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भारत सरकार
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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

लम्बी वेल्डित रेलों की अनुदेश नियमावली

MANUAL OF INSTRUCTIONS ON LONG WELDED RAILS

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MANUAL OF INSTRUCTIONS ON LONG WELDED RAILS 1996

(SECOND REPRINT)

INTRODUCTION

"Manual of Instructions on Long Welded Rails" was issued in 1979. This Manual contained instructions for the installation and maintenance of Long Welded Rails (LWR) and Continuous Welded Rails (CWR) on Indian Railways.

The Revised Manual issued in 1996 incorporated all the correction slips issued to the Manual of 1979 and also changes required due to use of 60kg rails, adoption of Alumino Thermic (SKV process)/Mobile Gas Pressure/Flash Butt welding, mechanized maintenance & adoption of Indian Railways Permanent Way Manual (IRPWM) in place of Indian Railways Way and Works Manual (IRWWM) etc.

To date, eight correction slips have been issued to the Revised Manual. This Manual is the second reprint of the Manual issued in 1996 and incorporates all these correction slips. This Manual shall have the same authority as IRPWM. The Chief Engineers may issue supplementary instructions from time to time to suit local working conditions.

The recommendations in the Manual have been framed for use of standard sleepers and fastenings already approved. Any other type of sleepers and fastenings may be used in LWR/CWR only after the same are approved or specifically authorized by the Chief Engineer.

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MANUAL OF INSTRUCTIONS ON LONG WELDED RAILS

1. DEFINITIONS

1.1 **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 greater than 250 metre on Broad Gauge (BG) and 500 metre on Metre Gauge (MG) will normally function as LWR (Fig. 1.1). The maximum length of LWR under Indian conditions shall normally be restricted to one block section.

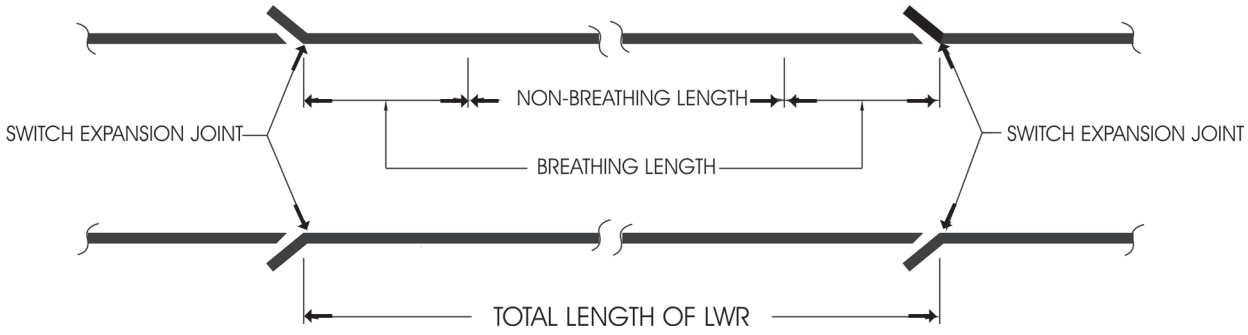

Fig. 1.1: LONG WELDED RAILS

1.2 **Continuous Welded Rail (CWR)** is a LWR which would continue through station yards including points and crossings.

1.3 **Short Welded Rail (SWR)** is a welded rail, which contracts and expands throughout its length.

Note: *Normally the length of SWR is 3 x 13 metre for BG and 3 x 12 metre for MG. Provisions for laying and maintenance of SWR are contained in Chapter V, Part 'B' of Indian Railways Permanent Way Manual (IRPWM).*

1.4 **Breathing Length** is that length at each end of LWR/CWR, which is subjected to expansion/contraction on account of temperature variations. Usual breathing lengths in BG and MG for different types of track structures and for different temperature zones, as laid down in para 1.7, are shown in Annexure - I A, I B and I C.

1.5 **Switch Expansion Joint (SEJ)** is an expansion joint installed at each end of LWR/CWR to permit expansion/contraction of the adjoining breathing lengths due to temperature variations (Fig. 1.1).

1.6 **Buffer Rails** are, a set of rails provided in lieu of SEJ at the ends of LWR/CWR to allow expansion/contraction of adjoining breathing lengths due to temperature variations. These will be laid with prior approval of Chief Engineer at locations where provision of SEJ is not permitted. Buffer rails may also be temporarily laid to facilitate maintenance/renewal operations.

1.7 **Rail Temperature** is the temperature of the rail at site as recorded by an approved type of rail thermometer as laid down in para 2.1. This is different from ambient temperature which is the temperature of air in shade at the same place.

Note: *Tracks on Indian Railways have been divided into four rail temperature zones as shown in the "Map of India showing Rail Temperature Zones" at Fig. 1.7.*

1.8 **Mean Rail Temperature (t_m)** for a section, is the average of the maximum and minimum rail temperatures recorded for the section.

1.9 **Destressing** is the operation undertaken with or without rail tensor to secure stress-free conditions in the LWR/CWR at the desired/specified rail temperature.

1.10 **Installation Temperature (t_i)** is the average rail temperature during the process of fastening the rails to the sleepers at the time of installation of the LWR/CWR.

1.11 **Destressing Temperature (t_d)** is the average rail temperature during the period of fastening the rails to the sleepers after destressing LWR without the use of rail tensor. If rail tensor is used, t_d for all practical purposes is equal to t_o as defined in para 1.13. Range of t_d or t_o shall be within the limits of rail temperature shown below:-

a) Temperature Zone - I, II, III

Rail Section	Range
All sections	t_m *to* $t_m + 5^0C$

b) Temperature Zone - IV

Rail Section	Range
i) 52kg & heavier	t_m+5^0C *to* t_m+10^0C
ii) Others	t_m *to* t_m+5^0C

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1.1.2 **Prevailing Rail Temperature (t_p)** is the rail temperature prevailing at the time when any operation connected with destressing is carried out.

1.13 **Stress-free Temperature (t_o)** is the rail temperature at which the rail is free of thermal stress. When tensors are utilised for the destressing operation the work has to be carried out at t_p, which shall be lower than stress-free temperature. The extension to be applied by the tensor shall be calculated from the following formula:-

Extension = L α (t_o - t_p)

where 'L' is the length of segment of the rail to which the extension is applied and 'α' is the coefficient of linear expansion of rail steel.

1.14 **Rail Tensor** is a hydraulic or mechanical device used for stretching the rail physically.

1.15 **Anchor Length (l_a)** is the length of track required to resist the pull exerted on rails by the rail tensor at temperature t_p. For practical purposes, this may be taken as equal to 2.5 metre per degree celsius of (t_o - t_p) for BG and 4.5 metre per degree celsius of (t_o - t_p) for MG.

1.16 **Hot Weather Patrol** is the patrol carried out when the rail temperature exceeds:

(i) **Td + 25 deg C on PSC sleeper track with sleeper density 1540 nos. Per km and above.**

(ii) **Td + 20 deg C on PSC sleeper track with sleeper density less than 1540 nos. Per km and track other than PSC sleeper.**

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1.17 **Cold Weather Patrol** is the patrol carried out during cold months of the year in specified sections as per instructions of Chief Engineer.

1.18 **Consolidation of Track** is the process of building up ballast resistance to the tendency of movement of sleeper either initially before laying LWR or making up subsequent loss of resistance by anyone of the following:-

i) For track structures consisting of sleepers other than concrete sleepers -

a) Passage of at least 3,00,000 gross tonnes of traffic on BG or at least 1,00,000 gross tonnes of traffic on MG when compaction of ballast is done using hand operated compactors/consolidators or rammers.

b) Passage of at least 50,000 gross tonnes of traffic on BG or at least 20,000 gross tonnes of traffic on MG or a period of two days, whichever is later, when compaction is done by means of mechanised shoulder and crib compactor.

ii) For the track structure consisting of concrete sleepers, passage of at least 50,000 gross tonnes of traffic on BG or at least 20,000 gross tonnes of traffic on MG or a period of two days whichever is later.

iii) Atleast one round of stabilisation by Dynamic Track Stabiliser (DTS).

iv) For newly laid LWR/CWR, at least three rounds of packing, last two of which should be with on-track tamping machines.

1.19 The term **'Chief Engineer'** includes **'Chief Track Engineer'** on Railways where latter post exists.

2. MEASUREMENT OF RAIL TEMPERATURE

2.1 THERMOMETER

2.1.1 The following are the types of approved thermometers for measuring rail temperature:-

i) Embedded type - This is an ordinary thermometer inserted in a cavity formed in a piece of rail-head, 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.

ii) 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 of the rail. A steady recording of the rail temperature is reached within 8 minutes.

iii) 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.

iv) Any other type of thermometer approved by RDSO/Chief Engineer.

2.1.2 Where a number of thermometers are used to measure the rail temperature at one place, as in case of laying of LWR, destressing etc., any of the thermometer showing erratic readings, appreciably different from the other adjoining thermometers, shall be considered as defective.

