions

(b) The two patrolmen shall then proceed in opposite directions showing the danger signals (red flag by day and red light by night) and when at 600 m from the point of danger, each should place one detonator on to the rail; they shall then proceed to a distance of 1200 m from the point of danger where they should place three detonators on the rail about10 metres apart. On the double line the detonators must be placed on the line, in the direction on which the trains will approach.

(c) Should the nature of obstruction be such as to render it impossible for either of patrolmen to get across the gap, as for instance a wash away with strong flood, one of the men should show the danger signal and endeavour to stop trains approaching the gap from the other side while the other man should proceed towards the station on his side of the gap, fix the detonators and act as in (b).

(ii) Reporting the damage to Station Master and Gangmate –

(a) After protecting the track one of the two patrolmen who is nearest to the station and in case mentioned in (c) above, the patrolmen who has protected the track will proceed in all haste, showing the danger signal, to the station and inform the station master of the danger. On his way back, if he meets with any gang quarter, he should inform the Mate of the occurrence and the gang must immediately proceed to the affected kilometerage and take necessary action to attend to the repairs.

(b) After protecting the track, the other Patrolman will proceed to the site of obstruction, and remain there showing the danger signal, until the first Patrolman joins him. In case the other Patrolman has not been able to locate the gang hut on his way back from the station, one of them should proceed to the gang hut and inform the Gangmate.

(b) In case where One Patrolman is Employed –

(i) Protection of line –

(a) When damage is detected on single line –

(1) Place a red lamp during the night and a red flag during the day in a prominent position to warn a train, which may approach from one direction. Then run in the opposite direction from which train is likely to come, with a danger signal (red flag by day and red light by night) and place one detonator at 600 m and three detonators at 10 metres apart at 1200 m from the site of obstruction/ damage.

(2) Return to the site of obstruction/ damage, and protect the other side with detonators similarly.

(3) In the event of it being impossible to get the other side of the obstruction/ damage (as in a wash away)place the red lamp so that it can be seen from

as great distance as possible by a train approaching from that direction and protect the other side with the detonators etc. as detailed in *Sub-Para (a) (1)*.

(b) When damage is detected on double line –

(1) Place the red flag/lamp in prominent position so as to warn an approaching train on one track. Then run along the other track on which train is expected first and place the detonators as in *Sub-Para (a) (1)*

(2) Run back and protect with detonators the line on which the lamp/flag was prominently placed earlier.

(ii) Reporting the damage to the Station Master – the Patrolman will return to the site of obstruction after protecting the line in both the directions and shall remain at the place of obstruction and send word about the danger through the first railway employee or other persons he is able to contact at the spot itself.

(9) *Responsibility of Engineering Officials in the Matter of Patrolling –*

(a) Inspection of Patrol Books – JE/SSE/P.Way must examine the patrol books, initial the entries each time he inspects and take corrective measures for irregularities noticed. The ADEN should examine the patrol books during his inspection.

(b) Supply of Equipment to Patrolmen and Watchmen – JE/SSE/P.Way will be responsible for ensuring that each Patrolman is provided with the equipment specified, and for periodical distribution of consumable stores like kerosene oil, match box etc. The Mate will be responsible for seeing that the Patrolman and stationary watchman possesses the correct equipment specified.

(c) The JE/SSE/P.Way will be responsible for instructing the patrolmen in their duties about the rules for the protection of the lines and in acquainting them with all vulnerable points on their beats. In addition to oral instructions, the JE/SSE/P.Way shall by practical demonstrations, drill the Patrolmen in their detailed duties and responsibilities.

(d) Inspection of Equipment – JE/SSE/P.Way should check the equipment of all patrolmen and watchmen once a month, record the results in patrol book and take steps to recoup deficiencies.

(e) Check over Patrolling at Nights –

(i) By JE/SSE/P.Way – The following are the schedule of inspection of night patrolling for JE/SSE/P.Way (Sectional) and the SSE/P.Way (In-charge) by train:

Official	**By train**
JE/SSE/P.Way(Sectional)	Once a fortnight
SSE/P.Way (In-charge)	Once a month

(ii) ADEN shall cover his entire sub-division once in a month by train in the night and check the Patrolmen.

(10) *Action by ADEN and JE/SSE/P.Way on Receipt of Information Regarding Damage to the Line –*

On the receipt of information of any damage to the line, ADEN and SSE/P.Way (In-charge) and JE/SSE/P.Way concerned should proceed to site by the quickest possible means and take necessary action for restoration.

1005 Hot and Cold Weather Patrolling for LWR/CWR – (*Back to* ***Para 117(4)(a), 353***)

(1) *Hot Weather Patrolling:* Period for hot weather patrolling shall be laid down by the Chief Track Engineer for each section and patrol charts prepared where necessary. Patrolling shall be organised by JE/SSE/P.Way accordingly. In addition, the JE/SSE/P.Way and the Gang Mate shall be vigilant during summer and on hot days. Patrolling will be introduced when the rail temperature rises above:

(a) (i) t_d + 30° C on Wider Base PSC sleeper track with sleeper density 1660 nos. per km.

(ii) t_d + 25° C on PSC sleeper track with sleeper density 1540 nos. / km and above.

(b) t_d + 20° C on PSC sleeper track with sleeper density less than 1540 nos. / km

Patrol beat for Hot weather patrolling will be as follows:-

(i) On single line or where only one road in a double line section is having LWR/CWR- One Patrolman for 2 km.

(ii) On double line section when LWR/CWR exist on both roads - One Patrolman for 1 km length of UP and DN road. The beats of each hot weather Patrolman will thus be restricted to 2 km.

(iii) Changes in beat length and man power deployment as given above, if found necessary, may be decided by the Sr. DEN (Co) of the division depending on prevailing local conditions, frequency of train service, weather conditions etc.,

The hot weather patrolman should always carry the following equipment:-

HS Flags - Red	2
Staff for Flags	1
Detonators	10
Canne-a-boule fitted with rubber ball	1

(2) *Hot Weather Patrolman:*

He shall patrol the track during the hottest part of the day, to look for prominent kinks, incipient buckles or tendency towards buckling. He shall protect the track at the site of the prominent kinks, incipient or actual buckles and report the same to nearest Station Master and JE/SSE/P.Way immediately. The patrolman shall preferably be provided with a GPS tracking device, to monitor his movements so as to ensure effective patrolling.

He will walk over his beat slowly over one rail/on sleeper non gauge side of rail in one direction and on the other rail/on sleeper non gauge side of rail in the return direction. On double lines, he will repeat this procedure alternately on UP and DN tracks. He will be vigilant and look out for kinks in the rail especially during the hottest part of the day. When a kink is observed, he shall immediately examine at least 100 sleepers ahead and in the rear of the kink for any floating condition of track. He should meticulously sound each and every sleeper, 100 sleepers on either side of the kink, to determine any floating condition. The amount of rebound will be noted by dropping a Canne-a-boule on each end of the sleeper to determine the extent of void under the sleeper. Should the amount of rebound reveal a floating condition, under which a buckle may be anticipated or the patrolman has detected actual buckling of track, he will take immediate steps to protect the affected portion by display of hand signals as per rules in force. After protecting the track, the patrolman will arrange to advise the Gang Mate, JE/SSE/P.Way of his apprehension of a buckle/actual buckle.

The Gangmate on receipt of advice of a danger of buckle will proceed to the site quickly with all available men. On arrival at site, he will first ensure protection of affected portion. He should then inspect the condition of track 100 m on either side of this suspected zone and commence heaping of surplus ballast, if available, on the shoulders and upto the rail head and keep on compacting the ballast with available means. No attempt should be made to slew or align the track or disturb the existing ballast section. The Mate should continue to remain at site till the arrival of JE/SSE/P.Way. The rail temperature will also be noted by one of these officials at the place of apprehended/actual buckle. The rail facing the sun will be covered up to the level of rail head on the outside by ballast or leaves etc. to bring down the temperature of the rail.

(3) *Cold Weather Patrolling:* Period and section where cold weather patrolling is to be done shall be laid down by Sr. DEN (Co) of the division based on rail/weld fracture analysis, extent of rail corrosion ,overdue rail renewals and traffic density. Cold weather patrolling shall compulsorily be started when rail temperature goes below (t_d-30^0 C). Patrol charts will be prepared where necessary. Patrolling shall be organized by JE/SSE/P.Way (In-charge) accordingly. Following guidelines may be followed for issuing detailed instructions. (*Back to* ***Para 337, 346***)

(4) Patrol Beat for Cold Weather Patrolling shall be as follows:

(a) On single line or where only one road in a double section is having LWR/CWR - One patrolman for four kilometre.

(b) On double line section when LWR/CWR are on both roads - One patrolman for two kilometre length of UP and DN road.

(c) Changes in beat length and man power deployment as given above, if found necessary, may be decided by the Sr. DEN (Co) of the division depending on prevailing local conditions, frequency of train service, weather conditions etc.

Cold Weather Patrolman should carry the following equipment :

(i) 10 fog signals in a tin case

(ii) Two tri-colour hand signal lamps/rechargeable LED torch

(iii) One match box

(iv) Two red flags and one green flag

(v) One three-cell electric torch

(vi) One staff

(vii) Number plate

(viii) Spanner

(ix) Protective clothing according to local dress regulations including industrial safety shoe / gum boots, safety jacket, rain coat, helmet with head light.

(x) Patrol charts shall be prepared as per ***Para 1004 (2).***

(5) *Cold Weather Patrolman:*

He shall patrol the track during the coldest part of the night and lookout for weld/rail fractures and excessive gaps at SEJ. He shall protect the track at the site of weld/rail fractures or excessive gaps at SEJ and report the same to nearest Station Master/JE/SSE/P.Way. The patrolman shall preferably be provided with a GPS tracking device, to monitor his movements so as to ensure effective patrolling.

He will walk over his beat slowly along one rail in one direction and on the other rail in the return direction. On double line, he will repeat this procedure alternately on UP and DN tracks. He will be vigilant and look out for rail/weld failure. He will also notice the gaps at SEJs if they fall in his beat. In case he notices a rail/weld failure or gap at SEJ becomes more than the designed maximum gap, he will take immediate action to suspend the traffic and protect the line as per **Para 812**. After protecting the track, the patrolman will arrange to report to Keyman/Gang Mate, JE/SSE/P.Way who shall arrange for making emergency repairs to pass the traffic.

1006 Watchmen at vulnerable locations – In addition to Patrolmen, stationary watchmen are posted at known or likely locations of danger or trouble.

(1) *Definition* – Vulnerable Locations (Points) are those, where conditions unsafe for the passage of trains are apprehended and there is need for stopping of trains in time in case such conditions develop e.g.

(a) Bridges, having inadequate water-way, liable to scour in foundations, oblique/ Parallel flow of water to the approaches, rise of flood above danger level frequently.

(b) Bad banks liable to slips and subsidence.

(c) Bridges located across river courses fed by railway affecting tanks.

(d) Cuttings and hill designated as vulnerable by DEN/Sr. DEN.

(e) Water over-flowing over the track, and

(f) Any other condition likely to affect the safety of the track.

(2) *List of Vulnerable Locations* – A list of Vulnerable Locations should be maintained by each Assistant Divisional Engineer/Divisional Engineer in a register form and should be reviewed and brought up-to-date.

(3) *Guarding of Vulnerable Locations* –

(a) Stationary Watchman should be posted round the clock at every nominated location during the monsoon period, as required.

(b) He should keep a watch on vulnerable location and in case he apprehends danger he should take action to protect the line in accordance with **Para 1004(8).**

(c) The equipment for the watchman should be on the same scale as Patrolman except that a watch man will not be provided with –

(i) Number plate.

(ii) Haversack.

(iii) Patrol book in tin case.

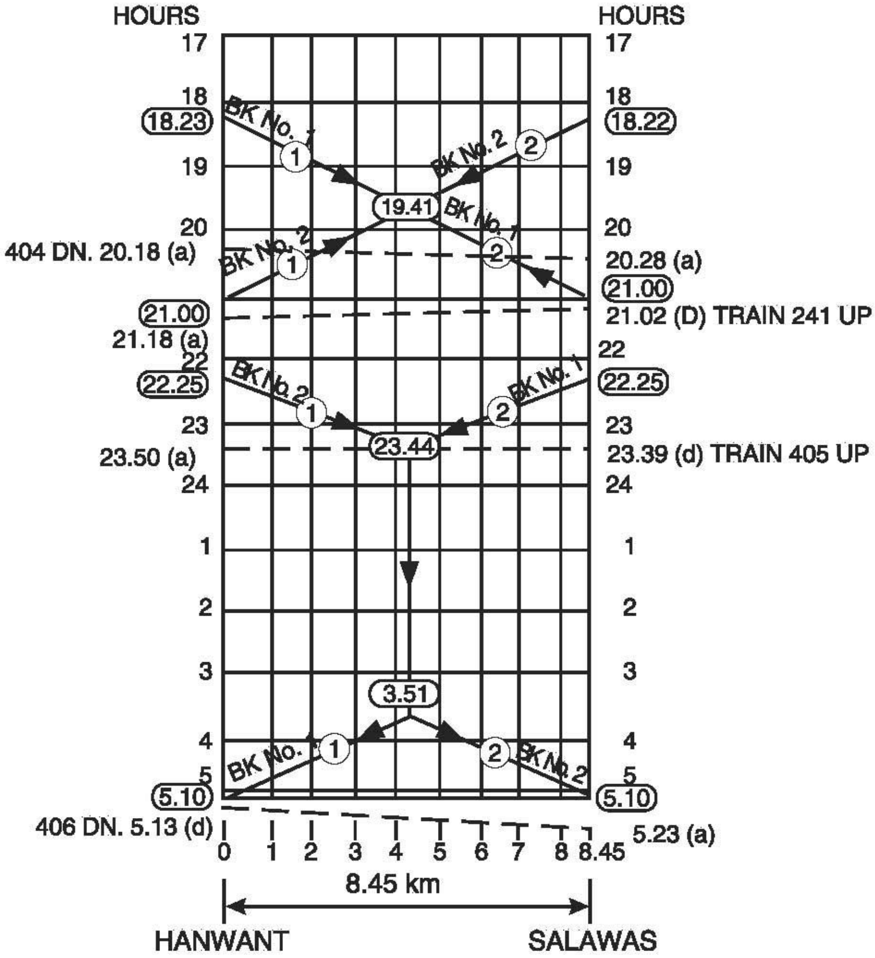
A notebook should however be provided to the watchman.

1007 Security Patrolling during Civil Disturbance and on Special occasions:

(1) On apprehension of a Civil Disturbance, the Divisional authorities should contact the local Civil authority and arrange, as circumstances may warrant for security patrolling of the railway line. This may be arranged on the pattern of the monsoon patrolling with modifications, as deemed necessary, in consultation with Civil authorities.

(2) Security patrolling on special occasions should be carried out according to the special instructions issued by the administration.

(3) The primary duty of the Patrolman employed on Security patrolling shall be to protect trains against any condition of danger, such as tampering with track or obstruction placed on line.

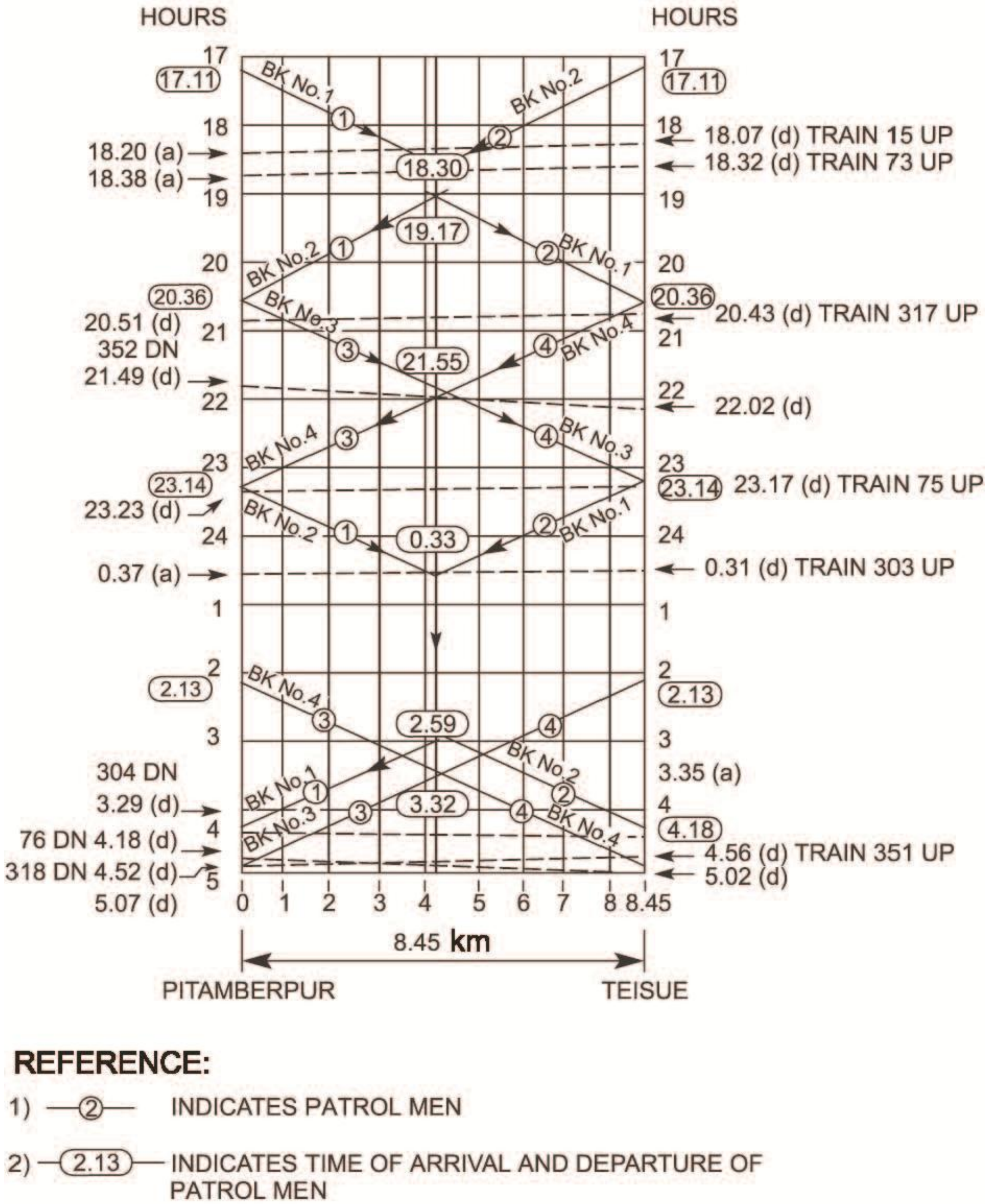


REFERENCE :

1. —②—◯— INDICATES PATROL MEN

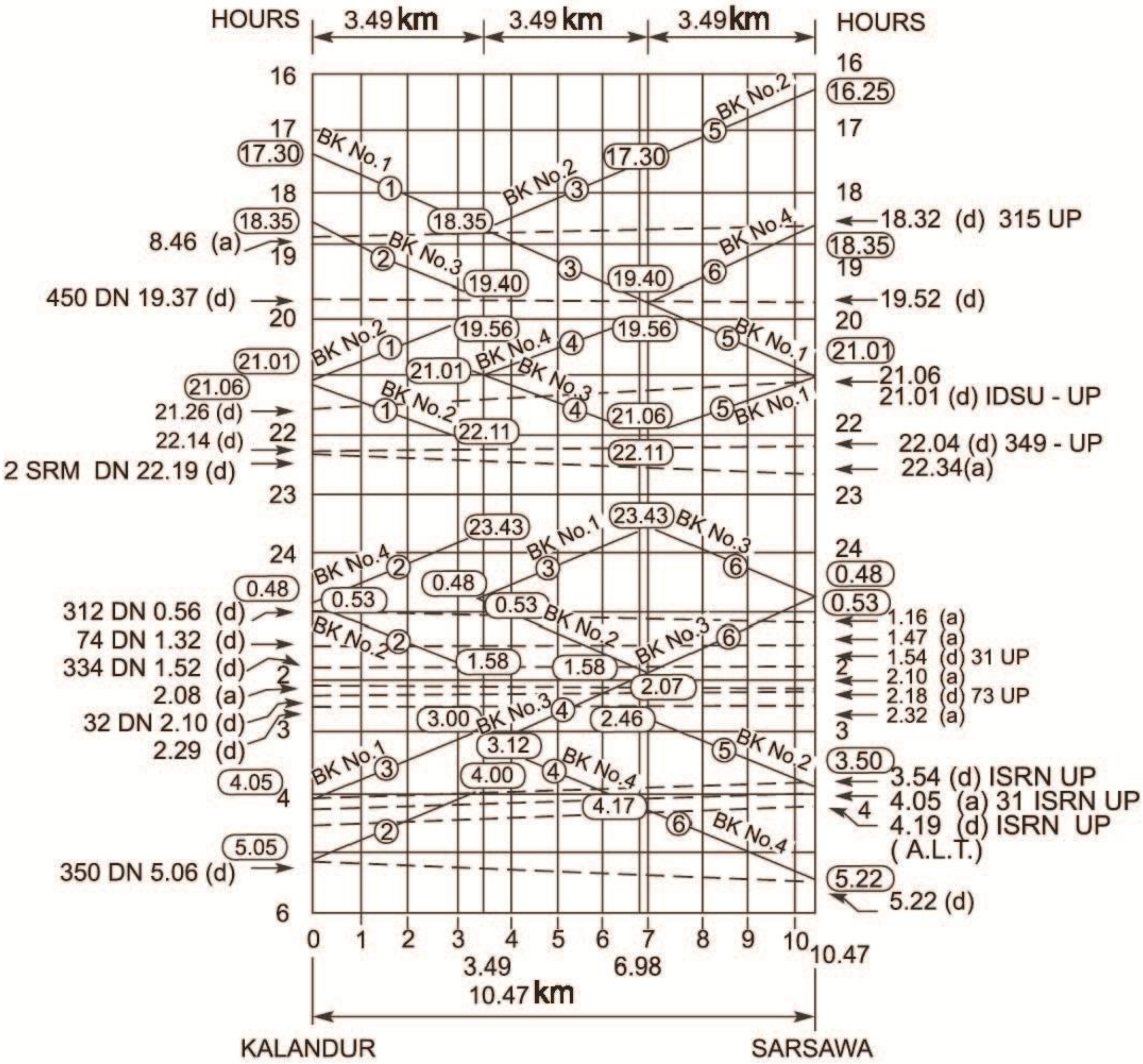
2. —(18.22)— INDICATES TIME OF ARRIVAL & DEPARTURE OF PATROL MEN

Specimen Patrolling Chart
Main Line and Branch Line Low Density Traffic
2 Beats Length 8.45 Km
Jodhpur – Marwar Section



Specimen Patrolling Chart
Main Line Heavy Density Traffic
2 Beats Length 8.45 Km
Rosa – Bareilly Section
(Double Line)

Annexure - 10/3 Para 1004



REFERENCE :

1. PATROL MEN ① ③ & ⑤ EXCHANGE BOOK No. 1 & 2.

2. PATROL MEN ② ④ & ⑥ EXCHANGE BOOK No. 3 & 4.

Specimen Patrolling Chart
Main Line Heavy Density Traffic
3 Beat Length 10.47 Km
Saharanpur – Ludhiana Section
(Double Line)

CHAPTER – 11

ACTION DURING ACCIDENTS INCLUDING BREACHES AND PRE-MONSOON PRECAUTIONARY MEASURES

PART – A

Action During Accidents Including Breaches

1101 Observance of Rules –

(1) Any occurrence within or outside the Railway limits, which does or may affect the safety of the Railways, its Engines, Rolling Stock, Permanent Way, Works, Passengers or Railway Servants or which does or may cause unusual delays to trains or physical and financial loss to the Railway, is termed an accident. For instance, a flood outside Railway limits may seriously threaten the safety of the line and should be treated as an accident.

(2) Rules for reporting and joint enquiries into the accidents are contained in the *Accident Manual* issued by Railways and in the *Railway (Notices of and Enquiries into Accident) Rules,1998*, issued under Section 122 of *The Railways Act,1989 (24 of 1989)***.**

(3) The *Indian Railways (Open Lines) General Rules, 1976 Edition,* **Rule 2.11** enjoins that –

(a) Every Railway Servant shall –

(i) See that every exertion effort is made for ensuring the safety of the public;

(ii) Promptly report to his superior any occurrence affecting the safe or proper working of the railway which may come to his notice; and

(iii) Render on demand all possible assistance in the case of an accident or obstruction.

(b) Every Railway servant who observes –

(i) that any signal is defective;

(ii) any obstruction, failure, or threatened failure of any part of the way or works;

(iii) anything wrong with a train; or

(iv) any unusual circumstance likely to interfere with the safe running of trains or the safety of the public;

(v) shall take immediate steps, such as the circumstances of the case may demand to prevent accident; and where necessary, advise the nearest Station Master by the quickest possible means,

(vi) provided that in the case of a train having parted, he shall not show a stop hand signal but shall endeavour to attract the attention of the Driver or Guard by shouting, gesticulating, or other means.

1102 Report of Accident to the Station Master / Railway Servant In-charge of Block Hut—Following actions to be taken by Engineering official:

(1) Soon after noticing the occurrence of an accident, Engineering official (if he is the first to reach the site of the accident) shall report the accident to the nearest Station Master through quickest possible means including electronic communication covering the following information; to issue an all concerned message:

(a) Name of the station at or stations between which the accident has occurred
(b) Kilometer of the accident.
(c) Number and description of the train or trains involved.
(d) Date and time of the accident.

(e) Particulars of loss of life and injuries to passengers and staff.
(f) Nature and cause, if known, of accident.
(g) Damage to Permanent Way, Works, Bridges, Overhead equipment (in case of electrified section), signal and interlocking gear, engines or vehicles.
(h) Probable duration the line may be blocked.
(i) Whether transhipment is required and if so whether it is feasible.
(j) Assistance (if any required) such as Medical assistance, break-down train etc.

(2) Acknowledgment of the receipt of message should preferably be taken from the Station Master.

1103 Accidents Impairing Through Traffic –

(1) Engineers to proceed to site –

(a) On receipt of intimation of the occurrence of an accident resulting in damage to any part of the Way/Works/Bridges and affecting the free passage of trains, the concerned JE/SSE/P.Way or (Works) or (Bridge) and ADEN shall proceed to the site of accident, by the quickest available means. On their way, they should collect information about the extent of damage to Permanent Way/Works/Bridges and arrange for movement of materials required for restoration. They should also collect additional staff and tools as required, the engineering tool van should be sent to the site, if so considered necessary, by the quickest means.

(b) On receipt of intimation of an accident, the DEN shall contact the section control and ADEN and get the information regarding the extent of damage to Permanent Way and Works, check on the arrangements made for labour and materials, etc., supplement them if necessary and proceed to the site of the accident by the quickest available means, if the seriousness of the accident requires his personal supervision and direction.

(2) Accident in an adjacent Division – In the event of an accident taking place on a division, where assistance could be more expeditiously rendered by officials of an adjacent division, such officials and the ADEN / DEN of the concerned adjacent division should be advised; these officials should proceed at once to the site of accident with necessary resources and render every possible assistance.

1104 Action at Site –

(1) By Engineering Supervisory Officials –

(a) *Protect Train* – Any Engineering staff available at the site of the accident shall assist the Guard and Driver to protect the train in accordance with **Para 6.03** and **9.10** of *The General Rules (1976).* The JE/SSE/P.Way should ensure that protection has been afforded to the train in front and in the rear, in accordance with the rules. In the case of double line, if the other line is also affected by the accident, steps shall be taken to protect both the lines. If no infringement exists, trains must be controlled and passed cautiously on the unaffected track.

(b) *First Aid and Rescue* – The JE/SSE should render assistance to give medical relief/ treatment to injured passengers and assist in rescue of trapped passengers.

(c) *Advice to nearest Station Master* – After a rapid survey of the position, particulars should be sent to the nearest Station Master as in ***Para 1102*** above. In case of controlled sections, a field telephone should be got commissioned at once.

(d) *Line Clear examination* – If the Engineering official has reached the site and no traffic official is available, he should carefully secure the line clear token or ticket and any caution order, where necessary. If the accident has occurred in a station yard, the train register book must be seized and if necessary, statement of staff concerned recorded; if line badges are in use, it should be recorded as to in whose possession each line badge was. The position of station control panel, block instruments, signals, points, point levers, indicators, keys, etc. should be noted and recorded, jointly with the JE/SSE of the other concerned departments, available at site. Item listed in ***Para 1108*** may also be referred for further guidance.

(e) *Preliminary Clearing Operation* –

(i) In all instances in which the means taken for the restoration of communication are likely to obliterate marks on the road and other evidence needed at a joint enquiry, the senior official who arrives first on the spot should carefully examine the track, train or vehicle and as soon as possible make notes, sketches etc. and hand over the same to his superior or produce them at the enquiry. He will, when the nature of the accident is such as will involve the question of eye-sight of any of the staff, verify (in case of those permitted to wear glasses) that they had worn glasses at the time of the accident and had carried a spare pair of glasses with them.

(ii) In all cases of accidents, the cause of which might possibly due to sabotage, it is essential that the clearance and restoration operations are not commenced till the Police officials arrive at the site and intimate their agreement to the commencement of clearance and restoration work, after, making thorough investigations.

A factual note of the conditions obtaining at the site prior to restoration work should be prepared and signed jointly by the senior-most Police and Railway officials at the site. In the event of any difference of opinion between the Police and the Railway officials, such difference of opinion may be recorded on the joint factual note.

This should not, however, be allowed to interfere with rendering of first aid to the injured, which is the first essential in all accidents.

(iii) In other cases, clearance and restoration operations can commence even before the arrival of the Police and it is not necessary that all the rails, sleepers and fastenings involved in an accident should be preserved, but only those, whether serviceable or otherwise, which bear wheel marks, etc., especially between the points of mount and drop. In all cases of serious derailments, these are essential for a later reconstruction of the scene and should be preserved and/or recorded by the first responsible official to reach the site of the accident, as these would be valuable evidence to ascertain the cause of the accident.

(iv) The senior most Railway Officers at the site of the accident should arrange to record the preliminary statements of the staff concerned, immediately after the injured persons have been attended to and arrangements made for the onward journey of the stranded passengers, as any delay in recording statements, might result in suppression of some facts or fabrication of some evidence during subsequent enquiries.

(v) In case sabotage is suspected, the procedure as outlined in *clause (ii)* above should be followed. In addition, it should be ascertained promptly from the CRS if he would like to inspect the site etc., before the commencement of clearance and restoration work and then action should be taken in accordance with his wishes. Before clearance and restoration operations are commenced all relevant clues, Materials and damages and the deficiencies on Rolling Stock etc., must be noted and preserved. In other serious accidents, however, the same procedure as outlined in *Clause (iii)* above should be strictly followed.

(f) *Contacting higher officials* – JE/SSE should get in touch with the ADEN or Divisional Engineer, explain the position on telephone, wherever possible; if not, he should himself organise the restoration of through running including ordering of ballast trains, requisitioning of required Materials and tools and send information to ADEN and Divisional Engineer of the preliminary measures undertaken, by the quickest possible means.

(g) *Recording of details and advice regarding restoration time* – He should arrange to record the details of the accident and prepare notes on any special features bearing on its cause, which may be of help in the enquiry.

(h) *Preservation of clues* –

(i) Nominated ART staff shall be responsible for taking photograph or recording video.

(ii) Photographs /Videos showing the details of damage to Permanent Way and Rolling Stock at the site of accident should be taken wherever necessary; in case of suspected sabotage, the photographs of the site of the accident showing the damage and possible clues should invariably be taken.

(iii) While taking photograph/video, the principle of 'whole to part' must be followed; i.e. the first shot (long shot) should cover the entire site along with OHE Mast No. /Hectometre Post No. and the entire coach /wagon with coach /wagon number. The 2nd shot (medium shot) should cover closer view showing particular bogie and track structure. The 3rd /4th shot (close shot) and so on should cover further closer view with finer details and specific components.

(iv) Photography /Videography should cover all the important locations on track and affected parts of rolling stock. It should show inside view of driver and guards' cabin and position of various switches, knobs, brakes, handles etc.

(v) At station, photograph/video should cover Panel and Block instrument, sealing of Relay room, various signalling and interlocking instruments.

(vi) Engineering officials should advise in writing or through electronic communication to Divisional Safety Officials for preserving evidences or clues identified at site.

(vii) In case of a suspected sabotage, Tell-tale sign must be preserved and recorded.

(viii) In case of rail/weld failure WILD data for preceding few trains must be collected and analysed.

(ix) Record of data logger should be preserved and analysed in all accident cases.

(x) Speed recorder and event recorder of locomotive shall be frozen by the concerned controlling/ safety officials.

(2) *By ADEN* –

(a) He should ensure that action specified under *sub-para (1)* above has been taken by JE/SSE/P.Way. If he is the first to arrive at site, the ADEN should take action as specified for JE/SSE/P.Way.

(b) He should get in touch with the Divisional Engineer and the Controller/Chief Controller and furnish complete information advising the details of action being taken and the probable time for restoring through running.

(c) He should arrange to organise the measure for expeditious restoration of through traffic and ensure incessant working until through running is achieved.

(d) A preliminary report should be prepared.

(3) *By Divisional Engineer* –

(a) He should examine the adequacy of measures taken for restoration of through running lines and ensure expeditious work.

(b) He should assess and advise the position to the DRM and PCE, with brief particulars (over the field telephones on Controlled Sections) and probable time of restoration. The Principal Chief Engineer/ Chief Track Engineer or HOD nominated by PCE may proceed to site in case of very serious accidents.

(c) A report should be prepared and submitted to the PCE and DRM.

(d) The DEN shall ensure that the fractured pieces of rail/weld are preserved and sent to RDSO for detailed investigations, at the earliest possible, in all cases of accidents, where rail/weld is a prima facie cause of the train accident.

(4) The senior-most Railway Officer at the scene of accident shall be responsible for the general appraisal of the situation and co-ordination of all works.

1105 Report to the Principal Chief Engineer –

(1) *Report on Accident –*

(a) The senior most Engineering Official at the site of the accident shall, after initiating measures for restoring traffic, submit a brief report to the PCE with a copy to the Divisional Railway Manager which will include the following particulars:

(i) Nature of the accident,

(ii) Cause, if known.

(iii) Particulars of loss of life and injuries to passengers and staff.

(iv) Extent of damage to Way, Works and Bridges.

(v) Particulars of rainfall and patrolling, in the case of damage by floods.

(vi) Steps taken for resumption of traffic.

(vii) Probable time, when normal working is likely to be resumed.

(viii) Whether transhipment is necessary and if so, for how long.

(ix) Whether a diversion is necessary and if so, when it is likely to be opened.

(x) Details of any assistance required, such as additional staff, labour, ballast trains and other Permanent Way and Bridging Materials.

(b) A sketch showing important dimensions, positions of vehicles, tracks made by derailed vehicles, marks on rails, particulars of condition of track for an adequate distance in the rear of the point of derailment and any other information likely to be of use in elucidating the cause of accident should accompany the report.

(2) *Reports on Breaches* – In the case of damages caused by floods, the Divisional Engineer should initiate necessary investigation and submit a Technical Report with drawings, to the Principal Chief Engineer, detailing the remedial measures required, with the past history, if any, of the kilometrages affected, within a month of the occurrence.

1106 Attendance of Police at Site –

Arrangements should be made for the police to attend the scene of accident in the case of derailment of a train carrying passengers (or of any other train when it is considered necessary) in order that they may observe the extent of disturbances caused to the line, keeping guard over loose materials lying about and over any evidence affecting the cause of the accident and safeguard passengers' luggage and mail as required.

1107 Examination of Site and Preparation of Sketches – (*Back to **Para 1121***)

The first Engineering representative to arrive at site shall attend to the following –

(1) He should examine the entire site inclusive of track over which the train has passed immediately before derailing, noting down any unusual features observed, especially any parts of vehicles or other material lying on or near the track.

(2) A dimensioned sketch should be prepared covering the entire site of accident, showing all relevant features inclusive of track leading upto point of derailment, showing position of derailed vehicles, point of mount and drop and other relevant details. All the details given in ***Annexure - 11/1A*** should be incorporated in the sketch.

(3) He should take note of the particulars as detailed in ***Para 1108.***

(4) An examination of the derailed vehicle/vehicles for defects not caused by the derailment but which may have been the cause of the derailment should be made. He should make out notes for inclusion in the joint report.

(5) He should examine the gang-charts/diary books to ascertain the date when track was last attended.

(6) Details of engineering works in progress, if any, at the site of accident, caution orders in force and nature of protection should be noted.

1108 Recording Particulars at Site of Accident (*Back to* ***Para 1104, 1121***)

(1) *Permanent Way particulars* – Permanent Way particulars shall be recorded jointly with the SSEs/Officials of the other concerned departments as per ***Annexure - 11/1B.*** These records will *inter alia* include particulars of the track structures, the condition of the track components, track geometry and other relevant details.