2.2 TEMPERATURE MEASUREMENTS

2.2.1 Zonal Railway should nominate 8 to 10 stations in their railway in a manner as to give the representative sample of the temperature variations on the Zonal Railway for the region allotted to each station. These stations shall be the existing PWI,JE/SSE(P.Way) Incharge offices. On these stations rail temperature records shall be built up using preferably a well calibrated continuous recording type thermometer. 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. These temperature records shall be analysed to assess the probable availability of time periods during different seasons of the year for track maintenance, destressing operations and requirements of hot/cold weather patrolling etc. Rail thermometer shall also be available with each Gang and sectional PWI,JE/SSE(P.Way) to enable the Gangs to work within the prescribed temperature ranges.

2.3 **THERMAL FORCES IN LWR/CWR:** 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 below, is to be resisted by suitable track structure.

$$P = E A \alpha t$$

where, P = *Thermal force in the rail (kg)*

E = *Modulus of elaticity of rail steel, (2.15 x 10^6 kg/sq.cm)*

α = *Coefficient of linear expansion of steel, (1.152 x $10^{-5}/^0C$)*

A = *Area of cross section of the rail (sq.cm)*

t = *Variation of rail temperature from t_d/t_o (^0C)*

3. PERMITTED LOCATIONS FOR LWR/CWR

3.1 GENERAL CONSIDERATIONS FOR LAYING LWR/CWR

3.1.1 As a rule, complete track renewals (Primary) shall provide for LWR/CWR wherever permissible by the provisions of this Manual. Also existing rails on permitted locations may be converted into LWR/CWR, provided they meet the requirements laid down in the Manuals for Welding of Rail Joints by Alumino - Thermic (SKV Process)/Gas Pressure/Flash Butt Process, as the case may be.

3.1.2 New constructions/doublings/gauge conversions/retired alignment/permanent diversion shall be opened with LWR/CWR, wherever permissible by the provisions of this Manual.

3.1.3 In goods running lines, goods yards, reception yards and classification yards, 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 Engineer, in each specific case.

3.2 ALIGNMENT

3.2.1 ***LWR/CWR shall not be laid on curves sharper than 440 metre radius both for BG and MG. However, in temperature zone-I LWR/CWR may be laid on curves up to 360 metre radius (50 Curve) on BG with following additional precautions:***

(i) *Minimum track structure should be 52kg rail on PSC sleeper, M+7 sleeper density with 300mm clean ballast cushion.*

(ii) *Shoulder ballast for curves shaper than 440m radius should be increased to 600mm on out side of curve and should be provided for 100m beyond the tangent point.*

(iii) *Reference marks should be provided at every 50m interval to record creep, if any.*

(iv) *Each curve of length greater than 250m should preferably be provided with SEJ on either side. SEJ should be located in straight track at 100m away from the tangent point.*

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3.2.2 LWR/CWR may be continued through reverse curves not sharper than 875 metre radius. For reverse curves sharper than 1500 metre radius, shoulder ballast of 600 mm over a length of 100 metre on either side of the common point should be provided.

3.3 GRADIENTS

3.3.1 The steepest permitted grade shall be 1:100.

3.3.2 A vertical curve shall be provided 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 percent, as laid down in para 419 of IRPWM.

The minimum radius of the vertical curve shall be kept as under:

Broad Gauge		Metre Gauge	
Group	Minimum radius	Group	Minimum radius
A	4000 metre	All routes	2500 metre
B	3000 metre		
C, D & E	2500 metre		

3.4 **Approval of Principal Chief Engineer :** 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 5.1.3. However, for any deviation from the provisions of this Manual, the approval of Principal Chief Engineer shall be obtained.

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4. TRACK STRUCTURE FOR LWR/CWR

4.1 FORMATION

LWR/CWR shall be laid on stable formation. Formation width shall be conforming to the extant instructions.

4.2 **BALLAST CUSHION AND SECTION:** The minimum clean stone ballast cushion (below the bottom of the sleeper) of 250 mm shall be provided at the time of installation of LWR/CWR. Where speeds in excess of 130 km/h on BG or 100 km/h on MG are to be introduced, at least 300 mm ballast cushion or 200 mm ballast cushion over 150 mm of sub-ballast shall be provided. The profile of ballast section shall be as shown in Fig.4.2.1 (a) to (d). The ballast section and cushion provided for LWR/CWR shall be continued over SEJ and upto 3 rails beyond it wherever it is followed by SWR/fishplated track.

4.3 SLEEPERS & FASTENINGS

Following types of sleepers and fastenings are approved for use in LWR/ CWR:-

4.3.1 On Broad Gauge

i) Concrete sleepers with elastic fastenings

ii) Steel trough sleepers with elastic fastenings for speeds not exceeding 130 km/h (as an interim measure speed up to 160 km/h may be allowed)

(See foot-notes below para 4.3.2)

4.3.2 On Metre Gauge

i)	Concrete sleepers with elastic fastenings	Preferably for speeds above 75 km/h but a must for speeds above 100 km/h.
ii)	Steel trough sleepers with elastic fastenings	
iii)	ST sleepers with keys	For speeds not exceeding 100 km/h.
iv)	CST-9 sleepers with keys	

Notes: *a) LWR/CWR already existing on steel trough sleepers and CST-9 sleepers with key fastenings for speeds upto 130 km/h on BG, if behaving satisfactorily, may be continued.*

b) On steel trough sleepers with key fastenings, the breathing lengths shall preferably be provided with elastic fastenings.

c) In case of CST-9 sleepers, precautions as indicated in Annexure-II shall be adhered to.

d) Existing LWRs/CWRs on wooden sleepers with anti creep bearing (ACB) plates & two way keys or elastic fastenings, if behaving satisfactorily, may be continued for maximum speed of 130 km/h on BG and 100 km /h on MG.

4.3.3 Sleeper density

The minimum sleeper density (number of sleepers/km) in LWR/CWR shall be as follows:-

Types of sleeper	Sleeper density (BG/MG)
i) PRC Sleeper	1340 in temperature Zones I & II ACS 16
ii) PRC Sleeper	1540 in temperature Zones III & IV
iii) Other sleepers	1540 in all temperature Zones

4.4 RAILS

4.4.1 i) Rails of the following sections shall be welded into LWR/CWR:-

Gauge	Rail section
BG	90R/52kg/60kg
MG	75R/90R

LWR/CWR already laid with 60R rails on MG may be allowed to continue.

ii) In one LWR, two different rail sections are not permitted. In case of any change in rail section, LWR should be isolated by providing SEJ.

iii) In case of LWRs laid on concrete sleepers having different rail section on either side of SEJs, instead of providing three normail rail lengths of each rail section between SEJs, two 3 rail panels, one of each rail section shall be provided with combination fish plated joint, between the two panels.

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4.4.2 While converting existing fishplated /SWR track into LWR/CWR, following precautions shall be taken:-

i) The rails shall be tested ultrasonically and all defective rails replaced before conversion into LWR/CWR.

ii) Rail ends which are bent, hogged, battered, or having history of bolt-hole cracks shall be cropped before welding for conversion into LWR/CWR.

4.4.3 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 metre long fishplates with special screw clamps/joggled fish -plates having slotted grooves & bolted clamps as in Fig. 4.4.3 (a), (b) & (c) with speed restrictions indicated in Annexure-III. Fish-bolt holes if any, shall be chamfered.

4.5 MISCELLANEOUS

4.5.1 **Continuity of track structure**: Wherever LWR/CWR is followed by fishplated track/ SWR, the same track structure as that of LWR/CWR shall be continued for three rail lengths beyond SEJ.

4.5.2 **Level crossings**: Level crossings situated in LWR/CWR territory shall not fall within the breathing lengths.

4.5.3 **Points and Crossings**: LWR/CWR shall not normally be taken through points and crossings. Three normal rail lengths shall be provided between stock rail joint (SRJ) and SEJ as well as between the crossing and SEJ. These normal rail lengths shall be provided with elastic rail clips/anchors to arrest creep. However, where concrete sleeper turnouts are laid, instead of three normal rail lengths, one three rail panel shall be provided between SEJ and SRJ as well as between heel of crossing and SEJ.

4.5.3.1 LWR/CWR shall not be taken through points & crossings. For any exceptions in this regard, special arrangements shall have the prior approval of RDSO.

4.5.4 **Glued Joints:** All insulations for track circuiting in LWR/CWR shall be done by providing glued joints G3(L) type.

4.5.5 **Location of SEJ:** The exact location of SEJ shall be fixed taking into account the location of various obligatory points such as level crossings, girder bridges, points and crossings, gradients, curves and insulated joints. SEJ with straight tongue and stock shall not be located on curves sharper than 0.5 degree (3500 m radius) as far as possible. SEJ shall not be located on transition of curves.

4.5.6 **Bridges with ballasted deck (without bearing):** LWR/CWR can be continued over bridges without bearings like slabs, box culverts and arches.