(2) *Particulars with respect to Rolling Stock and Signalling* – Engineering representative should associate himself with the concerned representative of the other departments in recording measurements of –

(a) The locomotive as per ***Annexure - 11/1C***;

(b) Carriages and Wagons as per ***Annexure - 11/1E*** and ***Annexure - 11/1D***, respectively; and

(c) Signalling, Interlocking and Telecommunication equipment-

(i) Position and condition of stretcher bars, its type, whether it is hugging the stock rail.

(ii) Last movement done over the points just before the accident and whether signalled or un-signalled.

(iii) How the points are being worked, method of locking of points, its connection with signal. Position, setting and locking condition of points and condition of switches.

(iv) Condition of motor point.

(v) Whether the crank handle is sealed, when was it last used and for what purpose.

(vi) Emergency operation of points, emergency route release etc.

(vii) TRS (Train Signal Register)/log book should be taken into custody to verify entries of last three movements in either direction.

(viii) SM's Control panel shall be frozen till the time position of the knobs, switches, points & crossings etc. are jointly recorded.

(ix) Whether Panel was sealed and relevant record for last operation was made and what were the indications shown on panel.

(x) Whether the relay room is in double locked condition.

(xi) Any S&T gear is under disconnection.

(xii) Data logger- Analysis of event recorded in the data loggers.

(xiii) Position of block instrument in details including its handle, commutator, dial indication, locking etc. In the case of electrified section, the block filter unit attached to the block instrument is checked.

(xiv) If any manipulation in any signalling and interlocking gear.

(xv) Locking of cabin basement

(xvi) Date of last overhaul of block instruments, date of last overhaul of lever frame, SM's control frame.

(xvii) Date of testing the block instruments and other interlocking gears by Inspectors /officers prior to the accident. Results of their test and action taken.

(xviii) Any interference with any signalling and interlocking gears.

(xix) Details of unsafe failures during last three months.

Note: *As a precautionary measure, the relay room, cabin basement, block instrument, device for crank handle/emergency operation of points/emergency route release, etc. should be locked immediately after the accident and the key kept in the safe custody of the Station Master/ responsible officials at site till joint observation and functional test of S&T gears are completed.*

(3) Operating particulars – The following operating particulars should also be recorded wherever relevant –

(a) Speed – The actual speed at the time of derailment, from the speedometer graph or if the locomotive is not provided with the speedometer graph, by referring to inter-station timings.

(b) The direction of the locomotive i.e., Short-hood or Long-hood leading.

(c) The brake power of the train.

(d) The marshalling of the train with reference to orders applicable on the section.

(e) Whether there has been sudden application of brakes.

(f) Whether there was sudden opening of regulators.

(g) Condition of loading in wagons, especially unequal loading, light loading, empties between loaded vehicles, over loading, moving loads and any infringement to standard dimensions.

(h) Particulars of Caution Orders issued to the Driver/Guard.

(i) Caution Order Register.

(j) Block ticket.

(k) Authority to proceed without line clear.

(l) Use of lever collars and slide collars

(m) Shunting Authority

(n) Station diary

(o) Private Number Book

(p) Securing of vehicle.

(4) In Case of level crossings:

(a) Km of Level Crossing and station in between.

(b) Class of level crossing

(c) Manned /unmanned and number of GKs posted.

(d) Location within station limits/outside station limits.

(e) Whether interlocked.

(f) Availability of telecom facilities and their working order.

(g) Availability of speed breakers, road signs

(h) Visibility of gate from road and from rail line.

(i) Whether on curve, cutting and gradient of rail line and as also for road.

(j) Normal position of gate and status at the time of accident.

(k) Position of gate signal, lever, panel at the time of Accident.

(l) Bio data of GK and whether as per roster.

(m) Number and type of road vehicle, its loading condition, Driver's name, registration details, licence etc.

(n) Numbers of trains and road vehicles passing through the level crossing on an average per day and last census taken.

(o) Weather condition at the time of accident.

1109 **Use of Recorded Data** – (*Back to* ***Para 1121***) The object of recording all available data at site and of evidence is to ascertain the cause of the accident with a view to prevent its recurrence, and where the cause is due to negligence, to fix responsibility.

(1) The joint measurement as per annexed proforma submitted by senior supervisors shall not be complete till all the measurement of rolling stock and track have been recorded. Only completed joint measurement w.r.t. rolling stock and track shall become a document to be relied upon by the enquiry committee for drawing conclusion regarding cause of accident.

(2) No enquiry shall be completed before the complete measurement of rolling stock and track is available and made part of the enquiry report. Enquiry Committee may get additional measurements done as per requirement of the derailment case.

PART – B

Restoration of Through Running

1110 **Repairs to Damaged Track** – Repairs to the track should in the first instance, be kept to the minimum necessary to restore traffic with the least possible delay, the required materials being expeditiously arranged for. Soon after, the track should be brought to its proper standard.

1111 **Procurement and Arrangement of Labour** –

(1) Adequate labour is the very first essential for restoration of through running. Engineers should acquaint themselves with all possible sources from which labour could be readily arranged in the event of a breach or a serious derailment on their section. Labour should, as far as practicable, be conveyed to the site of accident by train or any other faster mode depending upon availability.

(2) Labour should be arranged in one or more of the following ways:

(a) By ordering departmental labour within a reasonable distance to proceed to the site.

(b) By ordering two or more men from each permanent gangs to proceed to the site.

(c) By obtaining labour from adjoining divisions, if considered necessary and possible.

(d) By calling on the Revenue Authorities to supply labour.

(e) By hiring temporary labour locally or from known sources.

(f) By arranging labour through reliable Contractors (wages should be fixed prior to their engagement).

(3) In case contractor's labour is engaged, it is preferable to allot work in such a way that the departmental labour and contractor's labour do not get mixed up. Settlement of claims should be prompt. Labour should be organised in batches under the charge of JE/SSE. Proper muster sheets should be maintained.

(4) In emergencies, ADEN/JE/SSE/P.Way may authorise Station Masters by memo/electronically to issue proceed order for the journey of Track Maintainer/Labour required for the work along with their tools and equipment from specified station to the nearest station from the site of accident. As far as possible, all departmental labour shall move with complete tools and equipment.

(5) Adequate arrangements should be made for food, shelter, water and lighting.

1112 **Diversion –**

(1) General – Should a diversion be decided upon, the work should be commenced as quickly as possible.

(2) Classification of diversions – These may be classified as –

(a) Temporary – A temporary diversion is one which is not likely to be in use, for more than 10 days. All trains must "Stop-dead" before entering a temporary diversion and proceed at 10 Kmph speed.

(b) Semi-permanent – A semi-permanent diversion, is one constructed for the special purpose of facilitating the reconstruction of the line and/or bridges likely to be in use for a period of more than 10 days. On a semi-permanent diversion, trains may proceed at a non-stop reduced speed after adequate period of consolidation.

(3) Curvature and Gradients – As far as possible the radius of curve should not be less than 450 metres. Gradient should not be steeper than 1 in 100 and compensated for curvature.

In difficult terrain it may be necessary to lay curves of radius not less than 225 metres and adopt grades upto the ruling gradient on the section.

There should be no super elevation, in case of temporary diversions.

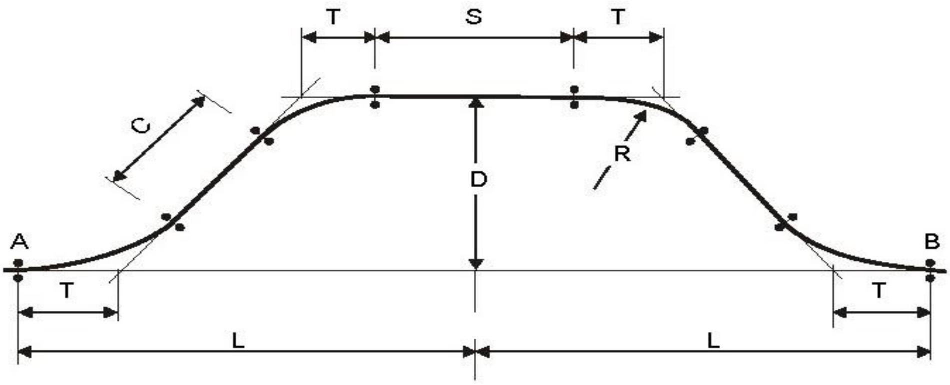
(4) Calculation for setting out diversion –

While setting out diversion, the following formula will be found handy –

$$L = \sqrt{C^2 + 4RD - D^2} + \frac{S}{2}$$

$$T = \frac{RD}{L - \frac{S}{2} + C}$$

All measurements to be taken in same units, where,



AB= Portion of existing line to be diverted.

L= Length of half the diversion, measured along the original alignment.

D=Maximum distance of diversion from original alignment.

S= Straight portion of diversion.

C= Length of straight between reverse curves.

R= Radius of curves.

T= Length of tangent.

(5) *Opening for traffic* – The diversion track should be adequately consolidated and tested by locomotive/ loaded wagons before opening for traffic. The most vulnerable portion of the diversion is at the junction of the old bank with the new bank. Care should, therefore, be taken to provide benching of slopes at the junction. Cross-levels should be checked after passage of every train and rectified till the track gets stabilised.

(6) *Issue of safety certificate* – The opening of line on temporary diversion shall be done in accordance with the ***Para 1209*** of this Manual.

1113 **Transhipment** – The decision as to whether transhipment is to be done, is taken by Transportation/Commercial Department. If it is decided to provide gangways, footpath etc., purely for the purpose of transhipment, these should, as far as possible, be laid away from the site of repairs, so that the progress of restoration is not interfered with.

1114 Funds Required During Emergencies –

(1) The Divisional Engineer or the ADEN on his behalf may draw upon the station earnings for expenditure necessitated by floods, accidents or earthquakes vide **Para 1405** *of Indian Railway Code for Engineering Department* for the following purposes –

(a) Payment to daily labour hired at the site of breach or accident.

(b) Purchase of tools or materials required in connection with accident which cannot be supplied in time by the Store Department.

(c) To provide food to engineering labour at the site of breach or accident with the assistance of Station Master or Inspectors of the Commercial Department.

Supply of food free of charge is permitted in special circumstances at the discretion of the administration to facilitate expeditious restoration of traffic. When food is supplied free at the site of an accident to engineering and other labour, the expenditure per head per day shall not exceed the prescribed limit.

(2) The Accounts Officer should be advised immediately by memo/electronically of each sum taken from station earnings.

In all cases, Engineers obtaining advances from station earnings should do so under a clear receipt. The purpose for which the money has been drawn should be clearly stated on the receipt. A complete account should be submitted at the earliest possible date to the Accounts Department supported by pay sheets and vouchers.

(3) All payment to labour should be witnessed by the ADEN at site.

(4) Works, which are considered to be urgently necessary to safeguard life or property or to repair damage to the line caused by flood, accident or other unforeseen contingency, so as to restore or maintain through communication may be started on Urgency Certificate in accordance with **Para 1103** *of Indian Railway Code for Engineering Department*.

1115 Obstructions Found on Track – When obstructions are found on the track those should be cleared after protecting the line and informing the nearest Station Master. Where sabotage is suspected, the Police should be advised immediately. The JE/SSE/P.Way should, if so required, arrange to meet the Police Official at the place of occurrence. A detailed report should be submitted by JE/SSE/P.Way to the ADEN/DEN. The DEN should in turn report such occurrences whether or not sabotage is suspected to the DRM and PCE.

1116 Flooded Causeways / Dips – (*Back to **Para 1117***)

(1) Permissible depth of water for passage of trains – In the case of causeways that are flooded and the velocity of current is insignificant, trains may be permitted to pass when the depth of water above rail-level does not exceed 300 mm for passenger and mixed trains and 450 mm for goods train, provided in each case JE/SSE/P.Way has satisfied himself by walking over and probing that Permanent Way is intact and in a fit condition.

(2) (a) Indication posts – Indication posts about 1200 mm in height shall be fixed at each dip, one at each end of the level portion, with flat bar attached to them to indicate level mentioned in sub Para (1) above.

(b) The posts should be painted black and white in 300 mm length so arranged that the flat bars which shall be painted white, show up against 300 mm length of black colour.

(c) The posts shall be fixed 3 m from the centre of the track in the case of Broad Gauge

(d) The details for fixing Indication Posts have been shown in ***Annexure - 11/2***.

(3) In the section where Electric Locos/Stock and or Diesel Locos ply, special gauges may be provided by the administration at the place liable to flooding, indicating the depth at which these Locos/Stock have to be stopped from the operation. These depths should be specified for each type of Locos/Stock by the administration.

1117 Special Precautions when Track is Submerged –

(1) The following precautions shall be observed when the track is submerged:

(a) In all cases train shall be stopped dead and allowed to proceed at a speed not exceeding 10 Kmph.

(b) If water rises over the top of the ballast but is below rail level, the track should be checked before each train, by two men walking abreast one at either end of the sleepers, and only if the track has not been disturbed, should the train be allowed over the track.

(c) When water overtops the rails, the JE/SSE/P.Way shall pilot the train, after ensuring that the track is safe, by walking over the track and checking by means of probing, subject to depths specified in ***Para 1116*** not being exceeded.

(2) Advice should be sent by the JE/SSE/P.Way to the ADEN and DEN, DRM and PCE when water rises above ballast level and again when it subsides. This should be followed up by special reports to the ADEN and DEN. Records of such occurrences should be entered in the SSE/P.Way in-charge's Section Register.

1118 Driver’s Report on Defects in Track –

(1) Intimation of Defects –

(a) The *Indian Railways (Open Lines) General Rules, 1976* **(Rule 6.07),** on report of conditions likely to affect running of trains, stipulates that-

(i) ‘Loco Pilots, Guards and Station Masters shall advise the Controller or the Centralized Traffic Control Operator of any known conditions or unusual circumstances likely to affect the safe and proper working of trains.

(ii) The Controller or the Centralized Traffic Control Operator, on becoming aware of such defect or failure shall inform the same to the railway servant responsible for the maintenance of the equipment and other railway servants concerned.’

(b) In this regard detailed procedure mentioned by Railways in Subsidiary Rules should be followed.

(2) Action on receipt of reports of defective track –

(a) By JE/SSE/P.Way – The JE/SSE/P.Way shall –

(i) Arrange to collect the requisite details and take necessary action for quick restoration of traffic. He will also proceed to site, if necessary, and inspect the length of track reported on and record *particulars* in detail. Then arrange to rectify the track and remove or modify the restriction imposed, as found necessary.

(ii) Submit a detailed report to the ADEN and copy the same to the DEN.

(b) By ADEN – Whenever possible, the ADEN should personally examine the track reported on for defects and make a detailed report to the DEN.

1119 Abnormal Occurrences Attributable to Locomotives and other Rolling Stock –

(1) Whenever distortion of track or any other abnormal occurrence attributable to locomotives or any other rolling-stock is noticed, the JE/SSE/P.Way shall:

(a) Immediately impose speed restriction as necessary and arrange protection of the line as per rules.

(b) Report the occurrence to the SSE (Loco) concerned copying the message to the ADEN / DEN and DME, Control and Station Master on either side of the block section. Whenever possible, the number of engine/rolling-stock considered to be responsible for distorting the track should be given.

(c) Make a careful examination of the affected track with a view to finding out if any inherent weakness or defect in the track has contributed in bringing about the “abnormal occurrences”, Particulars of defects should be noted in detail.

(d) Attend to defects as necessary and having done this, remove or modify the restriction as necessary.

(e) Submit a detailed report to the ADEN and copy the same to the DEN.

(2) On receipt of intimation of any abnormal occurrence attributable to Locomotive/Rolling- stock, ADEN should proceed to the site, examine the track minutely with reference to the report made by JE/SSE/P.Way and submit a special report to the DEN on the possible cause of damage with suggestion to prevent recurrence.

1120 Accident Not affecting Through Traffic –

(1) The JE/SSE/P.Way should immediately proceed to the site of the accident and take such measures, as necessary, to clear the obstruction and restore the line.

(2) The accident report in the prescribed form together with a sketch and statements of track particulars taken over sufficient length should be submitted in duplicate by the SSE/P.Way in-charge to the ADEN who will forward one copy of the report to the DEN with remarks.

Accident reports should be scrutinised by the DEN in all respects with particular reference to the time taken in restoring the line. Such instructions may be issued by the DEN to the ADENs and SSE/P.Way in-charge and to other departments, as may be deemed necessary.

The accident report form shall include particulars of date and time, Kilometer, description of accident, cause if known, number and type of train, engine, vehicles involved, names of Drivers and Guards, extent and cost of damage to the permanent way and rolling stock, time of restoration and the SSE/P.Way in-charge's special remarks. Accidents such as damage to the gate leaves/barriers by road vehicles, cattle run over and fire in which track is not affected, should be reported separately.

(3) As far as possible the ADEN should proceed to the site of accident of sufficient importance, such as derailments on running lines, gathering lines and of locomotives.

1121 Conducting Accident Enquiry-

(1) Stability of train against derailment depends on several factors such as track geometry, vehicle characteristics, the state of their maintenance, loading pattern of freight trains, engine-manship and speed of the particular vehicle at relevant point of time etc. Rail wheel interaction is a complex phenomenon and thus each derailment case therefore needs careful examination of all relevant available evidences in respect of rolling stock, track, speed of train and vehicle at the material time etc. to arrive at the cause.

(2) Careful observation of clues and a comprehensive record thereof is vital for accident enquiry. A comprehensive record of track and rolling stock Parameters; signalling, interlocking and operating features are required for investigation of derailments.

(3) There are two broad categories of derailment, viz. sudden derailment caused by wheel set jumping of the rails and derailment by flange climbing, caused by wheel mounting the rail in a relatively gradual manner.

(4) Derailment proneness increases with increased lateral wheel force, reduced vertical wheel load (Offloading) and increased positive angularity of wheel. Derailment proneness becomes substantially higher in case of axle moving with a persistently positive angularity. Track and rolling stock parameters and operating features should be critically analysed for their contribution towards these causes.

(5) While analysing the mechanism of derailment, relative contribution of track and rolling stock Parameters to the rail-wheel interaction forces needs a comprehensive analysis. Reference should be made to the safety limits/maintenance limits specified in this Manual/IRCA Rules/other Manuals.

(6) It is of vital importance to analyse whether any damage to track components is an after effect of the accident or otherwise.

(7) The track parameters stipulated in this manual shall be considered keeping the following view point-

(a) Various para of this Manual clarifies that the provisions and tolerances mentioned therein are not safety tolerance but with a view to maintain track geometry for good riding comfort.