4.5.7 **Bridges with/without ballasted deck**

i) LWR/CWR shall not be continued over bridges with overall length as specified in para 4.5.7.1 for BG and not more than 20 metre for MG.

ii) Bridges on which LWR/CWR is not permitted/provided shall be isolated by a minimum length of 36 metre well anchored track on either sides.

4.5.7.1 i) 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) The approach track upto 50 m on both sides shall be well anchored by providing any one of the following:-

   i) ST sleepers with elastic fastenings

   ii) PRC sleepers with elastic rail clips with fair 'T' or similar type creep anchors.

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.

4.5.7.1 ii) 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.

b) The bridge timbers laid on girders shall not be provided with through notch but shall be notched to accommodate individual rivet heads.

c) The track structure in the approaches shall be laid and maintained to the standards as stated in item 4.5.7.1 (i) (b) and (c) above.

d) The girders shall be centralised with reference to the location strips on the bearing, before laying LWR/CWR.

e) 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 on BG (in metre)

(Para - 4.5.7.1 (i) & (ii))

Temperature zones	Rail section used	Rail-free fastenings on bridges Para 4.5.7.1 (i)	Rail-free fastenings on bridges and partly box-anchored Para 4.5.7.1 (ii)
		Type of sleeper used in approaches	Type of sleeper used in approaches
		PRC/ST	PRC/ST
I	60kg	30	77
	52kg/90R	45	90
II	60kg	11	42
	52kg/90R	27	58
III	60kg	11	23
	52kg/90R	27	43
IV	60kg	11	23
	52kg/90R	27	43

4.5.7.1 iii) 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.4.5.7.1(iii).

4.5.7.1 iv) 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. 4.5.7.1 (iv)). 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 follows:-

Rail temp. zone	**Max. move ment of SEJ used (mm)**	**Max. length of bridge with SEJ**		**Initial gap to be provided at t_d**	
		With ST/PRC approach sleepers	With CST-9 approach sleepers	With ST/PRC approach sleepers	With CST-9 approach sleepers
IV	190	55 m	45 m	7.0 cm	6.5 cm
III	190	70 m	70 m	7.0 cm	6.5 cm
II	190	110 m	100 m	6.5 cm	6.5 cm
I	190	160 m	150 m	6.5 cm	6.0 cm
II	120	20 m	15 m	4.0 cm	4.0 cm
I	120	50 m	50 m	4.0 cm	4.0 cm

Note: *i) SEJ is to be installed 10 metre away from the abutments.*

(ii) Improved SEJ with 2 gaps of 65mm (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.

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4.5.7.1 v) Welded rails may be provided over a single span bridge with rail free fastenings and SEJs at 30m 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. On both side of approaches fully creep anchored fastening shall be used. The length of single span bridge permitted temperature zone-wise shall be as under:

Temperature Zone	Maximum length of single span girder bridge with SEJ (190mm gap) at 30m away from both abutments with full creep resistant fastenings at approaches ($t_d = t_m$)
IV	75m
III	87m
II	110m
I	146m

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5. LAYING OF LONG WELDED RAILS AND CONTINUOUS WELDED RAILS

5.1 SURVEY

A foot by foot survey of the sections where LWR/CWR is proposed to be laid shall be carried out in regard to the following:-

5.1.1 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. shall be identified. Such stretches of track shall be isolated from the remaining portion of LWR/CWR by provision of SEJs at either end.

5.1.2 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.

5.1.3 A detailed plan shall be made showing the exact locations of SEJs and of various other features mentioned in sub-paras 5.1.1 & 5.1.2. A sample of the detailed plan may be seen at Fig. 5.1.3. The plans may be prepared to a horizontal scale of 1:5000.

5.2 TEMPERATURE RECORDS

5.2.1 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 PWI,SSE(P.Way)-Incharge or as built up as per para 2.2.1.

5.2.2 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. 1.7), shall be adopted.

5.3 MATERIALS REQUIRED

Following materials are required for laying one LWR:-

i) Four numbers of 6.5 metre or longer rail pieces of the same rail section as LWR

ii) Two sets of SEJs with sleepers and fastenings

iii) Adequate numbers of 1 metre long fishplates with special screw clamps/ joggled fishplates with slotted grooves & bolted clamps as in Fig. 4.4.3 (a), (b) & (c)

Note: *Slotted fishplates as in Fig. 5.3*(iii) *with fish-bolts may be used in exceptional cases.*

iv) Rail closures of suitable sizes

v) 1 metre and 10 cm straight edges

vi) Callipers and feeler gauges (2 mm to 0.1 mm)

vii) Rail cutting equipment

viii) Destressing equipment i.e. rollers, mechanical/hydraulic rail tensor, mallets and side rollers for curves, Fig. 5.3 (viii) (a) & (b)

ix) Alumino-thermic/mobile gas pressure welding equipment and consumable materials

x) Equipment for protection of track

xi) Equipment for night working.

5.4 PRELIMINARY WORKS

5.4.1 Deep screening of ballast along with lifting or lowering of track, if required, should precede laying of LWR/CWR. Standard ballast section as stipulated in para 4.2.1 for LWR/CWR shall be provided.

All other preliminary works identified in para 5.1.2 shall also be completed before laying of LWR/CWR.

5.4.2 If any of the preliminary works can not be completed before installation of LWR/CWR, such stretches should be isolated by providing SEJs. On completion of these works, such stretches may be welded, destressed and joined with LWR/CWR in accordance with para 5.8.

5.5 WELDING OF RAILS TO FORM LWR

5.5.1 Rails shall normally be welded into sufficiently long panels of 10 to 20 rail lengths or more by flash butt welding/gas pressure 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).

5.5.2 While unloading 880 grade (90 UTS) or higher grade rails, handling instructions laid down in Annexure-IV, should be followed.

5.5.3 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 5.6. Closure rails of 6.5 metre or longer length shall be provided at LWR side/sides of SEJs to facilitate adjustment of gaps during destressing operation.

5.5.4 Laying of welded panels and/or welding of joints at site can be done at any time of the year. But after welding into sufficiently long panels of about 1 km or longer, destressing as per para 5.7 shall be undertaken as soon as possible. Under unavoidable circumstances where destressing 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 20^0C above the rail temperature at which welding of rails/laying of welded panels was done, temporary destressing shall be undertaken at a rail temperature of 10^0C below the maximum rail temperature likely to be attained until final destressing. If the rail temperature comes down appreciably, cold weather patrolling as per para 9.1.2 (ii) should be introduced. Final destressing shall be done after consolidation of track as per para 1.18 has been achieved.

5.5.5 Temporary speed restriction as indicated in Annexure-III shall be imposed on the length of track where welded panels are joined by 1m long fishplates with special screw clamps or joggled fishplates with slotted grooves & bolted clamps as in Fig. 4.4.3 (a) & (b) or (c).

5.6 GAPS AT SEJ

5.6.1 "Gaps at SEJ shall be adjusted at the time of laying/subsequent destressing of LWR/ CWR, as illustrated in Fig. 5.6.1 (IRS Design), Fig. 5.6.2 (Improved SEJ with double gap of max. 65 mm each i.e. DG65 Design), Fig. 5.6.3 (Improved SEJ with single gap of max. 80 mm i.e. SG80 Design) and shall be as under: :(CS NO-17)

Rail section laid	**Gap to be provided at 't_d'**
52kg/60kg	40 mm
Others	60 mm

5.6.2 The gaps between the reference mark and tongue rail tip/stock rail corner at various rail temperatures shall not differ by more than $\pm$ 10 mm from the theoretical range as shown in Annexure-V.

5.6.3 Where fishplated or SWP track is joined on one side of SEJ, the gap between the reference mark and tongue rail tip/stock rail corner on LWR/CWR side shall not differ by more than $\pm$10 mm from the theoretical range as shown in Annexure- V.

5.7 DESTRESSING OF LWR

5.7.1 General

i) The work of destressing shall be done during a traffic block under the personal supervision of a PWI,JE/SSE(P.Way) as laid down in Annexure-VI.

ii) It is preferable to impose a speed restriction of 30 km/h before actually obtaining the traffic block and to loosen/remove fastenings on alternate sleepers to reduce total duration of the traffic block.

5.7.2 Sequence of operations

The procedure to be adopted for destressing consists of the following steps:-

i) Remove impediments to free movement of rail such as rail anchors, guard rails, check rails etc.

ii) Create gap of about 1 metre at the centre of LWR during a traffic block and insert a closure rail there at a restricted speed.

iii) Mark anchor lengths at either end of the proposed LWR in accordance with para 1.15.

Notes: *a) Anchor length shall be determined on the basis of the lowest value of t_p at which destressing is likely to be carried out.*

b) Anchor length shall be increased suitably if the fastenings, rubber pads, liners or ballast conditions are poor.

iv) Erect marker pillars at the ends of anchor lengths on either side and at 100 metre intervals thereafter.

v) Obtain a traffic block when t_p is less than the desired installation temperature (t_o), remove the closure rail at the centre and unfasten the full length of rails leaving only the anchor lengths at either end. Mount the rails on the rollers.