(b) The maintenance tolerances given in different Paras of this manual are for mainline track unless otherwise specified.

(c) The maintenance tolerances for yard lines, other lines and work spots on mainline having low speed potentials should be suitably considered.

(8) Items mentioned in **Para 1107, Para 1108 and Para 1109** shall be fully complied particularly **Annexure - 11/1 (A to E)** shall be used for recording the details.

(9) Photography & videography of accident site shall be with great care & precision, similar to a crime scene photography/videography.

(10) M&C report from RDSO must also be part of accident enquiry report in case accident is attributed to breakage of any component of track or rolling stock.

1122 Records of Accidents –

(1) Apart from individual files, all important accidents, breaches, washouts and subsidence of track should be carefully recorded with complete particulars in the Section Register by SSE/P.Way.

(2) In the case of damage by flood at important bridges, detailed particulars with remedial measures adopted should be entered by ADEN in the rivers and floods register and reference made thereto in the bridge inspection register.

(3) Records of all the accidents should be maintained systematically in the offices of SSE/P.Way (In-charge), ADEN and Divisional Engineer so as to facilitate supply of statistical and other information as may be required.

1123 Accident Statements to the Railway Board –

(1) Returns of the accidents under specified categories are compiled by the Operating Department for submission to the Railway Board. Relevant particulars should be promptly furnished by the DEN and Works Manager/DCE of engineering workshops to the proper authority on such forms as may be prescribed.

(2) Workshop accident fall under Factories Act and should be reported according to the rules in force and to such local authority as may be specified.

PART – C

Pre-Monsoon Precautionary Measures

1124 General Precautions to be Taken Before Monsoon –

It is necessary to take certain precautions and carry out certain essential works before the commencement of monsoon, such as

(1) All catch water drains and side drains must be cleared of silt, vegetation and other obstructions to ensure free flow and quick drainage of storm water.

(2) The waterways of bridges must be cleared of vegetation and other obstructions. If silting is noticed in some spans, it should be removed to ensure that the full waterways is available for the discharge of flood water. During de-silting, care should be taken to remove the silt only upto the bed level.

Protective and river training works must be maintained in good condition and repairs carried out wherever necessary. Scour holes should be filled with boulders. *[Ref: Chapter VIII of IRBM]*

(3) The High Flood Level (HFL), Full Supply Level (FSL) in the case of canals with year of occurrence and Danger Level (DL) must be painted. The Danger Level mark shall be painted with bright red band across each pier adjacent to the abutment so as to be clearly visible to the Patrolmen, Special Watchmen and Drivers. Flood Gauges shall be painted on important bridges as specified.

(4) Water shall not be allowed to stagnate on the track. For this purpose, cross drains should be provided at regular intervals. In yards, cross drains and longitudinal drains should be cleared/provided to proper grades.

(5) In hilly areas, where there is incidence of falling boulders, a survey should be carried out to locate loose boulders. Such loose boulders should be dropped in a systematic manner.

(6) Selection of Patrolman and Watchman should be made in accordance with **Para 1004(6)** and they must be trained and tested for their knowledge of rules. The duties to be performed by them should be clearly explained to them. The equipment of Patrolmen and other watchman shall be complete in all respects.

(7) Spare trollies should be kept in readiness at the headquarters of the JE/SSE/P.Way and at other stations in the proximity of vulnerable locations. Motor Trollies must be overhauled and kept in fit condition.

(8) Rivers in the upstream reaches should be inspected for guarding against possible change in water course.

(9) The prescribed reserve stock of boulders, empty cement bags, wire netting and sand/ quarry dust should be kept at specified locations for rushing to site, in case of emergency and should be made good, in case of deficiency.

(10) Action should be taken as envisaged in **Para 1127(3)** in the case of Railway Affecting Works.

(11) The temporary engineering indicators must be painted and kept ready for use.

(12) The rain gauges should be inspected before the monsoon and it should be ensured that they are in perfect working condition.

(13) Use of modern technological advancements such as drone videography etc., can be deployed to assess the condition of specific assets/locations and water course etc., which are difficult to access.*[Ref: RDSO Report No.BS-129 entitled as "Guidelines for Inspection of Railway Bridges using Unmanned Aerial System (Drone)"]*

(14) Trees which are likely to fall on running lines during heavy wind/storms should be identified and cut in advance.

(15) Vulnerable locations/kilometrages should be reviewed jointly by the ADENs and Divisional Engineer and on the basis of past history and pre-monsoon inspections and the register of vulnerable locations should be brought up-to-date.

1125 Materials for Emergencies –

(1) Arrangements should be made to stock sufficient quantities of rails, sleepers, materials for cribs, ballast, sand/quarry dust/cinder and boulders at suitable points near Vulnerable locations, so that the materials may be rushed to site as required.

(2) Before the onset of monsoon, specified number of wagons loaded with sand/quarry dust/cinder, ballast and boulders should be kept at appropriate stations for quick movement to vulnerable locations.

(3) During monsoon, as far as possible, ballast train should be programmed to work in the vicinity of the vulnerable zones so that they may be utilised without delay in emergency.

(4) Locations and quantities of reserve stocks should be made known to all Divisional Engineer and ADENs by the PCE. Reserve stock should not be used except in an emergency. When it is used, it should be recouped.

Divisional Engineer should send a certificate to the PCE to the effect that monsoon reserve stock is in order and to the scale laid down, by the prescribed date.

(5) Bridge Engineer/Divisional Engineer should arrange to keep equipment like Service Spans, Trestles, Cribs, Derricks, Compressor, Equipment and Materials required for blasting, rock breakers, welding sets etc., ready for use in emergencies. These should be stocked in working order at convenient places so that they can be despatched to the site of breaches without delay.

1126 Service Spans and Rail Clusters – Details of temporary service spans and rail clusters available on each railway should be listed and circulated for the guidance of ADENs and Divisional Engineers before the monsoon. The detailed drawings of the same shall be circulated by the Principal Chief Engineer of the railway for the guidance of JE/SSE/P.Way and ADENs, who should be in the possession of the same.

1127 Railway Affecting Works (Including Railway Affecting Tanks) –

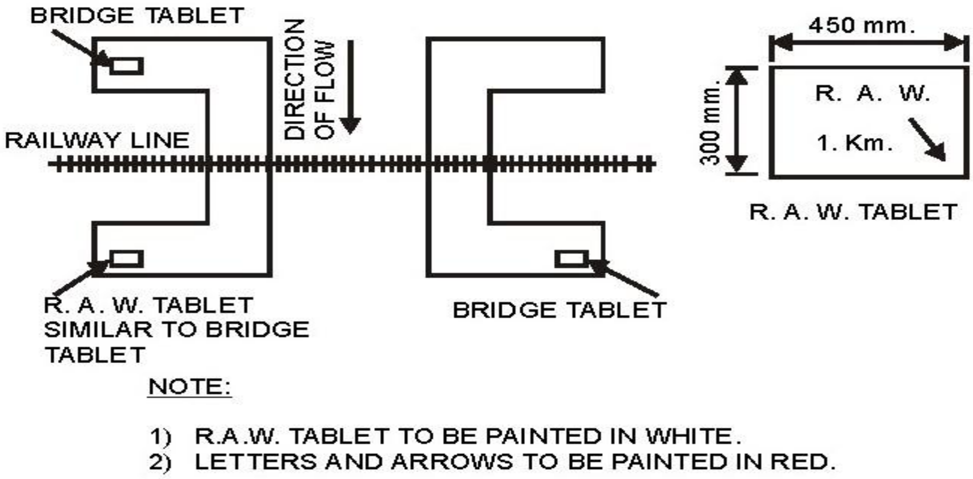
(1) *Definition* – The term “Railway Affecting Work” may broadly be taken to mean any work which if not constructed and maintained properly, or not operated properly may result in danger to railway line (bridge/embankment). This may include tanks, storage works, canals, bunds, etc.

(2) *Register of Railway Affecting Works* – The Divisional Engineer/ADEN will maintain an up-to-date list of Railway Affecting Works as jointly approved by the Railway and the State Government. The list shall invariably show the particulars of State Authority responsible for maintenance of each Railway Affecting Work.

(3) *Inspection of Railway Affecting Tanks* – Where, as per current practice the Public Works or Revenue Department forwards to the Divisional Engineer every year, their inspection reports on the condition of these tanks which are classified as Railway affecting, action should be taken as follows – (*Back to* **Para** ***1124, 1128***)

(a) The Divisional Engineer should peruse the reports carefully and mark those tanks which he considers are not in satisfactory state of repair. He should then forward the reports to the ADEN with instructions that the tanks so marked should be inspected and reported on.

(b) ADEN shall jointly inspect with civil authorities, all R.A.W / R.A.T. before the monsoon every year and arrange for their safe maintenance to avoid any danger to nearby tracks and structures. Records of the annual inspections should be kept in registers as prescribed. ADEN should report to the Divisional Engineer details of the action being taken by the Public Works or Revenue Department. The Divisional Engineer should timely prevail on the authorities concerned to carry out all necessary repairs before the ensuing monsoon and take other actions to ensure safety of Railway assets. A typical sketch of RAW tablet is shown below –



DETAILS OF "RAILWAY AFFECTING WORKS" TABLET (R. A. W.)

(c) Copies of the inspection notes of 'Railway Affecting Tanks' as received from the State Authorities with particulars of date of inspection and notes of action taken or proposed by him should be included in the register of Railway Affecting Works maintained by the ADEN.

1128 Vigilance over Railway Affecting Tanks during Heavy Rains –

(1) The DEN and the ADEN should arrange with the Local Authorities/Village Headman in whose jurisdiction 'Railway Affecting Tanks' are situated to watch them during periods of heavy rain and give timely intimation to the nearest Station Master, if there is likelihood of any tank failing. The Station Master will telephone/convey reports received from Village Headman/State Government authorities to the SSE/P.Way (In-charge), ADEN and DEN.

(2) When the railway line is threatened, ADEN and SSE/P.Way (In-charge) shall take adequate steps to ensure the safety of Railway property and staff and arrange patrolling of the line and or post watchmen with necessary equipment at the place or places threatened and advise the DEN accordingly.

(3) All the Bridges which are likely to be affected by 'Railway Affecting Tanks' or other storage works should be provided with a tablet on top of one of the Parapets, with the letters R.A.W. engraved on it, followed by an arrow mark pointing in the direction of the railway affecting storage work in question.

(4) If the bridge in whose catchment a Railway Affecting Tank is located is classified as a vulnerable location, Stationary Watchmen should be posted during monsoon, as necessary. If for any reason, repairs as envisaged during the inspection, as per ***Para 1127(3)*** is not carried out, the section of the Railway line likely to be affected should be considered as vulnerable and Watchman as considered necessary posted.

1129 Weather Warnings and Action to be Taken – (*Back to* ***Para 1003***)

(1) *General –*

(a) Arrangement should be made with the concerned Meteorological centre for receipt of bad weather warnings.

(b) The bad weather warnings to be received should cover both high velocity winds and cyclones as well as heavy rainfall and arrangement should be made for receipt of the same throughout the year.

(c) The list of officials who should receive the bad weather warnings and their addresses should be advised to the Meteorological Department by the Division. The list should be reviewed and updated every year.

(d) Detailed instructions and fool-proof arrangement should exist for prompt communication of bad weather warnings on receipt to the line staff.

(e) Anemometer should be installed at one of the adjacent stations of specially selected bridges where very high velocity winds are experienced and where there is a danger of vehicles capsizing (**Para 717** *of IRBM* may be referred**).**

(f) Suitable working rules should be framed prescribing for each location the danger level of wind velocity and enjoining upon the Station Master to control (stop) the traffic on the section concerned when the wind velocity exceeds the Danger Level and also to inform the Station Master on the other side and the Section Controller of the need to control the traffic.

(2) *Precautions to be taken by Station Master, Driver and Guard – Regarding controlling of trains –*

(a) When a weather warning message has been received forecasting heavy or cyclonic storm and there is reasonable doubt that a severe storm and high winds are going to break through, that may endanger the safety of passengers/train, the Station Master may, in consultation with the Guard and Driver, detain the train until the storm and high winds abate and it is considered safe to allow the train to proceed from his station.

(b) In spite of the action outlined above should the Driver be still caught on run in a storm and high winds of an intensity which in his opinion are likely to endanger the safety of Passengers/Train, he should bring his train with the least delay to a halt, avoiding such stoppage at places like sharp curves, high embankments, cuttings and bridges. The train could be restarted in consultation with the Guard only after the storm and high winds abate and it is considered safe to proceed.

(3) *Action by the SSE/P.Way (In-charge) –*

(a) The SSE/P.Way (In-charge) on receipt of weather/cyclone warning, should arrange to advise monsoon Patrolmen/Watchmen and Gang Mates to be extra vigilant. During the fair season, he should introduce monsoon patrolling as soon as possible and also post watchman as required at all vulnerable locations and bridges by day as well as by night, for a period extending upto 48 hours beyond the period specified in the weather/ cyclone warning message.

(b) The JE/SSE/P.Way should be out in his section, as far as possible by trolley, during the period of warning and 48 hours beyond, if the trains are in operation.

(4) *Action by the Gang Mates* – On receipt of advice from the Station Master, the Gang Mate should take the following action –

(a) During the fair season, the Gang Mate of station yard gang should depute two reliable Track Maintainer provided with patrolmen's equipment for patrolling the block sections on either side and for alerting the intermediate Gang Mates.

(b) During monsoon period also, the Gang Mate of the station yard gang should send two Track Maintainer in opposite directions to alert intermediate Gang Mates, Patrolmen and Watchmen.

(c) Should there be very heavy rain or a severe storm weather during the monsoon or fair season, the Gang Mate and Track Maintainer of all gangs on their own initiative should commence monsoon patrolling by day as well as night. Similar action to carry out patrolling should be taken on receipt of bad weather warning for the duration of warning and 48 hours beyond.

(5) The individual Railway may issue instructions in the form of joint circular to suit the local requirements.

(6) Inspecting officials should test the knowledge of Gang Mates and Track Maintainer about these instructions issued.

Annexure - 11/1 ***Para 1121***

Details of Recording to be done at Accident Site and Indication Posts for Flooded Causeways/Dips

Railway Board vide Letter No. 2018/Safety(A&R)/1/8 Dated 25.01.2019 issued revised Observation/ Measurement Proforma for various Parameters related to Track and Rolling stock for Accident Investigation /Inquiry. The same may be referred. These Proforma are incorporated herein as Annexure - 11/1A to E, however, latest Railway Board instructions as applicable may be referred-

(a) A sketch showing the accident site is to be prepared as per Annexure - 11/1A.
(b) The Track Parameters are to be recorded vide Annexure - 11/1B.
(c) The Parameter of Locomotive are to be recorded in Annexure - 11/1C.
(d) The Parameter of Wagon are to be recorded in Annexure - 11/1D.
(e) The Parameter of Coaches are to be recorded in Annexure - 11/1E.

Annexure - 11/1A ***Para 1107***

Site Sketch - **The following details are to be shown on the dimensioned sketch to be prepared in the case of accidents –**

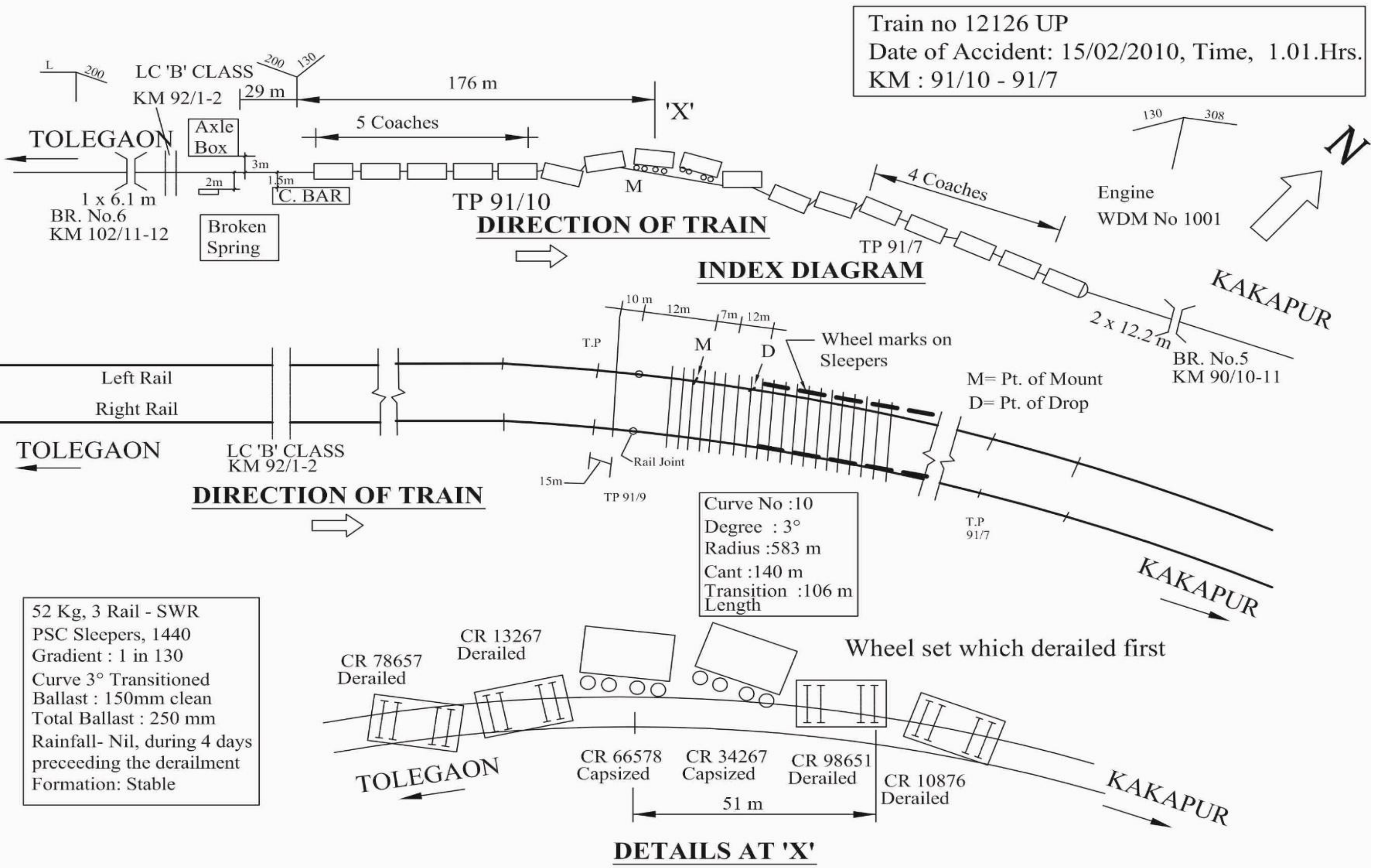
1. The train number, the date and Kilometerage of site of accident should be furnished.
2. The North point should be indicated.
3. It should indicate prominently the direction of movement, and also the names of stations in rear and advance of the accident site.
4. It should a show a length of about 300 metres behind the point of mount and almost an equal distance in front. However, track measurement should be limited as per proforma for track measurement.
5. Each track of the Permanent Way must be denoted by a pair of lines.
6. The position of Level Crossings, Telegraph Posts/ Electrical Posts, Bridges, Tunnels, Gradient Posts with Gradient Symbols, Curves- demarcating the beginning and end, giving details of degree of curvature, prescribed super elevation and length of transitions should be indicated.
7. It should also indicate the position –
   (a) of all derailed vehicles and the marks left by them either on sleepers, rails or ballast,
   (b) of the point of mount with position of rail joint on either side,
   (c) of the point of drop,
   (d) of the pair of wheels of the first derailed vehicle,
   (e) in which every displaced rail/wagon or part of a rail/wagon and detachable components were found.

   Note – *In all cases, dimension from nearest Kilometre post and center line of track should be given.*
8. In case of accidents within station limits, sufficient details about the station layout should be shown in order to fully explain the movement of the affected train in relation to the topography of the place. The signal aspects at the time of accident should be correctly depicted.
9. The distance of the site of accident from a permanent structure to fix the site of accident precisely should be indicated.
10. The distance should be indicated to show the extent of the disturbance caused in the Permanent Way or train composition on account of the accident.
11. Any marks on sleepers or other track fittings should be clearly indicated in their exact position in relation to the track or vehicles.
12. Locating and examining the wheel mounting mark(s) at the initial point of derailment is very important for identifying the category of derailment. Precise measurements and critical and detailed examination of the wheel mounting marks should be made e.g. their length, strong or faint, broken or continuous, single or multiple, etc. Photographs should be taken of such marks, not only on the rail, but also on the fastenings, sleepers and ballast.
13. Broken parts of other extraneous material, if found on the site of accident, should be shown in the sketch, with details giving their precise position in relation to track.
14. If necessary, more than one sketch should be enclosed one clarifying the yard layout and the system of working it and the other giving details, such as, position of wheels, wheel marks etc. In the former, one line should be used to represent both rails of track and such position of the station yard (in case of accidents within station limits) should be covered as may be necessary. All necessary details relevant to the issue must be embodied in the sketch. The terminal station on

the down side should be mentioned on the right extremity of the sketch, the terminal station on the up side being mentioned on the left extremity. If the accidents take place within station limits the shorter sketch should be based on the Station Working Diagram.

15. Details of track structure should be shown in the sketch.
16. Details of damages to bridges involved, span wise should be shown.
17. In the case of accidents to and near level crossings, full details of the level crossings should be furnished.
18. Any other details as may be considered necessary to reconstruct the scene of the accident should also be shown.

TYPICAL SKETCH OF ACCIDENT SITE



To Be Jointly Signed By		
Supervisor (C&W)	Supervisor (Traffic)	Supervisor (P.way)

Annexure - 11/1B (*Para 1108*)

Proforma for Track Measurement (Part – A)

(Proforma showing the detailed particulars to be collected in the case of Permanent Way during an Accident)

Soil			Type of Formation	Rain Fall	Ballast		
Sl. No	Type e.g. sandy, loamy clay, Moorum, Black cotton etc.	Condition - firm, Wet, slushy etc.			Type/stone, Moorum, Sand, Ash etc.	Depth below sleeper bottom in cms Stating whether clean or caked	Drainage
1	2	3	4	5	6	7	8

Width of shoulders in cm. from outside of rail				Sleepers				
Left	Right	Left	Right	Type	Condition - New/ second hand/ damaged/ unserviceable etc.	Density	Square or not	Packing loose or sound
9	10	11	12	13	14	15	16	17

Rails			Rail fastenings		Rail joints		
Weight 60 kg, 52 Kg (Year of manufacturing)	Condition of wear (attach rail profile. if wear is heavy)	GMT Carried	Number per sleeper seat	Condition: Tight or loose or missing (in each sleeper)	Condition: Hogged, battered, low etc.	Staggered or square	Creep-Direction and extent of creep
18	19	20	21	22	23	24	25

General remarks about cracks or fracture of fish- plates, fish bolts and other components	Description of anti- sabotage measures	Location of point of mount		Location of points of derailment	
		Whether on straight, curve or transition	Whether on a falling grade, level or rising grade and or on sag	Whether on straight, curve or transition	Whether on a falling grade, level or rising grade and or on sag
26	27	28	29	30	31

Note-

(1)Left and Right are with respect to direction of Train movement.

(2)The data in Col. 2 to 26 need not be collected when the defect is obviously and indisputably on account of sabotage and/or obstruction on track.

(3)Only broken track material which is not indisputably to be broken after the accident should be included in Col. 26 and should be preserved.

(4)Col. 27 need be filled in only when there is a suspicion about sabotage being the cause of derailment.

(5)Sag extends 90 metres on either side of theoretical junction of the grade lines Col. 29 and 31.

To be Jointly Signed By		
Supervisor (C&W)	Supervisor (Traffic)	Supervisor (P.Way)

Proforma for Track Measurement (Part – B)

Station No.	Distance apart (metres)	Gauge slack or tight from the Exact in loaded condition (mm)	Cross Level under loaded condition (mm)	Marks on sleepers or rail top	Grinding or rubbing marks on rails
1	2	3	4	5	6

Examination of alignment for perceptible kinds of track distortion in the vicinity of the point of derailment	Subsidence of track	Versine in mm in loaded conditions		Remarks regarding length of transition, degree of curve and specified super elevation general alignment etc.
		On 20 M. or 10 M. chord depending on practice prevalent on the Railway for flat curves more than 600 M. radius	On 10 M. or such shorter chords as considered necessary for sharp curves less than 600M. radius	
7	8	9	10	11

Note-

(i) The Point of Mount should be marked station No. 0 and the stations numbered serially as (+) for measurements ahead of site of derailment and (-) for measurements in rear.

(ii) The cross level will be measured on the left rail only as determined from the direction of movement.

(iii) Normally measurement will be taken at station 3 M. apart for a distance of 45 meters on either side of 0 station if the cause of derailment is indisputably known, otherwise they will be taken for a distance of 100 meters in rear and 45 meters ahead of zero station.

(iv) Where necessary measurements for Col. 3, 4 and 5 may in addition be taken at individual sleepers.

(v) This proforma need not be filled when the cause of derailment is obviously established as due to sabotage, obstruction on track, broken axle, and/or spring having fallen off prior to point of derailment.

(vi) Longitudinal levels should be recorded for 300 meters on rear and 100 meters in front, in case of straights at the middle of each rail and at versine recording points on curves @ 20/10M intervals.

To be Jointly Signed By		
Supervisor (C&W)	Supervisor (Traffic)	Supervisor (P.Way)

Annexure - 11/1C(*Para 1108*)

Proforma for Motive Power/ Locomotive (Diesel &Electric)

Proforma to be filled in case of accident /derailment when loco is involved in accident.

1. **Basic information:**
   (a) Date of Accident:
   (b) Train No. :
   (c) Loco Class:
   (d) Loco Number:
   (e) Loco manufacture year and place:
   (f) Base Shed of Loco:
   (g) Date & Place last POH:
   (h) Kilometres earned after last POH:
   (i) Date & place of last major inspection:
   (j) Date & place of last schedule inspection:
   (k) Whether any schedule is overdue?

2. **Give brief particulars of the safety items not provided or provided but missing/not working-**

Whether Loco is provided with:

Safety fittings	Provided	Working
Headlight		
Speedometer		
Speed Recorder		
Flasher light		
Horn		
Brake System		
VCD		

3. **Check & record the observations as follows:**

   (a) Position of control handles, cutout cocks etc. after the accident.
   (b) Functioning of brake synchronizing valve-whether working or not.
   (c) Position of brake blocks after the accident-whether applied or not.
   (d) Condition of cattle guard.
   (e) Any sign of seizure of roller bearing in Axle box including condition of its components
   (f) Condition of Pivot and Side Bearer arrangement of bogie including obstruction to Bogie rotation.
   (g) Condition of Friction Damper components/ Hydraulic Dampers
   (h) Condition of Traction Rod/ Guide Rod including its connection.
   (i) Condition of Traction Link including its connection.
   (j) Condition of Lateral Stop components between Bogie and Loco body underframe
   (k) Any other observation in respect to mechanical defect of the locomotive, which might have any bearing on safe running of loco.

Note: Defective or broken material should be sent to CMT for testing, if necessary.

4. Measurement for Wheels for All Classes of Locomotives with wheel gauge (04 locations applicable for Bo-Bo Locos)

S. No.	Description	Observed Value (in mm)			Remarks
1.	Particulars-of axle (ID No.)				
		1			
		2			
		3			
		4			
		5			
		6			
2.	Diameter of wheel at tread		LH	RH	
		1			
		2			
		3			
		4			
		5			
		6			
3.	Wheel Flange thickness		LH	RH	
		1			
		2			
		3			
		4			
		5			
		6			
4.	Wheel Root wear		LH	RH	
		1			
		2			
		3			
		4			
		5			
		6			
5.	Tread wear		LH	RH	Tread wear should be measured from tread at 63.5mm from wheel gauge face (from the back face of flange)
		1			
		2			
		3			
		4			
		5			
		6			
6.	UST of axle: Give the date of last UST test done	Axle	Observation		Information is relevant in case of axle breakage
		1			
		2			
		3			
		4			
		5			
		6			

S. No.	Description	Observed Value (in mm)		Remarks
7.	Wheel gauge: For checking wheel gauge, three measurements at equal spacing on the inner periphery of the two wheels on the same axle is to be recorded. Check for bent axle, if any.	1		All measurements shall be taken on a level tangent un-canted track. Information is relevant in case of wheel disc shifting/bent axle only. For safety, similar limits as applicable for track gauge are relevant for wheel gauge also.
		2		
		3		
		4		
		5		
		6		

Note:

i. Wheel number one is the outer end axle of truck under the short hood and wheel count increases towards the Long hood on diesel loco, whereas for Electric Loco, wheel number one is the outer end axle under Cab-I (Cab- 1 is that side of the loco which has the compressors and Cab-2 is that side of the loco which has the ARNO convertor) and wheel count increases towards the Cab-2

ii. The measurements of wheels are to be done using wheel gauges to ROSO drawing No.SKDL-3592 for all locomotives except WAP5 locos. For WAP5 locos RDSO's drawing No. SKDL-4446 and SKDL-4447 may be followed.

iii. All measurements are to be taken on a level, un-canted track at the nearest yard.

iv. Service limits given in the Maintenance Manual are for good maintenance practice and these are not safety limits. However, the measured values shall be compared with the service limits and degradation in values shall be discussed while finalizing the findings.

5. Measurement of other relevant items:

S. No.	Description		Observed Value (in mm)	Remarks
1	Buffer /coupler height Measurement of Parameters such as buffer length etc. may also be done to check possibility of buffer entanglement.			All measurement shall be taken on a level tangent un-canted track. This measurement is required to be taken only in case of trailing stock iswith buffers.
2	Lateral clearances	End Axles (1,3,4 &6)		
		Middle Axles (2&5)		
3	Lateral clearances	End Axles (1,2,3 &4)		Applicable for Bo-Bo Locomotives only.
4	Longitudinal clearances, between axle box &bogie. Pedestal liner (for all axles)			Except WDP3A, WDG4, WDP4, WDP4B, WAP5, WAP7, WAG9 Locomotives
5	Longitudinal clearances between axle box &bogie pedestal liner (for middle axles)			Applicable to WDP3A locomotive only.
6	Height of Rail Guard from rail level			
7	Condition of suspension Springs i.e. normal/ broken fresh and old fracture or deformities occurred after derailment due to sudden impact.			
8	Deflected height of coil spring after re-railing on level, uncanted track			
9	Condition of Rubber/ Elastomeric Spring Assembly at the Secondary stage			

Note - Measurement of items (e) to (j) in Para 3 & item 8 & 9 in Para 5 will be done as per site condition.

To be Jointly Signed By		
Supervisor (C&W)	Supervisor (Traffic)	Supervisor (P.Way)

Annexure - 11/1D(*Para 1108*)

Proforma for Wagon

Note: Details regarding all derailed vehicles should be given except:-

1. *(i) Where vehicles have derailed due to locomotive derailment*
   (ii) When the obvious and indisputable cause is sabotage or an obstruction on track
2. *Front and rear and left (L) and right (R) are with respect to direction of movement.*
3. *For an obvious cause of derailment such as a broken axle, spring dropping off the run, and/or some part of under gear hanging loose and causing obstruction only relevant particulars need be filled.*
4. *Particulars for each derailing vehicle should be given in one sheet. Information against columns (5), (6), (8), (16), (17), (21), (22) should invariably be given for adjacent wagons on the same sheet.*
5. *Relevant details of adjacent vehicles should also be given if cause of derailment is not apparent.*

S. No	Date of Incident &Time	Train No.	Details of BPC along with the name of station from where it is issued and of engineer (C&W) who issued	Wagon No.	Type	Mech. Code	Tare in Tonnes	Carrying capacity and Axle load	Built Date	Return Date
1	2	3	4	5	6	7	8	9	10	11

POH Particulars		ROH Particulars		Payload in Tonnes		Commodity loaded and remarks regarding uneven loading (give sketch for details of uneven loading)	Station		Position from Engine
Date	Shop	Date	Depot	From Labels	From Actual Weighment		From	To	
12	13	14	15	16	17	18	19	20	21

Buffer/Coupler Height	Wheel and axle face Particulars (in case of breakage of wheel /axle)		
(i) Measure Buffer/Coupler height after uncoupling &re-railing on uncanted level track (ii) Record whether there is buffer entanglement (Yes/No)	Axle face particulars	Ultrasonic particulars on the hub of the disc	Stamping particulars on wheel disc regarding Manufacturer/RA/RD
22	23	24	25
End 1L	1L	1L	1L
	1R	1R	1R
End 1R	2L	2L	2L
	2R	2R	2R
End 2L	3L	3L	3L
	3R	3R	3R
End 2R	4L	4L	4L
	4R	4R	4R

Wheel and Axle								
Wheel diameter (i) Measurement (ii) Record whether below condemning size (Yes/No)	Wheel gauge in mm *(taken at three places)	Observation after measuring the profile with tyre defect gauge (Good/ Rejectable) **						
			Thin flange	Sharp flange	Worn-out root	Deep flange	Hollow tyre	Flat tyre
26	27	28						
	1	1 L						
		1 R						
	2	2L						
		2R						
	3	3L						
		3R						
	4	4L						
		4R						

*The wheel gauge is to be measured at the horizontal plane passing through the center of the axle

** The wheel profile is to be checked with tyre defect gauge only (Ref: IRCA Pt. III Rule No.3.2.2 (d) and 4.18.1 Plate No.-57 to 66)

Roller Bearing (To be recorded in case of any abnormalities observed in Roller bearing / Axle Box)		
Condition of face cover plate	Condition of locking plates & studs	Condition of Roller Bearing and its components
29	30	31

Axle Box (for IRS Stock/UIC) (To be recorded only when failure of plain bearing is involved as a cause)				
Brass thickness mm	Condition of box and brass	Condition of sole plates	Condition of journals	Clearance between brass and collar of journal in(mm)
32	33	34	35	36

Lateral clearance between axle box and axle guard in (mm)	Whether axle guard can work clear of axle box	Are the axle guard bent or otherwise damaged to prevent free movement of axle box	Remark regarding bridle bar
37	38	39	40

Clearances for CASNUB Bogie (Corresponding measurements to be taken for IRS/UIC Bogie)			
Type of Bogie	Lateral clearance between side frame & bolster in mm	Lateral clearance between side frame & axle box adopter in mm	Longitudinal clearance between side frame &axle box adopter in mm
41	42	43	44

Spring and Spring Gear						
Any Broken / cracked/missing/ clearance of shackle and shackle pin and general condition (for UIC/IRS)	Thickness of packing plate under spring seat in mm	Remarks whether any spring eye touches sole bar (for laminated spring only)	Condition of suspension springs i.e. normal, broken /fresh and old fractured or deformities occurred after derailment due to sudden impact	Camber of spring in mm after re-railing on a level uncanted track (for laminated spring only)	Deflected height of coil spring after re-railing on level, uncanted track (for CASNUB)	Condition of elastomeric pad above adaptor (for CASNUB)
45	46	47	48	49	50	51

Bogie		
Condition of Center Pivot including lubrication and wear (for CASNUB)	Condition of Side Bearer including Vertical clearance at side bearers (for stock having clearance type side bearers only)	Condition of Friction Snubber Wedge Assembly (for CASNUB)
52	53	54

Whether a load is placed on more than one wagon	Any other defect in vehicle which may have contributed to or caused the derailment	Details of broken parts giving location w.r.t. point of mount and drop	List of damages to the wagon due to accident	Other observations*
55	56	57	58	59

Note - Measurement of item 3, 4 & 5 of opening note, item 42, 43, 44, 46, 47, 49, 50, 56& 59will be done as per site condition.

To be Jointly Signed By		
Supervisor (C&W)	Supervisor (Traffic)	Supervisor (P.Way)

Annexure - 11/1E(*Para 1108*)

Proforma for Carriage

Proforma to be filled in case of Derailments

Note: Details regarding all derailed vehicles should be given except:

1. (i) Where vehicles have derailed due to locomotive derailment.
(ii) When the obvious or indisputable cause is sabotage or an obstruction on the track or broken axle or wheel.

2. Particulars for each derailed vehicle should be given in one sheet. Information against columns nos. (5), (6), (7), (14), (50) and (51) should invariably be given for adjacent coaches on the same sheet.

3. Front and Rear, left (L) and Right (R) are with respect to direction of movement.

4. For an obvious case of derailment such as a broken axle, spring dropping off on run, and/or some part of under gear hanging loose and causing obstruction, only relevant particulars need to be filled.