Note : *Side rollers shall also be used while undertaking destressing on curved track. Side supports on the inside of curve should be spaced at every n^{th} sleeper,*

$$\text{where, } n = \frac{\text{Radius of curve (R) x No. of sleepers per rail length}}{50 \times (t_o - t_p)}$$

Outside supports shall be used in addition at the rate of one for every three inside supports.

vi) Fix rail tensor across the gap at the centre and apply tension so as to get the required amount of extension as provided in Annexure -VII.

vii) Re-fasten the rails starting from the anchor lengths at either end after removing the rollers progressively and adjusting tension at the rail tensor to make sure that the required extension has been achieved at each marker pillar.

viii) Put paint marks on either side of the gap at the centre, spanning over the gap at a distance of 6.5 metre. Insert a closure rail of a length equal to (6.5 metre - 2 gaps for welding + 1 mm for saw cut ends) and clamp as per arrangements shown in Fig. 4.4.3 (a) & (b) or (c).

ix) Release and remove the rail tensor.

x) During another traffic block, weld both the joints of the closure rail at the centre.

xi) Equalise stress at the centre and at the anchor lengths.

5.7.3 DESTRESSING OPERATION OF LWR WITH THE USE OF RAIL TENSORS

For destressing of LWR with the use of rail tensor, the following procedure shall be adopted:-

i) During the first traffic block, create a gap of 1 metre at location 'B' i.e. centre of LWR (Fig. 5.7.3). Introduce rail closure as required and fasten with special fishplates and clamps. Allow traffic at restricted speed.

ii) Mark the anchor length $A_1 A_2$ and $C_1 C_2$ each equal to l_a at either end of the length $A_2 C_2$ to be destresed (Fig. 5.7.3.(a)).

Note : *The anchor length 'l_a' should be determined on the basis of the lowest value of t_p at which the destressing is likely to be carried out.*

iii) 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 : 5.7.3(a)).

Note : *The distances $W_0 W_1$, $W_1 W_2$ etc. shall be marked at about 100 metre intervals, the distance from the previous pillars and the last pillar W_B may be less than 100 metre.*

iv) During the second traffic block, when t_P is less than the desired t_o (Fig. 5.7.3 (b)), destressing operation shall be carried out for the lengths A_2 B and C_2 B as described below:-

a) Remove the closure rail from location 'B.' Unfasten and mount on rollers the portion from $A_2 C_2$.

b) 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 minimise the friction in the rollers etc. Release the tension and note the movement Y_0 at W_0.

c) Transfer marks W_1, W_2,..... onto the rail foot and note temperature t_p.

d) Calculate the required movement at W_1 as under:-

Movement at $W_1 = Y_o$ + elongation of length $W_0 W_1$ (L) due to temperature difference $(t_o - t_p) = Y_0 + L\alpha (t_o - t_p)$

Calculate the required movement at W_2 as under:-

Movement 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.

Mark the above calculated extensions with respect to the transferred marks referred at (c) above on the rail foot on the side away from the tensor.

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.

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.

Note : *i) Annexure-VII gives the value of $L\alpha(t_o - t_p)$ for different values of L and $(t_o - t_p)$.*

ii) Only one value of t_p has to be taken at the time of marking W_1,W_2 etc. on the rail foot. The values of t_p is not required to be taken thereafter. The variation of temperature, if any during the destressing 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 A_2B and C_2B can not be fastened down simultaneously, the final adjustment in pull and fastening down of the individual segments may be done in series, first from A_2 to B and then, from C_2 to B.

e) After the fastening down of the last length A_2B and C_2B is completed, make a paint mark near free end of one rail at a distance of (6.5 metre + 2 x 25 mm -1 mm), measured from the end of the other rail across the gap spanned by the rail tensor.

f) Remove the tensor, close the 1 metre gap temporarily and allow traffic at restricted speed (Fig. 5.7.3 (c)).

v) During another traffic block, cut the rail at the paint mark, insert a rail closure of length exactly equal to 6.5 metre and weld one end thereof (Fig. 5.7.3 (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 and pull the rails with rail tensor to get the desired gap of 25 mm (Fig. 5.7.3 (e)); refasten the rail and weld the joint. Release the tensor after a lapse of a minimum of 20 minutes after pouring of the weld metal.

vi) During a subsequent traffic block, when t_p is less than t_d, equalise the forces in the rail by releasing the fastenings over a length of 100 metre on either side of location 'B' and tapping with wooden mallets etc. (Fig. 5.7.3 (f)). Fasten down the rail and allow traffic.

vii) During another traffic block, when t_p is within the range of temperature specified for t_d in para 1.11, destress the end 100 metre from SEJ. Thereafter, weld the closure rail next to SEJ duly ensuring setting of the SEJ as per para 5.6.1.

5.7.4 In case rail temperature at the time of destressing is within the range specified in para 1.11, detailed procedure as given in Annexure -VIII without using rail tensor, may be adopted.

5.8 JOINING LWRs INTO CWR

Detailed procedure for joining of LWRs into CWR is as given below (Fig. 5.8 (a) to (f)):-

i) Replace the existing SEJs/buffer rails between the LWRs with ordinary rails, of which there should be two temporary rails about 6.5 metre long for each of left and right sides. Leaving the temporary rails fishplated, weld the other rails.

Note: *Where fluctuations of temperatures during the period of joining are likely to be small, only one temporary rail instead of two, may suffice.*

ii) Provide W_0 marker pillars for each of the LWRs at a distance of 100 metre from the centre of temporary rails, to mark the ends of the breathing lengths.

iii) Keep ready two rails of standard length. Measure their lengths 'l' correct to the nearest millimetre.

iv) Transfer the marks W_0 to the rail flange for both the LWRs.

During the first traffic block when t_p is less than desired t_0, remove the fish-plates 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 destressing.*

v) Note t_p and mark the anchor length on either side as shown Fig.5.8 (b).

vi) Make a paint mark near the end of either of the LWRs at a distance of $l + L\alpha(t_0-t_p) + Y_0 + Y'_0 + 2 \times 25 - 1$ mm measured from the end of other LWR. Here L = 200 metre, 25 mm is the allowance for each thermit weld and 1 mm is the allowance for a saw cut. The value of $L\alpha(t_0-t_p)$ may be read from Annexure-VII, e.g. for $(t_0 - t_p) = 10^0C$, $L\alpha(t_0 - t_p) = 23$ mm.

vii) Remove the rollers, fasten down the length 'L', introducing closure pieces, if necessary, and allow traffic (Fig. 5.8 (c)).

viii) During the second block (Fig. 5.8 (d)), 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.

ix) During the third block (Fig. 5.8 (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. Refasten and weld the rail. Release the tensor after the lapse of a minimum of 20 minutes after pouring of the weld metal.

x) During the fourth and final block (Fig. 5.8 (f)), equalise the forces in the rail by releasing the fastenings over the portion marked 'L' and also over the anchor lengths on either side and tapping with wooden mallets, etc. Fasten down the rail and restore traffic.

5.9 REFERENCE MARKS

Reference marks shall be fixed at each SEJ and at the centre of LWR/CWR, on the reference pillars erected for this purpose. 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. In no case, a saw mark shall be made on the running rail. Reference marks are required to be fixed immediately after destressing of LWR/CWR and shall not be shifted or tampered with thereafter. Additional reference marks in fixed portion and breathing length may be provided to know the behavior of LWR/CWR.

6.0 MAINTENANCE OF LWR/CWR

6.1 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 para 9.2.2 and level of authorisation not lower than what is laid down in Annexure-VI.

6.2 REGULAR TRACK MAINTENANCE

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 buffer rails

6.2.1 General

i) a) Track structure consisting of other than concrete sleepers in LWR/CWR

The regular track maintenance in LWR/CWR shall be confined to hours when rail temperature is between t_d +10°C and t_d-30°C and shall be completed well before onset of summer. If rail temperature after maintenance operation exceeds t_d + 20^{0}C during the period of consolidation as per para 1.18, the speed restriction of 50 km/h on BG and 40 km/h on MG shall be imposed when shoulder and crib compaction has been done and 30 km/h and 20 km/h respectively when shoulder and crib compaction has not been done in addition to posting mobile watchman.

ACS 9

b) Track structure consisting of concrete sleepers :-

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. If rail temperature after the maintenance operation exceeds t_d+20°C during the period of consolidation as per para 1.18, then the speed restriction of 50 km/h on BG and 40 km/h on MG shall be imposed. **ACS 9**

ii) Ballast section shall be properly maintained, specially 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. 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 Gangmate by taking out minimum quantity of ballast from the centre of the track between the two rails over a width not exceeding 600 mm/350 mm and a depth not exceeding 100 mm/ 75 mm for BG/MG respectively.

iii) Sufficient quantity of ballast shall be collected to provide full ballast section before commencing any maintenance operation, specially lifting.

iv) When crow bars 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 224(d) (ii) of IRPWM shall be followed.

v) Special attention shall be paid to maintenance of track at following locations:

- SEJs/breathing lengths
- Approaches of level crossings, points & crossings and unballasted deck bridges
- Horizontal and vertical curves

vi) Special attention shall be paid to maintenance of fastenings in LWR/CWR especially on concrete sleepers according to para 1411 of IRPWM .

vii) All fastenings shall be complete and well secured.