5. Relevant details of adjacent vehicles should also be given if cause of derailment is not apparent.

S. No	Date of Incident &Time	Train No.	Details of BPC along with name of the station where issued and Engineer (C&W) who issued it	Vehicle no.	Type	Tare in tones	Carrying capacity in tones	Built date	Return date	POH details
1	2	3	4	5	6	7	8	9	10	11

Station		Position from engine	Wheel gauge in mm (to be measured at three locations) measured in empty condition at the horizontal plane passing through the center of the axle	Wheel diameter (i) Measurement (ii) Record whether below condemning size (Yes/No)		Any indication of bent axle or wheel having shifted on axle
From	To					
12	13	14	15	16(i)	16(ii)	17

Wheel and axle face particulars (in case of breakage of any wheel / axle)		Stamping particulars on wheel discs regarding manufacturer/ RA/RD (in case of breakage of any wheel/axle)		Observations after measuring the profile with wheel defect gauge(Good / Rejectable)	
Axle Face particulars	Ultrasonic particulars on the hub of the disc			L	R
18	19	20		21	22
1L	1L	1L			
1R	1R	1R			
2L	2L	2L			
2R	2R	2R			
3L	3L	3L			
3R	3R	3R			
4L	4L	4L			
4R	4R	4R			

Roller Bearing (To be recorded in case of any abnormalities observed in Roller bearing/ Axle Box)			
Condition of axle box, rear and front covers/end cap (FIAT)	Condition of face cover plate	Condition of bearing seal & studs/ locking plate and bolts (FIAT)	Condition of Roller Bearing and its components
23	24	25	26

Spring and Spring Gear								
Condition of suspension spring i.e. Normal /Fractured (old/fresh)	Condition of Rubber spring i.e. Normal /Cracked including length of crack(for LHB only)	Condition of Air Spring including leakage in piping	Deflected height of Coil spring after re-railing on a level uncanted track	Vertical clearances(for ICF)			Condition of Rubber Disc and Bump Stop of Primary Suspension (for LHB)	Height of Bogie Bolster base plate from rail level (for LHB)
				Crown clearance	Bogie frame-Bolster clearance	Body-Bogie frame clearance		
27	28	29	30	31	32	33	34	35

Condition of Bogie Components			
Condition of Hanger (for ICF)	Condition of Equalizing Stay (for ICF)	Condition of Anchor Link (for ICF)	Condition of Control Arm, Rubber element and Bore (for LHB)
36	37	38	39

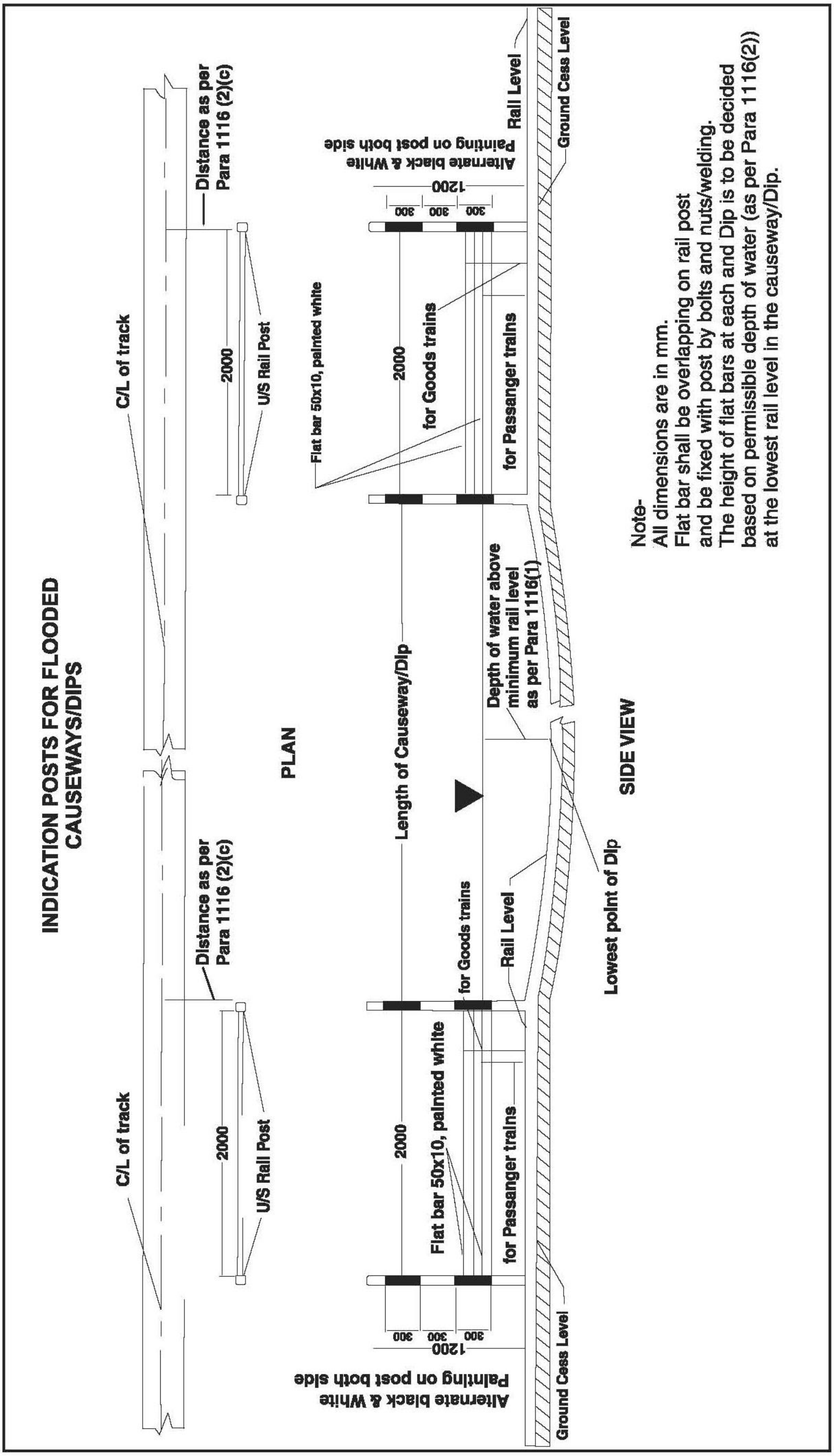
Damping System		
Condition of Axle Guide Cum Dash Pot including Oil level (for ICF)	Condition of Hydraulic Dampers	Condition of Anti Roll Bar (for LHB)
40	41	42

System of Bogie Rotation and Clearances					Condition of Grounding cables, Wheel Slip Protection (WSP), and Speed sensor (for LHB)	Condition of Brake Gear Assembly
Condition of Center Pivot including verticality of Pivot Pin (for ICF)	Condition of Side Bearer including Oil level and Wear (for ICF)	Condition of Longitudinal/ Lateral flexibility of Secondary Spring (for LHB)	Clearance between Traction Center and Longitudinal/ Lateral Bump Stop (for LHB)	Remarks regarding free movement of bolster and pivot and their condition		
43	44	45	46	47	48	49

Buffer/Coupler height (to be taken on a level uncanted track after uncoupling and re- railing) (in mm)		Condition of Side Buffers Working, dead, drooping, entanglement	Details of broken parts giving location w.r.t. point of mount and derailment and whether breakage considered due to accident	Any other defect in the vehicles which may have contributed to or caused the derailment such as condition of coupler, draft gear pocket, shearing plates etc.	List of Damages to the Coach due to accident	Other Observations considered relevant to derailment
Front	Rear					
50	51	52	53	54	55	56

Note - Measurement of item 5 of opening note, item 24, item 28 to 49, item 54 & item 56will be done as per site condition.

To be Jointly Signed By		
Supervisor (C&W)	Supervisor (Traffic)	Supervisor (P.Way)


INDICATION POSTS FOR FLOODED CAUSEWAYS/DIPS
PLAN
C/L of track
Distance as per Para 1116 (2)(c)
2000
U/S Rail Post
Alternate black & White Painting on post both side
1200
300
300
300
Flat bar 50x10, painted white
for Goods trains
for Passanger trains
Length of Causeway/Dip
Rail Level
Ground Cess Level
Depth of water above minimum rail level as per Para 1116(1)
Lowest point of Dip
SIDE VIEW
Note-
All dimensions are in mm.
Flat bar shall be overlapping on rail post and be fixed with post by bolts and nuts/welding.
The height of flat bars at each and Dip is to be decided based on permissible depth of water (as per Para 1116(2)) at the lowest rail level in the causeway/Dip.

CHAPTER – 12

CRS SANCTION FOR WORKS AFFECTING PASSENGER RUNNING LINES

1201 References to Act/Rules –

(1) The safety of the travelling public is governed (ensured) by the Rules laid down in –

(a) *The Railways Act, 1989 (24 of 1989)* (as amended from time-to-time),

(b) *The Indian Railways (Open Lines) General Rules, 1976* (as amended from time-to-time),

(c) *The Railways (Opening for Public Carriage of Passengers) Rules, 2000* (as amended from time-to-time), and

(d) *Indian Railways Schedule of Dimensions* (as amended from time-to-time).

(2) The above documents specify the authority competent to sanction and specify the procedure for obtaining sanction for any work which affects a running line, before the work is started or brought into use or before a new section of line is opened for traffic operations.

1202 Works Requiring the Sanction of Commissioner of Railway Safety and Notice thereof –

(1) Requirement of sanction of Commissioner of Railway Safety (CRS) for works is covered under Section 23 of The Railways Act, 1989 (24 of 1989) and Chapter VII of the "The Railways (Opening for Public Carriage of Passengers) Rules, 2000". Sanction of CRS will however not be required for execution of works affecting running of trains carrying passengers and for temporary arrangements necessary for carrying it out, in case of emergency.

(2) The sanction of Commissioner of Railway Safety shall be obtained for the opening of the following works if they form part of, or are directly connected with, a railway used for the public carriage of passengers and have been constructed subsequent to the giving of a report by the Commissioner, namely –

(a) Opening of additional lines of railway and deviation lines;

(b) Opening of stations, junctions and level crossings;

(c) Re-modelling of yards and re-building of major and important bridges; and

(d) Any alteration or reconstruction materially affecting the structural character of any work.

Note: (I) Decision whether a component of work is materially affecting the structural character or not, will be taken by Chief Engineer/Construction for Construction works and by Chief Track Engineer/Chief Bridge Engineer for open line works.

(II) Further, any work which in opinion of CTE/CBE is affecting the safety of running lines will be processed for sanction of Commissioner of Railway Safety.

(3) Sanction of CRS will not be required for execution of works in respect of –

(a) Construction, rebuilding, modification and strengthening of foot-over-bridges and road-over-bridges;

(b) Construction, rebuilding, regirdering and strengthening of minor bridges;

(c) Regirdering and strengthening of all existing bridges, other than minor bridges;

(d) Elimination of manned level crossing;

(e) Upgradation of level crossing, including interlocking outside station limits;

(f) Introduction of Electric Traction;

(g) Works related to Dedicated Freight Corridor.

1203 Application for Sanction of Works –

(1) Application to Commissioner of Railway Safety for sanction for carrying out works affecting the passenger running lines should be submitted in the manner specified below –

(a) In the case of the Divisional Works, the application should be made by Senior Divisional Engineer and/or Senior Divisional Signal and Telecommunication Engineer for track, bridges, and signaling and interlocking works as the case may be. When a Junior Administrative Grade Officer does not exist on the Division in any department the Divisional Railway Manager/Additional Divisional Railway Manager should sign the application.

In case of works executed by Construction Organisation whether for Civil Engineering or Signal and Interlocking, applications will be signed by the Junior Administrative Grade Officer for Chief Engineer (Construction) and/or Chief Signal and Telecommunication Engineer (Construction) as the case may be.

(b) For Divisional works which involve both Civil Engineering and Signal and Interlocking, the application shall be signed jointly by the Junior Administrative Grade Officers of both Civil Engineering and Signal and Telecommunication Departments of the Division. In the absence of a Junior Administrative Grade Officer, the application will be signed by Divisional Railway Manager/Additional Divisional Railway Manager.

In the case of works executed by Construction Organisation, which involve both Civil Engineering and Signal and Interlocking, the application shall be signed jointly by Junior Administrative Grade officers representing Chief Engineer (Construction) and Chief Signal and Telecommunication Engineer (Construction).

(c) (i) Signaling and Interlocking works on Open Line undertaken by Railway Electrification Organisation shall be carried out as per instructions for Signaling works included in the Indian Railways Signal Engineering Manual (IRSEM). Applications to CRS for such signaling works shall be prepared, signed, and submitted by an officer, not below the rank of Senior Divisional Signal and Telecommunication Engineer or Deputy Chief Signal & Telecom Engineer. Dy.CSTE/ RE shall also countersign.

(ii) While such Signaling and Interlocking works are executed by Railway Electrification Organisation, Dy.CSTE/RE and Sr.DSTE Open Line of Division shall sign a joint certificate indicating that all Safety precautions and necessary checks as per extant instructions have been carried out for commissioning the Signaling and Telecom works.

(2) In all cases, the name and designation of the signatory should invariably be given.

1204 Documents to Accompany Applications –

(1) Documents to accompany the application are detailed in Form (**Annexure - 12/1**) and they should be complete in every respect.

(2) The officer should furnish along with his application a Track Certificate, where applicable, on Form (**Annexure - 12/2**) signed by Deputy Chief Engineer (Track) and in his absence by Chief Engineer (Track) to the effect that the track is suitable for the maximum axle loads stated therein. The certificate will be countersigned by the Chief Track Engineer/Principal Chief Engineer.

(3) For a major bridge or when special spans (designed and constructed by Zonal

Railways based on site requirement) are used, a certificate on Form (**Annexure - 12/3**) issued by Deputy Chief Engineer (Bridges) to the effect that the bridge or bridges are designed to carry the axle loads proposed to be run, should accompany the application. The bridge certificate will be countersigned by the Chief Bridge Engineer/Principal Chief Engineer.

(4) For the purpose of Forms (**Annexure - 12/2** and **12/3**),the Principal Chief Operating Manager should be consulted in regard to the types of locomotives and rolling stock to be used, their axle loads, and speeds. The rules for traffic working obtained from the Operating Department and particulars of electric block- signaling work, if any from the Signal and Telecommunication Department should accompany the application. In the case of electrified section, suitable certificate should be given by Electrical Department.

1205 Submission of Safety Certificate –

(1) The Commissioner of Railway Safety in according his sanction may or may not propose to inspect the works.

(2) If the Commissioner of Railway Safety decides to inspect the work prior to opening, he will, after inspection in the company of the officers concerned, communicate in writing his sanction to open the work.

(3) Should the Commissioner of Railway Safety decide not to inspect the work prior to opening, the Safety Certificate in Form **(Annexure - 12/4),** together with the certificates referred to therein shall be completed and submitted before the work is opened, e-mail to be sent to the Commissioner of Railway Safety, by the Engineer(s)-in-charge. Copies of Safety Certificate should be sent to the Divisional Railway Manager and Principal Chief Engineer and/or Principal Chief Signal and Telecommunication Engineer.

(4) The Safety Certificate for engineering works should be signed by the ADEN concerned and countersigned by the Divisional Engineer. If any conditional sanction is given by CRS, it should be specifically certified that the conditions as stipulated are fulfilled. If the signaling and interlocking work are involved, the Safety Certificate should be signed jointly by the officers of the Signal and Telecommunication Department also.

(5) Safety Certificate shall be dispatched to the Commissioner of Railway Safety expeditiously.

(6) When phase working is involved, a separate Safety Certificate should be issued, whenever each phase of work is completed.

1206 Deviations from Plans Approved by Commissioner of Railway Safety –

If any deviations from the plans approved by the Commissioner of Railway Safety which affect the layout of lines or the arrangement of signals or the working rules, are found necessary, his prior approval to such deviations should be obtained with reference to his sanction.

1207 Applications for Running of New Types of Locomotives and/or Rolling Stock or for Increasing Speed of Existing Locomotives and/or Rolling Stock –

Application to the Commissioner of Railway Safety for sanctioning the running of new types of locomotives or rolling stock or increasing the maximum permissible speed of existing locomotives or rolling stock on a specified section or sections, or for Double Heading/ Multiple Heading should ordinarily be made by following the procedure prescribed in Policy Circular No. 6 as amended from time to time**.**

1208 Notification to Railway Officials When Opening Works –

Except as described in **Para 1209**, no new work affecting the running of trains or the traffic working at stations should be brought into use until the staff of all departments has been notified by means of a circular notice issued by the Divisional Safety Officer/Divisional Operating Manager. Timely intimation of the date of opening of works should be sent to the Divisional Operating Manager/Divisional Safety Officer, wherever any new or revised working rules are to be brought into operation, to enable him to give the running staff due notice.

1209 Works Arising Out of Accidents Including Breaches – (*Back to **Para 1112***)

(1) An abbreviated procedure to be adopted in the case of accidents as laid down in *Section 24 of The Railways Act, 1989 (24 of 1989)* as reproduced below:

"Temporary suspension of traffic - When an accident has occurred on a railway resulting in a temporary suspension of traffic, and either the original lines of rails and works have been restored to their original standard or a temporary diversion has been laid, for the purpose of restoring communication, the original lines of rails and works so restored, or the temporary diversion, as the case may be, may, without prior inspection by the Commissioner, be opened for the public carriage of passengers, subject to the following conditions, namely:

(a) The railway servant in charge of the works undertaken by reason of the accident has certified in writing that he opening of the restored lines of rails and works, or the temporary diversion will not in his opinion be attended with danger to the public; and

(b) A notice of the opening of the lines of rails and works or the diversion shall be sent immediately to the Commissioner."

(2) A certificate on Form (**Annexure - 12/5**) which is worded in accordance with *Section 24 of The Railways Act, 1989 (24 of 1989),* must be written out and signed by representative of Engineering Department in charge of the work before opening it. This certificate shall be dispatched by quickest means to the Officers concerned followed by confirmatory copies by letter**.** The Engineering representative should hand over a copy of the certificate to the representative of the Operating Department at the site of accident; the latter will not permit the passage of traffic over the restored road or the diversion until he is in possession of the certificate.

(3) Diversions should, wherever possible, be tested by running a Material train, or light engine over them, before opening for public traffic.

(4) The Certificate to Commissioner of Railway Safety need not be sent when the line is restored through communication within 24 hours.

(5) Where the use of temporary diversion is likely to be extended for more than three days, the Commissioner of Railway Safety may if, he considers necessary take the earliest opportunity of inspecting it.

1210 Opening of New Lines –

Whenever it is proposed to open a new line for traffic, or to initiate the use of Electric Motive Power on a line already opened, or to commission a line where gauge conversion has been done- rules and procedure contained in the relevant Chapters of "*The Railways (Opening for Public Carriage of Passengers) Rule 2000* (as amended from time to time)" shall be strictly followed.

.... RAILWAY
Application for Sanction

No. .... Dated: …………..
From: ....
To,

The Commissioner of Railway Safety,
.... Circle.