6.2.2 Mechanised Maintenance

i) Maintenance tamping:

Tamping in LWR/CWR with general lift not exceeding 50 mm in case of concrete sleeper and 25 mm in case of other sleepers including correction of alignment shall be carried out during the period when prevailing rail temperatures are as per para 6.2.1 (i) together with precautions laid down therein.

ii) Lifting of track:

Lifting where needed, in excess of 50 mm in case of concrete sleepers/ 25 mm in case of other types of sleepers shall be carried out in stages with adequate time gap in between successive stages such that full consolidation of the previous stage as per para 1.18 is achieved prior to taking up the subsequent lift.

iii) Cleaning of shoulder ballast:

Mechanised cleaning of shoulder ballast shall be undertaken when prevailing rail temperatures are within the limits prescribed in para 6.2.1(i) together with the precautions mentioned therein.

6.2.3 Manual maintenance

i) At no time, not more than 30 sleepers spaces in a continuous stretch shall be opened for manual maintenance or shallow screening with atleast 30 fully boxed sleeper spaces left in between adjacent openings. Maintenance of in between lengths shall not be undertaken till passage of traffic for atleast 24 hours in case of BG carrying more than 10 GMT or 2 days in case of other BG and MG routes.

ii) 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.

iii) 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 PWI,JE/SSE(P.Way). It should however, be ensured that rail to sleeper fastenings on the entire length of LWR are functioning satisfactorily and SEJs do not indicate any unusual behaviour.

6.2.4 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 6.2.1(i) together with precautions mentioned therein.

6.2.5 Renewal of fastenings

The work of renewal of fastenings shall be carried out when rail temperature is within the limits specified in para 6.2.1 (i) with following additional precautions:-

i) Renewal of fastenings not requiring lifting:

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 atleast 15 sleepers in between shall be kept intact. Work shall be done under supervision of Keyman.

ii) Renewal of fastenings requiring lifting:

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 sleepers are required to be renewed at a time, then atleast 30 sleepers in between shall be kept intact. Work shall de done under supervision of Gangmate.

6.2.6 Maintenance of SEJs/buffer rails

i) 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. Movement of SEJs shall be checked and action taken for destressing if necessary as per para 6.4.

ii) During his daily patrolling, Keyman shall keep special watch on the SEJs falling in his beat.

iii) Buffer rails shall be maintained in accordance with Annexure-IX.

6.2.7 Renewal of defective rails/welds

The procedure laid down in para 7.2 of this manual for repairs to track after rail fracture shall be followed.

6.3 SPECIAL TRACK MAINTENANCE

Special track maintenance in LWR/CWR includes following operations:-

i) Through fittings renewal

ii) Deep screening/mechanised cleaning of ballast

iii) Lowering/Lifting of track

iv) Major realignment of curves

v) Sleeper renewal other than casual renewals

vi) Rehabilitation of bridges and formation causing disturbance to track

6.3.1 Through fittings renewal

Whenever it is decided to carry out through renewal of fittings so as to ensure proper functioning of LWR, the LWR shall be destressed alongwith the through fittings renewal.

6.3.2 Deep screening/mechanised cleaning of ballast

i) Provisions laid down in para 238 of IRPWM will also apply mutatis- mutandis to LWR/CWR with further provisions as mentioned hereafter in this para. Wherever mechanised cleaning of ballast is resorted, the detailed procedure laid down in para 238 (2) (e) of IRPWM for manual deep screening shall stand replaced by the sequence of operations of Ballast Cleaning Machine (BCM).

ii) Ballast Cleaning Machine (BCM), tamping machine and Dynamic Track Stabilizer (DTS) shall, as far as possible, be deployed in one consist.

iii) 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 three methods may be adopted for carrying out the work of deep screening/mechanised cleaning:-

   a) If range of rail temperature falls within t_d+10^{O}C to t_d-20^{O}C, deep screening may be done without cutting or temporary destressing.

   b) If range of rail temperature falls outside (a) above, temporary destressing shall be carried out 10^{O}C below the maximum rail temperature likely to be attained during the period of work. CWR shall be cut into LWRs of about 1 km length with two temporary buffer rails of 6.5 metre long clamped as per arrangements shown in Fig. 4.4.3 (a) & (b) or (c).

   c) Wherever rail renewals are being carried out, LWR/CWR may be converted into three rail panels and deep screening done.

iv) Constant monitoring of rail temperature shall be done during the progress of work. Should the temperature rise more than 10^{O}C above t_d/temporary destressing temperature, adequate precautions shall be taken including another round of temporary destressing.

Note : *Deep screening shall be undertaken within 15 days of temporary destressing failing which temporary destressing may become due again, if the rail temperature varies appreciably.*

v) During the period of deep screening, if there is any possibility of minimum temperature falling 30^{O}C below t_d /temporary destressing temperature, cold weather patrol as per para 9.1.2 (ii) should be introduced to detect/ guard against rail fractures.

vi) Sequence of operation: -

a) Deep screening of LWR may be done from one end of LWR to other end.

b) After deep screening and consolidation as per para 1.18, destressing of LWR shall be undertaken as per para 5.7.

6.3.3 Other special maintenance

i) 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. For carrying out such maintenance, the affected length of track may be isolated from LWR/ CWR by introducing SEJs or buffer rails as needed.

ii) Temperature records of the section shall be studied and action taken in accordance with para 6.3.1(iii) & (iv).

iii) After completion of work, the affected length of track shall be destressed at the required destressing temperature and joined with rest of the LWR/CWR in accordance with para 5.8.

6.4 DESTRESSING DURING MAINTENANCE

6.4.1 Abnormal behavior of LWR/CWR whenever gets manifested in one or more of the following, destressing shall be undertaken as per procedure laid down in para 5.7:-

i) When the gap observed at SEJ

a) differs beyond limits specified in para 5.6.2 & 5.6.3

b) exceeds the maximum designed gap of SEJ

c) **When tip of tongue rail/corner of Stock Rail crosses the reference line. (ACS 10)**

ii) After special maintenance operations mentioned in para 6.3

iii) After restoration of track following an unusual occurence mentioned in para 7.1

iv) If number of locations where temporary repairs have been done exceed three per km.

6.4.2 Destressing of CWR shall be done by cutting it into LWRs of about 1 km length which shall be joined after destressing in accordance with para 5.8.

6.5 SPECIAL EQUIPMENT FOR MAINTENANCE OF LWR/CWR

Staff responsible for maintenance of LWR/CWR shall be trained in using and equipped with additional equipment detailed below:-

6.5.1 Additional equipment with the Gangs

i) A pair of joggled fishplates with bolted clamps (Fig. 4.4.3 (c))

ii) Rail thermometer with markings for temperature ranges for maintenance

iii) Special 1 metre long fishplates with screw clamps (Fig. 4.4.3 (a) & (b))

iv) Rail closure pieces.

6.5.2 Additional equipment with PWI,JE/SSE(P.Way)

Equipments as listed in para 5.3 shall be available with PWI,JE/SSE(P.Way).

7. UNUSUAL OCCURRENCES

7.1 LIST OF UNUSUAL OCCURRENCES

Unusual occurrences in LWR/CWR comprise of the following:-

i) Rail fractures or replacement of defective rail/ glued joint

ii) Damage to SEJ/buffer rails

iii) Buckling or tendency towards buckling

iv) Factors causing disturbance to LWR/CWR such as accidents, breaches etc.

7.2 RECTIFICATION OF RAIL FRACTURES

7.2.1 Equipment required

i) Special 1 metre long fishplates with screw clamps and joggled fishplates with bolted clamps (for fractures at welded joints) as per arrangement shown in Fig. 4.4.3 (a) & (b) or (c)

ii) Steel tape capable of reading upto one mm

iii) Alumino-thermic welding and finishing equipment

iv) Equipment for destressing

v) 6.5 metre long sawn rail cut piece of the same section as LWR duly tested by USFD

vi) Rail closures of suitable lengths

vii) Equipment for protection of track

viii) Equipment for night working

7.2.2 Procedure for repairs

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 Gangmate/Keyman/PWI,JE/SSE(P.Way), who shall arrange for making emergency repairs to pass the traffic immediately. Repairs shall be carried out in four stages as described below:-

a) Emergency repairs to pass the traffic immediately

b) Temporary repairs

c) Permanent repairs

d) Destressing.

7.2.3 Emergency repairs

The fractured rails shall be joined by using the arrangements shown in Fig. 4.4.3 (a) & (b) or (c). If the gap at fracture does not exceed 30 mm, insertion of any closure rail piece is not necessary. The traffic may then be resumed at a speed of stop dead and 10 km/h for the first train and 20 km/h for subsequent trains.