Sir,

I hereby apply for your sanction to …... being commenced and opened for the public carriage of passengers, when ready.

(2) With reference to Chapter VII of the Railways (Opening for Public Carriage of Passengers) Rules, 2000, I beg to enquire whether you wish to inspect the work prior to its opening for the public carriage of passengers, in which case intimation will be given of the date of completion.

(3) In the event of your deciding not to inspect the work prior to opening, the Engineer-in-charge will, on completion of the work, submit the Safety Certificate duly signed by him, prior to the opening of the work for the public carriage of passengers and when required, also dispatch an e-mail** to your address intimating that the work has been opened and the Safety Certificate has been signed by him.

(4) The application for the use of locomotives and rolling-stock to be drawn or propelled thereby on the proposed line, in accordance with Section 22(a) of the Railways Act, 1989 (24 of 1989), is sent herewith/not required.

(5)The following documents+ are appended: –

- (1) Temporary works –
  - (a) Description of proposed works.
  - (b) Drawing of temporary works.
  - (c) List of infringements to Schedule of Dimensions.
  - (d) List of deviations from the Manuals of Instructions for Signaling and Interlocking and Block Signaling.
  - (e) List of deviations from General and Subsidiary Rules.
  - (f) Restrictions.
  - (g) Rules for Traffic Working.
  - (h) Documents for bridges as Chapter VII of the Railways (Opening for Public Carriage of Passengers) Rules, 2000.
- (2) Permanent works –
  - (a) Description of proposed works.
  - (b) Drawing of permanent works.
  - (c) List of infringements to Schedule of Dimensions.
  - (d) List of deviations from the Manuals of Instructions for Signaling and Interlocking and Block Signaling.
  - (e) List of deviations from General and Subsidiary Rules.
  - (f) Restrictions.
  - (g) Rules for Traffic Working.
  - (h) Documents for bridges as per Chapter VII of the Railways (Opening for Public Carriage of Passengers) Rules, 2000.

(6) Certified that a detailed examination of the strength and arrangement of the Materials to be used in the temporary/permanent works in above connection has been made and that the design and the materials to be used are up to the loads, which will be required to carry and that their opening for the public carriage of passengers will not be attended with any danger.
(Delete temporary or permanent work, as the case may be).

Yours faithfully,

No. ....Dated ....
From,
The Commissioner of Railway Safety,
.... Circle.
To,
The ....
.... Railway.
Sir,

Your No. ....

Sanction is accorded to the above work being carried out.

* I do not propose to inspect the work prior to its opening for the carriage of passengers. When ready, it may be opened on a Safety Certificate (vide Paragraph 3 of your letter), which should be submitted to me directly without any delay.

* I propose to inspect the work prior to its opening for the public carriage of passengers. The advice of the date when the work will be ready for inspection should be intimated at least 14 days before it is proposed to open it.

Commissioner of Railway Safety.

Note-

** Strike out Paragraph not applicable.*

$ Here enter the name of work and mention whether permanent or temporary.

*** Form e-mail – "Reference sanction No. .... dated .... Work opened for public traffic on .... The first train to pass ………………... No danger to the Public. Certificate signed".*

+ If any of the documents are not sent, "NIL" to be written against such items.

Working rules for extensive remodeling schemes may be sent in not later than one month before the date on which the work is to be brought into use and in such cases 'will follow' should be written instead of 'NIL'.

Annexure - 12/2 - Para 1204

Track Certificate

(To accompany application)

I do hereby certify that the track on section................................ (Station ……………….. to Station ....) from ....km ………………… to .... km, the * weakest portion of which consists of .... kg rails ……………… meters long each with maximum wear of ....% on.................................sleepers of density .... and minimum depth of ballast cushion below sleepers out of which .... minimum of clean ballast exists under sleepers on consolidated and stable formation is to the required strength which can safely take. …………… rolling stock (brief description)** up to .... tonnes axle load at a maximum speed of ………………………….. Kmph subject of the local speed restrictions noted below:

Sl. No.	**From Km**	**To Km**	**Between Stations**	**Nature of restriction**	**Brief reason for the restriction**

....
Deputy Chief Engineer (Track)

Countersigned by

....
Chief Track Engineer/Chief Engineer

*Note – * The weakest portion on which no speed restriction has been imposed only needs to be given.*

*** The maximum number of locomotives proposed to be coupled together for multiple operations shall be specifically mentioned.*

Annexure - 12/3 Para 1204

Bridge Certificate

(To accompany application)

1. Certified that the bridges on Section............................ (station .... to station ....) from .... km to .... km the minimum strength of superstructure being .... % of RBG/BGML/MBG/………….. standard as per Bridge Rules 1941/1964 Revised corrected up to and inclusive of .... Correction slip No. .... dated .... are safe to carry ………… (Rolling stock) not exceeding .... units (in the case of the locomotive) coupled together, at a maximum speed of ……. Kmph subject to the following restriction:

Sl. No.	**Bridge No.**	**Location Km**	**Spans and description**	**Nature of restriction**	**Brief reasons**

2. Sub-structures of all the bridges are in satisfactory condition and safe to carry the above rolling stock at the speed proposed, conforming to the provisions of the I.R.S. Sub-structure Code ……., corrected up to Correction Slip No. ………, except those that are weak and distressed which will be kept under observation with adequate speed restrictions on the same as follows:

Sl. No.	**Bridge No.**	**Location Km**	**Spans and description**	**Nature of restriction**	**Brief reasons**

……………………………………….
Dy. Chief Engineer (Bridge Design)

Countersigned by:

…………………………………………..
Chief Engineer/Chief Bridge Engineer

Safety Certificate

(When the Commissioner of Railway Safety does not inspect the work prior to opening, this certificate must be signed before opening temporary or new works)

From,

The Divisional Railway Manager / Divisional Engineer/ Divisional Signal & Telecommunication Engineer,

....Division.

To,

The Commissioner of Railway Safety,

....Circle.

Description of work ....

Reference: Chief Engineer/Divisional Railway Manager.......................

Application No. .... dated …………… . .. sanctioned under Commissioner of Railway Safety No. .... dated …… …… .. to commence and open the above work.

Following Permanent / Temporary work has been done ....

....

(1) I do hereby certify that, in the work above mentioned –

(i) The Schedule of Dimensions has not been infringed* except in regard to the items sanctioned under................................letter No. .... dated............. ....

(ii) Engineering work has been carried out in accordance with Plan No. .... *except in regard to the alterations sanctioned under...................... letter no. .... dated...............

(iii) *The weight of rails, the strength of bridges and general structural character of the works are such as have been prescribed under the rules.

(iv) The*Signaling/*Interlocking/*Block-signaling has been carried out in accordance with Signaling Plan No………and the requirements laid down in the Manuals of Instructions for the installation and maintenance of Signaling, Interlocking and *Block-signaling apparatus have been fully complied with *except in regard to the items sanctioned under letter No. .... dated..

(v) The work has been carried out in accordance with the documents already supplied.

(2) A certificate from the Divisional Operating Manager/Divisional Safety Officer stating that the necessary working rules have been issued and giving reference in regard to sanction to deviation (if any) from General and Subsidiary Rules is attached/not required.

(3) I hereby certify that on the..., I have carefully inspected (and tested +) the above work and that I have satisfied myself that it has been properly completed (and is in good working order +) and that the work can be opened for the public carriage of passengers without endangering the safety of the travelling public or the employees of the Railway, *subject to the following speed restrictions: –

Temporary.. Kmph due to ....

Permanent.. Kmph due to ....

(4) The work is being opened on...

Assistant Divisional Engineer Dated	Countersigned by .... Dated...................................
Assistant Signal & Telecommunication Engineer Dated	Countersigned by …………………………… Dated...................................
Assistant Bridge Engineer Dated	Countersigned by .... Dated...................................

No.. Dated........................

Copy forwarded to .... for information.

*Note – * To be scored out if not applicable.*

+ Necessary in case of Signaling and Interlocking work only.

Annexure - 12/5 - Para 1209

Certificate in connection with Restoration of Through Running after Accidents.

Commissioner of Railway Safety .... ,

Copy - Chief Engineer, Chief Signal and Telecommunication Engineer, Chief Operating Manager, Divisional Railway Manager, Divisional Engineer, Divisional Operating Manager, Divisional Signal and Telecommunication Engineer, Station Masters.

Station Master's .... All concerned Message No. .... dated .... line and works restored to working order/temporary Diversion laid. Certificate signed. Work being opened to traffic without danger to public or goods, subject to a speed restriction of .... Kmph.

....

Engineer-in-charge.

CHAPTER – 13

TRACK MANAGEMENT SYSTEM

1301 **General -** Track Management System (TMS), is a web-based IT application, using internet as the communication backbone for effective communication among the various users, facilitating 24x7 availability of information such as track assets, inspection records, testing and recording details, maintenance details and managerial outputs etc.

1302 **Modular Structure -** TMS software has been developed in a modular fashion in such a way that modules developed in future can be easily integrated into it. Master data of section details, various components of track structure e.g. rail, sleepers, fastenings, ballast, formation, gradient, special features like points and crossings, level crossings, bridges, LWR etc. have been entered into the system. Data on condition of various components are also stored and updated by various manual and mechanized inspections, work data and asset change data. Data are fed into TMS using various tabs in the portal. Some of the more common tabs are discussed as under :

(1) Asset Tab - allows the user to input track asset details which include rail, sleeper, fastening, weld, joint, blanket/ballast, formation, catch water drain, longitudinal drain, switches, switch expansion joint, long welded rail, bridge, level crossing etc. The identification of left and right rail shall be in the direction of increasing kilometer irrespective of direction of traffic.

(2) Inspection Tab – permits user to record inspections of track geometry, track components and track features. All manual (including USFD) and machine-based inspections can be fed into TMS through this function.

(3) Planning Tab – permits the user to plan the inspection schedule and track maintenance.

(4) Work Tab – Locations needing inspection/attention provide a tool to the user to assign resources (man & machine) and report compliance. Details of gang work, special works and machine works, asset change details etc. are entered through this module.

(5) Miscellaneous Tab – Message centre, circulars, inspection notes etc. are entered through this module.

(6) Store Module – This module facilitates the maintenance of ledgers for issue, receipt and accountal of various types of P.Way Material.

(7) Report tab gives the user, opportunity to take out various standard as well as analytical reports such as Track Diagram, TRC, OMS results, Track asset details, USFD defects, welding performance analysis, inspection records, track component condition details and track asset details. Results and various analysis of Track Recording Cars and Oscillation Monitoring Systems are also available.

1303 **Integration with TRC and OMS -** TMS also facilitates uploading of mechanised recording done by machines such as Track Recording Car (TRC), Oscillation Monitoring System (OMS) and analysis thereof. TMS system provides various alerts in the form of SMS, email, application home page alerts etc. to end users for maintaining the track geometry and adhering to their inspection schedules.

1304 Security Features of TMS - It is pertinent to note that the access to the TMS software is based on username and password-based authentication method. Thus, the role of System Administrator in assigning the various roles to the individual user is very vital. Further, the access to various modules is custom designed for the various functionalities of different users. Thus, users such as Divisional Engineering Control, JE/SSE/P.Way (USFD), Divisional Administrators (TMS), Senior Officers of the Division, Headquarters and officers of track machine organization have customized user interfaces to enable effective use of the TMS modules. Accordingly, various analytical/managerial reports are available for Divisional users, Head Quarter users and Railway Board for planning and decision-making.

1305 Single Source of Information Management - TMS system is a single source of information management pertaining to Permanent Way for various relevant documents such as Railway Board Circulars, Zonal Circulars, Important Instructions and letters etc. These are being uploaded by designated officials and are being used by all concerned in the hierarchy.

1306 Utilization of TMS:

a) Elimination of manual record keeping.

b) Effective monitoring of inspections & follow-ups.

c) Improved transparency at every level.

d) Proactive maintenance actions possible using Data.

e) Better inventory management control.

f) Optimum resource utilization is possible.

g) Prioritization of works is feasible.

h) Holistic planning at Zonal/Divisional level for fixing priorities of maintenance works.

i) Quick access to information.

j) Anywhere anytime access through web-based application.

k) Complete data is available through single window.

l) Automated alerts, e-mails & SMSs for inspection due/overdue etc.

1307 Withdrawal of Registers -

Due to the implementation of TMS, the following registers have been withdrawn and replaced by the TMS module.

a) Curve Inspection Registers.

b) Points and Crossing Registers. (Joint P&C inspection register with S&T to continue but inspection of this register to be entered in TMS by JE/SSE/P.Way).

c) Level Crossing Registers

d) LWR Registers.

e) Welding Registers.

f) Rail / Weld Failure Registers.

g) Toe Load Measuring Registers.

h) Push Trolley / Footplate / Rear window inspection Registers. (Footplate inspection booklet of JE/SSE/P.Way/ ADEN / DEN / Sr. DEN is to be maintained but entry to be made in TMS by respective officials.)

i) Rail / Sleeper / fastening / Ballast inspection Registers.

j) Sand hump Registers

k) Gap Survey Registers.

l) USFD Registers.

m) TRC Registers.

n) OMS Registers.

o) Track Diagrams.

Note: - (i) The list extends to all the aforesaid P.Way Maintenance Registers excluding Material handling and Bridge Registers. The old manual registers closed as above should be preserved in ADEN's office.

(ii) Section register, Gang chart and Gang diary shall continue to be maintained in physical form.

1308 Administrators in TMS – The users who are authorized to create, edit or delete users and also to create jurisdictions for various users along with various other works such as:

a) Railway Board TMS Administrator - Railway Board Administrator is authorized to define sections, routes, stations, line and material master, etc.

b) Railway Board Security Administrator - Security Administrator in Railway Board is authorised to create new users (Board Level), update users' profile, reset password, upload circulars and important letters

c) Zonal Security Administrator - Security Administrator in Zonal Railways is authorised to create new users (Zone Level), update users' profile, reset password, and upload circulars and important letters

d) Zonal TMS Administrator - TMS Administrator in Zonal Railways is authorised to enter Engine Run Section, Traffic Control Section, Tamping Frequency, Upload RAW Manual, System Map, define Special Routes (e.g. Golden Quadrilateral & D route, major coal route, etc.).

e) Divisional Security Administrator - Divisional Security Administrator is authorised to create role, new users, update users' profile, reset password, role transfer, provide jurisdiction and maintain details of gangs Departmental as well as Pvt. Agency, creation of agency, Certification of USFD Machines, Flash butt welding plants, etc.

f) Divisional TMS Administrator - Divisional Administrator is authorised to fill the various details which are of the common interest such as details of Stations, Sections, Loop Line, Supplier, Master Code, USFD Team, USFD Machine, Special Works, GMT , Gradient, PSR, etc.

g) Store Administrator - Store Administrator performs verification of Scrap, Assigning of ART, scale of Material for SSE/P.Way, etc.

h) TRC Administrator - TRC Administrator performs Uploading of TRC and OMS recordings along with TRC Extraction, TRC Bifurcation, OMS Extraction, OMS Bifurcation

i) TWTC: Various activities related to Certification of welders by the Thermit Welding Training Centre (TWTC).

CHAPTER – 14

TRAINING, COMPETENCY & REFERENCES

1401 Types of Training Courses – Permanent Way staff need to be trained for their job both through theoretical class room training and practical work at site using the tools and equipment of the particular trade. Use of audio video aides is desirable for better understanding of the subject. Training is a continuous process right from the time of recruitment. Following four types of training courses should be organized in the Training Institutes run by the Railway Administration:

(1) Initial/Induction/Basic Courses.

(2) Promotional Courses.

(3) Refresher Courses.

(4) Special Courses.

The duration for various courses for above training is listed in ***Annexure - 14/1***.

1402 Initial /Induction Courses –

(1) General – Initial and induction Courses are for new entrants. It is meant for directly recruited categories such as Track Maintainers and Apprentice JE/SSE/P.Way. The syllabi and the training program for the initial course should be drawn up by the Railway Administration and circulated to all zonal/ divisional training institutes.

(2) Induction Course for Track Maintainers – This course will be held at the Divisional Training Centre under the direction of a JE/SSE/P.Way. It should include introduction to the working of the Department in general and to the gang work in particular in a clear and simple manner.

(3) Initial/ Induction Course for Apprentice JE/SSE/P.Way –

(a) This course should be held at the Zonal Railway Training Institute. The course content should include class room lectures, field demonstrations and practical training.

(b) The Class Room lectures should include –

(i) General working of the Railways and Organization of various Departments. All establishment matters including extant rules and various Acts.

(ii) Permanent Way – Organization and distribution of Permanent Way staff, Methods and systems, works incidental to maintenance, rails and rail joints, sleepers and fastenings, ballast, formation, maintenance in electrified and track circuited areas, permanent way renewals, maintenance and laying of curved track, inspection systems and speed indicators, patrolling during monsoon and emergency, pre- monsoon precautions, action to be taken during accidents and breaches, level crossings, working of trollies, motor trollies and lorries, laying and maintenance of SWR and LWR/CWR, maintenance of high speed routes, points and crossings and layouts, maintenance of tools and other common equipment in use and details of Track Structure.

(iii) Transportation **–** General Rules, fixed and detonating signals, various systems of train working and signaling, failure of communication on single, double and multiple lines.

(iv) Office work – Accountal of stores and Permanent Way materials, imprest, Tools and Plants, stock verification, classification and disposal of surplus material and materials at site Account through TMS (store) Module.

(c) Practical Training – Practical training shall include visits to various sites open line and construction site where Permanent Way maintenance/Construction work is being done.

(4) Training shall be given to permanent way staff as prescribed in Training Manual. Gang Mate/Keyman shall be given competency certificate by Divisional Training Centre before deputing them on LWR/CWR sections. The competency certificate shall be valid for five years from the date of issue. In exceptional cases, competency certificate can be given by ADEN by duly examining his level of competence. Such a competency certificate will be valid for a period of one year.

1403 **Promotional Courses** – The course for promotional training will be necessary in the case of staff promoted from a lower to a higher status by a process of selection. The promotional training courses should undergo by the employees immediately after the promotion at the first available opportunity and is applicable in the following cases:

(1) Promotion from Track Maintainer/Gateman to work as Keymen/Gang Mates: This Basic/Promotional Training should be held at the Divisional Training Centers.

(2) Promotion from Track Maintainer to JE/P.Way: This promotional course should be held at the Zonal Railway Training Institute.

(3) Promotion from JE/P.Way to SSE/P.Way: This course should be held at the Zonal Railway Training Institute.