7.2.4 Temporary repairs

If a welding party is not readily available, the fracture shall be repaired by using a cut rail (not less than 4 metre long) and clamped/bolted as per arrangement shown in Fig. 4.4.3 (a) & (b) or (c).

i) A traffic block shall be taken as soon as possible preferably when the rail temperature is within the range specified for t_d in para 1.11.

ii) a) Two points on either side of the fracture shall be marked on the rail such that the length of closure rail (not less than 4 metre) 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. 7.2.4.

b) 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 metre at the time of permanent repairs. See Fig. 7.2.4.

iii) The rails shall then be cut through at these points simultaneously, if possible. The closure rail shall then be inserted and joined as per para 7.2.3. After joining, the traffic shall then be resumed at restricted speed in accordance with Annexure-III. In case closure rail as per para (ii) (a) 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.

7.2.5 Permanent Repairs

i) 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.

ii) In case rail closure as per para 7.2.4(ii)(a) 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.

iii) In case rail closure as per para 7.2.4(ii)(b) 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 para 7.2.5 (ii).

iv) After welding of joints, a length of track equal to breathing length or about 125 metres on either side be unfastened and tapped to ensure equalisation of stress and then refastened.

7.3 DAMAGE TO SWITCH EXPANSION JOINT

7.3.1 The damaged/broken SEJ shall be replaced. The new SEJ shall be adjusted as per para 5.6.1. Traffic may be allowed if necessary at a restricted speed and thereafter restriction relaxed progressively.

7.3.2 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-III. 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.

7.4 BUCKLING OF TRACK

7.4.1 General

Buckling or a tendency towards buckling may occur, among others, in the following circumstances:-

i) Failure to adhere to the temperature ranges specified for operation on LWR/CWR

ii) Inadequate resistance to longitudinal, lateral and vertical movement of track due to deficiencies in ballast section or/and inadequate ballast consolidation

iii) Use of ineffective fastenings or missing fastenings resulting in loss of creep resistance and torsional resistance

iv) Excessive settlement of formation

v) Improper functioning of SEJ.

7.4.2 Buckling and its investigation

i) 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.

ii) As soon as the tendency for buckling is detected, the traffic shall be suspended and the track protected. The track shall then be stabilised 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.

iii) Each case or buckling shall be investigated by AEN soon after its occurrence and a detailed report submitted to DEN/Sr. DEN.

7.4.3 Repairs to buckled track

i) When the track actually buckles, the traffic shall be suspended and the cause of buckling ascertained. The position of tongue and stock rails of the SEJ shall be checked. The methods for rectification are explained below.

ii) The rectification shall normally be carried out in the following stages under the supervision of PWI,JE/SSE(P.Way):-

a) Emergency repairs

b) Permanent repairs

c) Destressing.

7.4.4 Emergency repairs

The buckled rails shall preferably be gas cut adequately apart not less than 6.5 metre. 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-III.

7.4.5 Permanent repairs

i) As soon as possible the clamped joints shall be welded adopting the same procedure as in paras 7.2.4 and 7.2.5. 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.

ii) The entire panel shall be destressed as soon as possible as per para 5.7.

7.5 BREACHES, TEMPORARY GIRDERS AND DIVERSIONS

7.5.1 The affected portion shall be isolated by insertion of SEJs preferably within the temperature range specified for t_d in clause 1.11. The track thus isolated shall be replaced by fishplated track which shall be box anchored, if necessary.

7.5.2 In the breached sections where the new banks are constructed, the formation shall be fully consolidated before laying LWR/CWR again.

7.5.3 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.

7.5.4 LWR/CWR panels in the affected portion shall be destressed immediately after the LWR/CWR are restored.

8. INSPECTION AND RECORDS

8.1 **INSPECTION**:- While requiring less maintenance, LWR/CWR necessitate intensive inspection at supervisory and officer's level.

8.1.1 The profile of the ballast section shall always be as shown in Fig 4.2.1(a) to (d). This should be checked, specially 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.

8.1.2 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.

8.1.3 Knowledge of staff in regard to prescribed maintenance practices shall be periodically checked and it shall be ensured that the work is done accordingly.

8.1.4 Ultrasonic examination of rails should not be in arrears. Defective rails/welds should be replaced expeditiously.

8.1.5 Inspections of gaps at SEJ and creep/movement at centre of LWR/CWR by Permanent Way officials would be done as per following schedule:-

i) PWI,SSE(P.Way)-Incharge/PWI,JE/SSE(P.Way) Sub-section:-

a) JE(P.Way) - Once in fortnight during two coldest and two hottest months of the year at about minimum and maximum temperatures otherwise once in two months by rotation with SE (P.Way).

b) SE (P.Way) - Once in fortnight during two coldest and two hottest months of the year at about minimum and maximum temperatures otherwise once in two months by rotation with JE (P.Way). **ACS 15**

ii) Assistant Engineer:-

At least once in six months, preferably during coldest and hottest months.

8.2 RECORDS

8.2.1 Record of LWR/CWR, as per the proforma laid down in Annexures-XI, XII, XIII A, and XIII B, shall be maintained by the PWI,JE/SSE(P.Way) in a permanent register called the Sectional LWR/CWR Register. The PWI shall be responsible for keeping this register up-to-date.

8.2.2 An indication plate similar to that suggested in para 212(4) of Indian Railways Permanent Way Manual shall be fixed on the cess at each SEJ showing the date of destressing, destressing temperature t_d/ t_o and length of LWR/CWR.

8.2.3 Observations of gaps at SEJ and creep/movement in fixed portion of LWR/CWR shall be recorded by the PWI,JE/SSE(P.Way)/AEN as per Annexure-XIII A and XIII B.

8.2.4 When creep in fixed portion of LWR/CWR exceeds 20 mm, full investigation shall be carried out and remedial measures undertaken.

8.2.5 AEN will analyse the observation of each LWR/CWR in his jurisdiction and give a certificate at the end of LWR/CWR register before onset of summer regarding satisfactory behavior of all LWR/CWRs. DEN/Sr.DEN will scrutinise observations of each LWR/CWR, initial each page and send exception report to Chief Track Engineer only when his orders are required. **ACS 14**

9. DUTIES, RESPONSIBILITIES & TRAINING OF STAFF

9.1 DUTIES AND RESPONSIBILITIES:- The following are the special duties and responsibilities with reference to LWR/CWR:-

9.1.1 Keyman

i) He shall carry out fortnightly oiling and greasing of SEJ, checking and re-tightening of fastenings at SEJ and other sleepers, if necessary (Para 6.2.6).

ii) He shall replace missing fastenings not requiring lifting or slewing of track as per para 6.2.1(iii) and tighten the loose fittings.

iii) He shall ensure that all creep anchors, where provided, butt against the sleepers and in case of large scale displacement of anchors, shall report the matter to Gangmate/PWM,JE/SSE(P Way), /PWI.

iv) He shall watch for unusual features and on noticing any buckling tendency or damage to track, shall take necessary action to protect the track and report the same immediately to nearest Station Master/ PWI,JE/SSE(P.Way).

v) He shall keep a sharp look out on winter mornings for any rail fractures. On noticing a rail fracture, he shall take prompt action to protect track and carry out emergency repairs to permit the restoration of traffic promptly and report to nearest Station Master/PWI,JE/SSE(P.Way).

9.1.2 Patrolman & Watchman

i) 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 bucklings. 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 PWI,JE/SSE(P.Way) immediately. Detailed instructions for carrying out hot weather patrols as given in Annexure-X A shall be followed.

ii) 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/PWI,JE/SSE(P.Way). Detailed instructions for carrying out cold weather patrols as given in Annexure-X B shall be followed.

iii) Mobile Watchman:

a) He shall be posted, till period of consolidation is over, on stretches where after maintenance operation, rail temperature has exceeded t_d + 20^{O}C during the period of consolidation as given in para 1.18.

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

c) He shall protect the track at site if any of the situations as given in (b) above occurs and report the same to nearest Station Master/ PWI,JE/SSE(P.Way).

Detailed instructions for the works to be carried out by mobile watchman are given in Annexure-X C.

9.1.3 Gangmate/Permanent Way Mistry (PWM,JE(P. Way)

i) They shall carry out maintenance work under their personal supervision only if they are in possession of valid competency certificate issued by Zonal/ Divisional Training Centre to work on LWR/CWR section.

ii) They shall undertake only those works of track maintenance for which they are authorised as per Annexure-VI.

iii) They shall maintain additional/special equipment issued to them in good condition and bring to the notice of PWI,JE/SSE(P.Way) defective equipment requiring repairs.

iv) They shall ensure that hot weather patrolmen turn out on duty during the specified patrol period and carry out the patrolling duties correctly. They shall be vigilant during hot weather and order patrol if the temperature is likely to reach t_d+20^{O}C and report to their supervisors any unusual occurrences which take place on the LWR/CWR in their beat.

v) They shall 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/PWI,JE/SSE(P.Way).

vi) They shall take immediate steps to secure the safety of the trains as per para 157 and 806 of IRPWM, if they consider that track is likely to be rendered unsafe.

vii) They shall impose the specified speed restriction and post watchman if the temperature exceeds t_d + 20^{O}C during the period of consolidation after the maintenance work had been completed.

viii) They shall make up the shortage of ballast at isolated vulnerable locations and report any ballast deficiency or disturbance of track to the PWI,JE/SSE(P.Way).

ix) They shall inspect SEJ and LWR/CWR under their jurisdiction frequently, specially during the hottest part of the afternoons in summer and report any unusual occurrence on LWR/CWR to PWI,JE/SSE(P.Way) and obtain his order.

x) They shall ensure that men working under them have knowledge of working on LWR/CWR.

xi) They shall introduce cold weather patrolling when instructed by their Supervisors.

9.1.4 Permanent Way Inspector,JE/SSE(P.Way) (Incharge of Section/Sub-section)

i) They shall be in possession of Manual of Instructions on LWR/CWR posted up-to-date at all times. They shall 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. They shall ensure that the maintenance instructions are strictly followed by all the staff under him dealing with maintenance of LWR/CWR.

ii) They shall supervise all track maintenance work for which they are responsible as per Annexure-VI.

iii) They shall be responsible:-

a) For inspection of gaps at SEJ and creep/movement at centre of LWR/CWR as per para 8.1.5 and recording observations of each LWR/CWR as per Annexure- XI, XII, XIII A and XIII B in a register.

b) For making arrangements for patrolling of track in hot and cold weather and post mobile watchmen as and when required. They will ensure that patrolmen and mobile watchmen are issued proper equipments for carrying out patrolling.

c) For repairs and restoration of traffic in case of accident, derailment, buckling, washaways, rail fracture etc.

d) For carrying out destressing, welding and other maintenance operation correctly and complete them within the block period for which block has been taken.

iv) They shall inspect LWR/CWR under their jurisdiction frequently, especially during the hottest part of afternoons in summer to look out for unusual features, tendency towards buckling and check patrolling.

v) They shall ensure that all maintenance staff under them are fully aware of their duties and responsibilities at all time with regard to maintenance of LWR/CWR.

vi) They shall always carry during their inspection a pair of joggled fishplates, clamps, rail thermometer, feeler gauges and one meter straight edge.

vii) They shall record rail temperatures, destressing temperature, minimum and maximum rail temperatures and also periodically check the rail thermometers used far recording rail temperature with reference to standard thermometer.

viii) They shall carry out all operations of maintenance under their personal supervision, in case Permanent Way Mistry/Gangmate possessing valid competency certificate is not present.

ix) They shall impose necessary speed restriction, in case the temperature exceeds t_d + 20^{O}C after the maintenance work has been completed on LWR/CWR for the period of consolidation.

x) They shall ensure proper maintenance of the ballast section of the track and shall arrange to complete replacement of ballast before the onset of summer.

9.1.5 Permanent Way Inspector,JE/SSE(P.Way) (Incharge of Section)

PWI,SSE(P.Way) Incharge of section will be responsible for following additional duties, apart from the duties as mentioned in para 9.1.4:-

i) He shall be responsible for the procurement of the permanent way materials and the equipment required for the maintenance of LWR/CWR for all the staff working under him. He shall ensure that the materials are properly distributed and kept in good order and shall recoup the materials well in time.

ii) He shall maintain a permanent record of each LWR/CWR as per the proforma laid down in Annexure-XI, XII, XIII A and XIII B. He shall be responsible for keeping this register up-to-date and the same shall be handed over by him to his successor.

9.1.6 Permanent Way Inspector,JE/SSE(P.Way) (Special/Relaying)

When PWI,JE/SSE (Special/Relaying) is posted for carrying out special works etc. he shall be responsible for all the items indicated in para 9.1.4 & 9.1.5 apart from other responsibilities assigned to him.

9.1.7 Assistant Engineer

i) He shall inspect all SEJs and movement at centre of LWR/CWR at every six months and record his observation in the LWR/CWR register.

ii) He will scrutinise/analyse LWR/CWR register to investigate the reasons of unsatisfactory performance of LWR/CWR and shall give directions to his staff to take remedial action, if any.

iii) He shall bring to the notice of the DEN/Sr.DEN any work pertaining to LWR/CWR, which is beyond his capacity to deal with and any other item which he considers necessary for safe functioning of LWR/CWR.

iv) He shall ensure that the staff working under him are fully conversant with their respective responsibilities in regard to laying and maintenance of LWR/CWR.

v) He shall ensure that all remedial action for LWR/CWR showing unsatisfactory behavior are taken in time.

vi) He shall give certificate that all the LWR/CWR in his jurisdiction are behaving satisfactorily. He would arrange to send the LWR/CWR register for scrutiny of DEN/Sr.DEN once in a year before summer.

9.1.8 Divisional Engineer/Senior Divisional Engineer

i) He shall be responsible for ensuring that AENs and supervisors working under him are fully conversant and comply with provisions in this manual and such other supplementary instructions issued by Principal Chief Engineer from time to time. ACS 14

ii) He shall ensure that proper arrangements are made for training of staff working on LWR/CWR sections and posts for LWR/CWR sections are manned by qualified staff at all times.

iii) He shall make arrangements for sufficient quantity of ballast required for LWR/CWR sections.

iv) He shall scrutinise LWR/CWR registers of his jurisdiction every year in the month of February and record his certificate about satisfactory behavior of LWR/CWR in his jurisdiction. He shall refer the details of all LWR/CWR to Chief Track Engineer where he requires his orders/ decision. ACS 14

v) He shall specify the coldest and hottest months in which fortnightly observations of gaps at SEJs and movement of LWR/CWR in fixed portion are done.

9.2 TRAINING

9.2.1 Arrangements for training of all Permanent Way Staff working on LWR/CWR sections shall be made by Chief Engineer by holding special/regular courses in Zonal Training centres and by Sr. DEN/DEN in Divisional Training Centres.

9.2.2 Keyman, Gangmate, PWM,JE(P. Way), PWI,SSE(P.Way) Incharge of section/Sub-section

Only staff trained in laying and maintenance of LWR/CWR shall be posted on LWR/CWR sections. In case of Keyman, Gangmate & PWM,JE(P. Way), only such staff who possess valid competency certificate issued by Zonal/Divisional training centre shall be posted on LWR/CWR section.

9.2.3

9.3 The competency certificate shall be valid for three years from the date of issue.

"DO'S" AND "DONT'S"

For the guidance of Keyman, Gangmate and PWM,JE(P. Way) important do's and dont's have been listed at Annexure-XIV.

ANNEXURE-I A
(Para 1.4)

BREATHING LENGTHS
(For 1310 sleepers/km)

Zone	Type of sleeper	Breathing length (in metres)				
		Broad Gauge			Metre Gauge	
		60kg(UIC) rails	52kg rails	90R rails	90R rails	75R rails
I	PRC	61	52	39	…	…
II	PRC	69	60	45	…	…

Note: *Breathing lengths given above are indicative and are likely to vary as per site conditions.*

ANNEXURE-I B
(Para 1.4)

BREATHING LENGTHS
(For 1540 sleepers/km)

Zone	Type of sleeper	Breathing length (in metres)				
		Broad Gauge			Metre Gauge	
		60kg(UIC) rails	52kg rails	90R rails	90R rails	75R rails
I	PRC	60	52	38	…	…
	ST	77	66	49	134	111
	CST-9	…	89	66	152	126
II	PRC	69	59	44	…	…
	ST	88	75	57	156	130
	CST-9	…	101	76	178	147
III	PRC	77	66	51	…	…
	ST	98	85	65	179	149
	CST-9	…	114	87	202	168
IV	PRC	82	71	55	…	…
	ST	105	90	70	192	160
	CST-9	…	122	94	217	181

Note: *Breathing lengths given above are indicative and are likely to vary as per site conditions.*

ANNEXURE-I C
(Para 1.4)

BREATHING LENGTHS
(For 1660 sleepers/km)

Zone	Type of sleeper	Breathing length (in metres)				
		Broad Gauge			Metre Gauge	
		60kg(UIC) rails	52kg rails	90R rails	90R rails	75R rails
I	PRC	58	50	37	…	…
	ST	73	63	46	…	…
	CST-9	…	86	63	…	…
II	PRC	66	57	43	…	…
	ST	84	72	54	…	…
	CST-9	…	98	74	…	…
III	PRC	74	64	49	…	…
	ST	94	81	62	…	…
	CST-9	…	110	84	…	…
IV	PRC	79	68	53	…	…
	ST	100	86	67	…	…
	CST-9	…	118	91	…	…

Note: *Breathing lengths given above are indicative and are likely to vary as per site conditions.*

ANNEXURE-II
(Para 4.3.1& 4.3.2)