1404 **Refresher Courses –** It will be necessary to conduct Refresher Courses to enable the staff to keep themselves abreast with the latest rules and techniques. Keymen, Gang Mates, and JE/SSE/P.Way should be sent for Refresher Courses once in five years. In the Refresher Courses, all subjects pertaining to the concerned categories shall be covered as enumerated under promotional courses but the extent of coverage will be on a limited scale.

1405 **Special Courses** – In addition to the regular courses mentioned above, special courses on any of the following subjects should also be arranged periodically to increase a sense of awareness of the staff on these subjects – Rail Wheel Interaction & derailment, Geotechnical Investigation, Survey, USFD, AT & FB welding, Mechanized Maintenance, Points & Crossings, Curves, High Speed Track, Track Recording, TMS including Store Modules :

It is desirable that the staff posted for the maintenance of welded track or posted on sections maintained by Machines, should be given a special training on the relevant subjects pertaining to their duties in a short course arranged before they are posted in these areas.

Training Module for Non-Gazetted staff of Civil Engineering Department as circulated by Railway Board shall be followed.

1406 **Certificate of Competency – (***Back to* ***Para 822, 912*****)** In order to ensure safe working & proper output, a qualified person shall be appointed. Such qualified person shall be responsible for supervising Track works and its proper protection. The qualified person shall hold a certificate of competency, which shall be issued according to prescribed instructions. Staff in whose favor a certificate is issued should be literate, having knowledge of Hindi or other local language, should have passed the prescribed Medical test. The certificate of competency will be issued for a specified period, by an authorized officer, and renewed periodically. Categories of staff competent to supervise and execute the works are listed in ***Annexure - 14/2***.

1407 **Training and Certification of welders-**

(1) Certification of Welders of Approved portion manufacturing firms and labour contracting firms shall be done by RDSO as per provisions of ***"****Indian Railway Standard Specification for Fusion Welding of Rails by the Alumino-Thermic process****"***.

(2) Training and certification of Departmental welders and supervisors shall be done by Thermit Portion Plant (TPP), Northern Railway, Lucknow and Thermit Welding Centre (TWC), Vijayawada as per procedure for certification given in **Annexure - 1 of "***Manual for Fusion Welding of Rails by The Alumino-Thermic process*".

1408 **Category of Medical Examination –** In order to secure continuous effective service and to ensure that one shall not possesses any disease, unfitting him or likely to unfit him for that Service, Regular medical examination of railway staff should be done.

Following different Medical category, based upon the nature of work and responsibility for P.Way Non Gazetted staff as prescribed in **Chapter V** of *Medical Manual* is reproduced as under -

(1) Group A: Vision tests required in the interest of public safety. Categorized as A-1 to A-3.

(2) Group B: Vision tests required in the interest of the employee himself or his fellow workers or both. Categorized as B-1 & B-2.

(3) Group C: Vision tests required in the interest of administration only. Categorized as C-1 & C-2.

Frequency and Standard of medical test shall be qualified by P.Way staff during their service as listed in ***Annexure - 14/3***. Authorized Medical Examiner for these tests shall be DMO and above.

1409 **Books of Reference –** Books of reference listed in ***Annexure - 14/4*** and other publications from RDSO and IRICEN/Pune including Technical Monograms considered essential, should be supplied to the officers and the JE/SSE/P.Way of each Division.

The Chief Engineers' and the Divisional Engineers' Offices should make arrangement to ensure circulars and instructions are available in TMS and/or at Zonal web site as a separate tab on Engineering department page.

Various Training and Duration					
SN.	**Category**	**Type of Training**	**Place of Training Duration**	**Duration**	**Frequency/Remarks**
1	JE/SSE/P.Way	Induction (For new recruits posted in Railway	Training in Zonal Training Institute (Training Institute-6 month in field- 6 month)	1 year	Once on joining Railway service /Promotion through LDCE from P.Way category
2	SSE/P.Way	Promotion	Training in Zonal Training Institute	17 days (3 weeks)	Once on Promotion from JE
3	JE/SSE/P.Way	Refresher	Training in Zonal Training Institute / Training in Centralized Training Institute	17 days (3 weeks)	Once in five year
4	Gang Mate	Promotion	Training in Divisional Training Institute	18 days	Once on promotion from Keyman to Mate or from track maintainer to key man
5	Keyman	Basic			
6	Gang Mate/Keyman	Refresher		6 Days	Once in five year
7	Gateman	Induction		12 Days	For new recruits
8	Gateman	Induction		6 days	For gateman picked up from track maintainer capacity
9	Gateman	Refresher		6 Days	Once in five year
10	Track Maintainer	Induction		30 Days	Once on joining Railway
11	Track Maintainer	Refresher		6 Days	Once in five year
12	JE/SSE/USFD	Initial	Training at RDSO	4 weeks	Once selected for USFD testing
13	JE/SSE/USFD	Refresher	Training at RDSO/IRICEN	1 week	First refresher after three year. Thereafter once in five year
14	Welder (AT)	Initial	Training in TPP/LKO & TWC/Vijayawada	2 weeks	Once on selection as Welder
15	Welder (AT)	Refresher		1 week	Once in Two years
16	JE/SSE (Welding supervisor)	Initial		1 week	One time in service

Annexure - 14/2 ***Para 344, 1406***

List of Functionaries Authorise to Issue Competency Certificate for Various Track Activities.

SN	Nature of Activity /Work	Lowest Authorized Level of Supervision	Functionaries Authorized to Issue Competency / Permission for Work. (Minimum Level)
1	To carry out Maintenance work under their personal supervision in LWR/CWR for following works 1. Renewal of fastenings not requiring lifting. 2. Emergency repairs to Rail fracture 3. Inspection and Checking of SEJ, oiling and greasing and re-tightening /renewal of fittings once a fortnight.	Keyman	Divisional Training centre. (Valid for 5 years from the date of issue) In exceptional cases, by ADEN for one year as per **Para 1402 (3) (c)**.
2	(a) Hot weather patrolling (b) Cold weather patrolling Protection of track and secure safety of trains in case of buckling, rail fractures, or any abnormal behavior of track. (c) Any other Patrolling (d) For passing of train in emergency at rail/weld fracture site.	Patrolman (Railway Employee)	SSE/P.Way (Overall In-charge) (Experienced and trust worthy men from the Permanent Gang to work as patrolman/Watchman.)
3	Carrying out various activities in connection with maintenance of track as given in relevant chapters of this manual.	JE/P.Way	Subject to passing of Initial/Refresher/ Promotional courses
4	To use Trolley /Lorry/Dolly To Use Trolley/Lorry To use Motor trolley	Gang Mate / Head Trolleyman / Motor Trolley Driver	ADEN (Valid for Two years)
5	To work as Gateman	Gateman / Trackman	SSE/P.Way (In-charge)/ Divisional Training Centre (Valid for 5 Years)
6	To use of trolley/ Motor Trolley/ Lorries	JE/SSE/P.Way	Senior Scale officer, (Valid for Two years)
7	To Supervise AT welding.	JE/SSE/P.Way	TPP/Lucknow or TWC/ Vijayawada (after satisfactory completion of TW3 course)
8	To execute AT weld (Provisional Certificate)	Departmental AT Welder	TPP/Lucknow or TWC/ Vijayawada (TW1 competency valid for executing 100 joint or 6 months whichever is earlier)
9	To execute AT weld (Regular Competency Certificate for departmental welding.	Departmental AT Welder	TPP/Lucknow or TWC/ Vijayawada (after satisfactory completion of TW2 course with validity up to 2 years and after two year reassessment valid for next 2 year.)
10	Provisional Competency certificate for welder of private firm.	Contractor/ Firm AT Welder	M&C Directorate of RDSO (Valid for 2 years)
11	Regular Competency Certificate for Welder of private firm.	Contractor/ Firm Welder	M&C Directorate of RDSO (Valid for 5 years)
12	Supervision of FB Welding (Min Diploma in Mech/Elect Engg. Or BSc duly passing test as per Flash Butt welding manual provision)	Departmental/Firm FB welding supervisor	CTE/CE(con)

13	Welder for FB welding (Min class X or equivalent duly passing test as per Flash Butt welding manual provision)	Departmental/Firm FB welders	CTE/CE(con)
14	Supervision of FB Welding of Railway PSU / Metro (Min Diploma in Mech/Elect Engg. Or BSc duly passing test as per Flash Butt welding manual provision)	Railway PSU / Metro/Firm FB welding supervisor	CTE
15	Welder for FB welding of Railway PSU / Metro (Min class X or equivalent duly passing test as per Flash Butt welding manual provision)	Railway PSU / Metro/Firm FB welders	CTE
16	USFD operator of departmental USFD machines (Initial certification)	Departmental USFD Operator	M&C Directorate of RDSO (Valid for 3 years)
17	USFD operator of departmental USFD machines (Subsequent certification.)	Departmental USFD Operator	M&C Directorate of RDSO (Valid for 5 years)
18	USFD operator of contracted USFD machines (Provisional certificate)	USFD Testing by contractor operator	M&C Directorate of RDSO (Valid for 6 months)
19	USFD operator of contracted USFD machines (Regular Certificate)	USFD Testing by contractor operator	M&C Directorate of RDSO (Valid for 2 Years)
20	Quality Control in charge for outsourcing of USFD	Quality control In-charge by contractor	M&C Directorate of RDSO (Valid for 3 Years)

Annexure - 14/3 ***Para 1408***

Medical Examination Standard

SN.	Category	Visual standards	Validity/ Periodical medical exam (PME)
1	JE/SSE/P.Way	A-3	Every four years till 45 yrs. and then every two years till 55 yrs. and thereafter annually till retirement.
2	Gateman		
3	Trolleyman		
4	Gang Mate, Keyman, Track Maintainer.	B-1	On attaining the age of 45 yrs. and there after every 5 yrs.
5	Safaiwala, Watchman	C-2	No PME

Annexure - 14/4 ***Para 1409***

Item No.	Publications	Offices, which should be equipped with a copy of the publication			
		For the personal use of such officers and inspectors as may be prescribed	Divisional Engineer's office	Assistant Divisional Engineer's office	JE/SSE/ P.Way's office
1	Act- Indian Railways	...	1	1	1
2	Code- Indian Railway for the Engineering Department.	...	1	1	1
3	Indian Railway Permanent Way Manual	1	1	1	1
4	Indian Railway Works Manual	1	1	1	1
5	Indian Railway Bridge Manual	1	1	1	1
6	Manual- Accident & Circulars pertaining to Accidents.	1	1	1	1
7	Rules for the opening of a Railway for the public carriage of passengers.	...	1	...	...
8	Rules- General and Subsidiary, Parts I & II	1	1	1	1
9	Schedule of Dimensions	1	1	1	1
10	Standing Orders-Engineering Department	1	1	1	1
11	Working Time Table and Appendix thereto	1	1	1	1
12	Manual of instructions for fabrication, installation and maintenance of glued insulated rail joints.		1	1	1
13	Manual for Flash Butt Welding of Rails		1	1	1
14	Manual for Fusion Welding of Rails by the Alumino-Thermic process		1	1	1
15	Small Track Machine Manual		1	1	1
16	Track Machine Manual		1	1	1
17	Manual for ultrasonic testing of rails and welds		1	1	1
18	Guidelines for handling and stacking of rails (No. CT-35)		1	1	1

CHAPTER – 15

EMERGING TRACK TECHNOLOGY ITEMS

1501 **Canted Turnouts –** Canted turnouts provide better riding quality, increased service life and enhanced safety.

Canted Turnouts may be procured on the basis of design / Functional Requirements and Specifications approved by RDSO.

1502 **Modern Sleeper & Fastening System –** In modern rail networks, Railway track is dealt as a system i.e., all the components of fastenings are designed, developed and procured together thereby improving overall tolerances of fastening system. In addition, the modern fastening system effectively addresses the problems associated with the present fastening system such as liner biting corrosion, jamming and loosening of Elastic Rail Clips, crushing of Rail pads etc. Modern Fastening Systems are often complemented with Fully Automated sleeper plants to improve quality through lesser human intervention. The Production of sleepers and their machine-based inspections are integrated which results into better tolerances. Modern fastenings factory fitted on the sleepers in parked condition can be supplied from the Concrete Sleeper Plants. Modern fastening system and automated sleeper manufacturing plants should progressively be used for better quality control and higher track standards.

1503 **Ballastless Track System (BLT) –** It is desirable to provide Ballastless track in Tunnels/Viaducts/Station Yards/formation in cuttings due to lesser maintenance efforts and economical life cycle costs.

BLT should be constructed as per RDSO approved "Technical eligibility and Special Conditions of Contract for Design and Construction of Ballastless track for Indian Railway".

1504 **In-sleeper Point Machine –** In-sleeper point machines are designed in such a way that the point machine and other gears are completely housed in a shell which serves as sleeper. There is no need of disconnection and removal of point machines from the track for tamping of turnouts where In-Sleeper point machines are provided. RDSO approved In-Sleeper point machine may be used in place of ordinary point machine to ensure seamless tamping and improved maintenance.

1505 **Composite Sleepers –** Due to non-availability of bridge timbers, Steel Channel/ H-Beam sleepers have been provided on steel girder bridges. However, search for a material as versatile as wood is on for a long time to avoid problems of maintenance and fitment with Steel Channel / H-Beam Sleepers. Composite Sleeper is an eco-friendly option having potential of a suitable substitute for the bridge timber. RDSO approved composite sleepers may be used at special locations.

1506 **Phased Array Ultrasonic Testing (PAUT) –**

PAUT is an advanced non-destructive ultrasonic technique that permits the shaping and steering of the ultrasonic beam angles and enhanced beam coverage. The Phased Array beam sweeps across the entire section of the rail/weld, resulting in a recordable image that reveals defects hidden inside a rail or weld. Phased Array has advantages over conventional ultrasonic, since it shows defect representation in A-Scan, B-Scan, C-Scan and S-Scan that can produce more accurate results and provide a higher level of reproducible results which minimises human error. PAUT technology as approved by RDSO may be used for testing of rails/welds.

1507 High Performance Rail Clamp –

High Performance Rail Clamps are being used in many railway systems to expedite relaxation of the speed restriction on the discontinuities of the track (rail flaw/weld flaw/rail fracture/weld fracture). RDSO approved High Performance Rail Clamps may be used for permitting speeds of 50 kmph and higher on track discontinuities.

1508 Rail Inspection Vehicle (RIV) is a self-propelled vehicle borne Rail Head Inspection and Analysis System for use on the tracks. The self-propelled Rail Inspection Vehicle (RIV) can be installed with Rail Head Profile Inspection & Analysis System to facilitate advance digital inspection of rails for selection of an optimum rail grinding program.

1509 Milling of Rail – Rail milling machine is meant to improve the worn profile of rail head to remove fatigued material having micro cracks of more than 0.3 mm size & other surface defects on the rail head.

1510 Replacement of existing system of inspection – In order to carry officials for inspection a Self-Propelled **Rail-cum-Road Inspection Vehicle (RCRIV)** may be used to replace existing manual push trolley in phased manner. It is capable of facilitating safe travel on electrified/non-electrified section.

1511 Advancement in Rails –

New rail grades of 60E1 profile, R260, R260NC & R350HT have been developed comparable to global standards to meet the requirements of high speed and high axle load on IR network and to align with best international practices in rail manufacturing.

R260 rail has better mechanical properties as compared to 880 grade rail.

R260NC (NCC – Nickel Chromium Copper) grade rail has been developed to resist severe corrosive environment in costal and industrial regions. Mechanical properties of R260NC rails are similar to that of R260 grade rails.

R350HT is heat treated rail suitable for higher axle load.

1512 Portable track geometry measurement system for Point & Crossing –

In order to reduce manual measurement system for Point & Crossing, Portable track geometry measurement System for Point & Crossing can be used. It will progressively replace the existing system of manual measurement. After introduction of this system, magnitude of errors in parameters measured manually will be reduced. This will also result in time saving in measurement & reduction in manpower deployed in the work.

1513 Ground Penetration Radar (GPR) –

Ground Penetration Radar (GPR) survey is a non-invasive method that uses high frequency radio waves, yielding data with very high resolution in a short amount of time which can be utilized for assessing the ballast health and condition of railway track bed. The GPR system will be mounted on a dedicated vehicle and shall be deployed for scanning of ballast and top layer of formation of IR. GPR Survey will help in assessment of the clean/fouling condition of ballast, locations of bad formation etc. which will help in scientific and rational planning of deep screening of ballast and formation rehabilitation etc.

1514 Unattended track inspection system (UTIS) on Smart loco –

Smart Loco is an onboard monitoring system, installed on Locomotive to monitor the health of various vital components of Loco and report it to a base station on real time basis and generate alerts. Unattended track inspection system (UTIS) can be mounted on Smart locomotive for assessing the track health including condition monitoring of track components, generating alerts and facilitate predictive maintenance of Railway Track on dedicated routes on Indian Railways. The unattended track inspection system may have following sub-systems;

(a) Line scan video inspection system for condition monitoring of track components.

(b) Measurement of acceleration at axle box level

(c) System for drivers view video recording.

1515 Vehicular Ultrasonic system for rail testing –

The vehicular Ultrasonic test system can either be Rail Bound or Rail Cum Road type self-propelled vehicle. Self-Propelled Ultrasonic Rail Testing (SPURT) Car is rail bound vehicle equipped with advanced USFD system for detection of internal defects in rails/welds.

(a) Rail cum Road Vehicle Ultrasonic System (RCRV)

At present pedestrian Ultrasonic Flaw Detection system (SRT/DRT) is being used for detection of internal defects in Rails/Welds which is slow and subjective and depends on the expertise of the operator. With the increase in speed & frequency of trains, moving on track for this testing has become difficult.

A Rail cum Road Vehicle (RCRV) fitted with Ultrasonic Flaw Detection System is a versatile vehicle used for ultrasonic testing of rails/welds. RCRV is capable of running on road as well as on track. The design Speed of the vehicle on track is about 80 kmph in transit and 40 kmph in testing mode. RCRV fitted with USFD testing System is in under development stage for Indian Railway network. The sophisticated software used in RCRV based vehicular USFD system captures, filters and analyses the testing data to produce a list of suspected defects along with their location. Confirmatory testing of the suspected defect locations is carried out using manual USFD testing system.

(b) Self-Propelled Ultrasonic Rail Testing Car (SPURT Car)

SPURT Car is capable of testing at 40 kmph. The software used in SPURT Car captures, filters and analyses the testing data to produce a list of suspected defects along with their location. Confirmatory testing of the suspected defect locations is carried out using manual USFD testing system.

Self-propelled, high-speed ultrasonic testing vehicles offer a modern solution to the limitations of the manual USFD system on the Indian Railway network.

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