SUPPLEMENTARY INSTRUCTIONS FOR LAYING & MAINTENANCE OF LWR ON CST-9 SLEEPERS ON BG

The following precautions shall be observed before laying and while maintaining LWR/CWR on CST-9 sleepers:-

i) LWR/CWR shall not preferably be provided on CST-9 sleepers in areas where the incidence of derailment is large and/or theft of fastenings is frequent.

ii) Sleepers already in service shall have minimum wear at rail seat and jaws so that keys are effective.

iii) Ballast shall be heaped up in a slope from shoulder to the bottom of rail head on the outside of track.

iv) Crib and shoulder compaction shall invariably be carried out soon after sleeper renewal/through packing/screening/ deep screening or any other operation causing reduction of ballast resistance. Till such compaction is done, suitable speed restriction shall be continued.

v) On single line, both keys in a sleeper should be driven in the same direction and the keys in the next sleeper shall be in reverse direction and so on.

vi) On double line 75 percent of keys should be driven in the direction of traffic and 25 per cent in the opposite direction in the central portion of LWR/CWR. In the breathing lengths, keys should be driven alternately in both directions on successive sleepers.

vii) Attempt should be made to keep both the keys of the same sleeper uniformly tight so as to avoid plates going out of square. Whenever, a fallen key is driven back, the opposite key on the same sleeper should also be adequately driven.

viii) Wherever possible reverse jaw type plates should be replaced with ordinary type plates, since the former afford hindrance while lifting LWR on rollers during destressing.

On-track tamping machine shall preferably be used for maintaining LWR/CWR lengths. In case of manual maintenance, lifting of LWR/CWR track on CST-9 sleepers in excess of 20 mm shall be carried out under the supervision of an Inspector not below the rank of Permanent Way Inspector JE/SSE (P. Way)/Incharge of Sub-Section.

ix) During destressing, before the rail is supported on rollers, the rail seats should be covered by a 3 mm thick MS plate of suitable size so that the rollers do not get stuck into the slits at the rail seats. The cover plates should have two of the opposite edges bent downwards to prevent their slipping off from the rail seats.

x) If it is not possible to drive 100 percent keys within the block period after destressing, 33 percent keys in central portion and 100 percent of the keys in the breathing lengths should be driven first and the traffic resumed at restricted speed. Full speed should be restored only after driving 100 percent keys and giving other attention required.

xi) Creep shall be regularly measured at SEJs and in fixed portion of each LWR panel and records seen by AEN and DEN for taking remedial measures, if required.

ANNEXURE-III

SCHEDULE OF SPEED RESTRICTIONS

Sl. No.	Conditions of track	Restriction imposed in km/h
1.	When 1 metre long slotted fishplates (Fig. 4.4.3(a)) with screw clamps (Fig. 4.4.3(b1)) & M.S. clamp(Fig. 4.4.3(b2)) or joggled fishplates with bolted clamps (Fig. 4.4.3(c)) are used at a temporary rail joint and there is 24 hrs. watch(both BG & MG). However, if the above arrangement is not under 24 hrs. watch, speed restriction of 20 kmph should be imposed, as mentioned in drawings.	30
2.	~~When other clamps are used at a temporary rail joint (both BG and MG)~~	~~20~~
3.	When sleeper fastenings on alternate sleepers are loosened before destressing (both BG & MG)	30
4.	At fracture after emergency repairs are completed:-	
	i) First train	STOP DEAD & 10
	ii) Subsequent trains	20
5.	After emergency repairs to track after buckling:-	
	i) First train	STOP DEAD & 10
	ii) Subsequent trains	20
6.	Speed restriction during consolidation period of track, after regular track maintenance operations when rail temperature exceeds t_d + 20^{O}C:	
	i) When shoulder and crib compaction has been done:-	
	For BG	50
	For MG	40
	ii) When shoulder and crib compaction has not been done:-	
	For BG	30
	For MG	20

ANNEXURE-IV
(Para 5.5.2)

HANDLING INSTRUCTIONS FOR 90 UTS AND HEAD HARDENED RAILS

1. Protection of straightness

Barely visible straightness deviations, for example, a deflection of 0.75 mm over 1.5 metres span, renders a rail unacceptable and require careful handling and stacking. Therefore,

AVOID

- Heavy static loading
- Sudden impact or dynamic loading
- Localised point or line contact loading in stacking
- Excessive end drop and flange overlaps while lifting/moving
- Criss-cross stacking of rails of alternative layers at right angles as far as possible.

DO

- Keep rails horizontal and straight while lifting/moving
- Stack rails of same length on firm level base of well drained platform preferably of concrete
- Stack subsequent layers on uniformly placed spacers in vertical alignment with base supports
- Keep rail ends in vertical alignment
- Place rails of shorter length in upper layers.

2. Protection of rail surface

Surface notches of even less than 0.75 mm in depth are liable to cause rail fracture in service. Therefore,

AVOID

- Impact abrasion of rails against separators in wagons
- Round link chain slings for securing the rails.

DO

- Use conventional slings for lifting rails made of flat link chains

- Lifting of rails preferably with magnet lifting device.

3. Prevention of metallurgical damage

These rails are thermally very sensitive and are likely to develop metallurgical defects if exposed to localised heating, which produces very hard, brittle and cracked metallurgical structures which may lead to sudden failures. Therefore,

AVOID

- Heating, flame cutting, on or adjacent to rails

- Contact with electric arcs and molten metal splashes, i.e. from loose cables or adjacent welding operations.

DO

- Flame cutting when found essential, after preheating minimum of 10 cm of rail length on either side of the cut to about 250-350^{O}C by uniform movement of heating torch.

4. Protection from contact with injurious substances

These rails can withstand normal degree of rusting but localised corrosion pitting may cause subsequent rail fractures. Therefore,

AVOID

- Contact with injurious substances which produce high corrosion of a steel, i.e. acids, alkalis, salts, etc.

DO

- Stack rails on well drained platform preferably on concrete as per drawing No. RDSO/T-4962.

5. Slinging principles

The single point slinging increases risk of bending and surface damage to the rails. The overhang beyond the outer lifting point should not be greater than one half the distance between lifting points. Therefore,

AVOID

- Single point slinging.

DO

- Use two point slinging for rail length upto 13m
- Recommended locations of lifting points for various rail lengths are tabulated below:

Rail length (metres)	No. of lifting points	Distance between lifting points (m)	Max. rail overhang (m)
12 - 13	2	6 - 6.5	3 - 3.25
26	4	6.5	3.25
39	6	6.5	3.25
130	20	6.5	3.25
260	40	6.5	3.25

Use of lifting beams fitted with slings is desirable.

6. Safety of Personnel

AVOID

- Standing under suspended loads.

DO

- Use protective gloves and clothing to minimise the risk of skin abrasion
- Wear distinctive coloured helmet and clothing for easy identification by crane and machinery drivers to avoid accidents.

ANNEXURE-V
(Para 5.6)

GAPS AT SEJ FOR VARIOUS RAIL TEMPERATURES AND TRACK STRUCTURES

1. Gap at SEJ depends on following factors:-

   a) Longitudinal Ballast Resistance of sleepers

   b) Area of rail section

   c) Modulus of Elasticity (E) for rail steel

   d) Coefficient of linear expansion (α) for rail steel

   e) Destressing temperature of the section where gap at SEJ is required

   f) Initial gap at SEJ at destressing temperature

2. Values of above variables for Indian conditions are tabulated below:-

TABLE-I

Rail Section	Area (cm^2)	E (kg/cm^2)	α (/^oC)
60kg (UIC)	76.86	2.15×10^6	1.152×10^{-5}
52kg	66.15	- do -	- do -
90R	56.95	- do -	- do -
75R	47.37	- do -	- do -

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TABLE-II

Longitudinal Ballast Resistance (R) for various sleepers and sleeper density

Type of sleeper	Longitudinal Ballast Resistance in kg/cm/rail			
	Broad Gauge			**Metre Gauge**
	1310 sleepers/km	1540 sleepers/km	1660 sleepers/km	1540 sleepers/km
PRC	12.93	13.28	13.74	-
ST	11.48	12.14	12.68	3.86
CST-9	9.92	10.65	11.04	3.47
Wooden	7.58	7.97	8.06	5.00

Note: *The values given above are indicative and can vary as per site conditions.*

TABLE-III

Initial gap to be provided at destressing temperature (t_d)

Rail Section	Initial gap at t_d (mm)
60kg (UIC)/52kg	40 mm
Others	60 mm

EXAMPLE:-

To find out the gap at SEJ at rail temperature of 58^0C with the following data:

i) Rail section 52kg/m

ii) Type of sleeper PRC

iii)	Sleeper density	1540 sleepers/km
iv)	Temp. zone	IV
v)	Destressing temp.	t_d = 48^{O}C
vi)	Gap at SEJ at t_d	40 mm

First of all hysteresis curve of movement of tongue/stock rail of SEJ will be drawn at different temperatures.

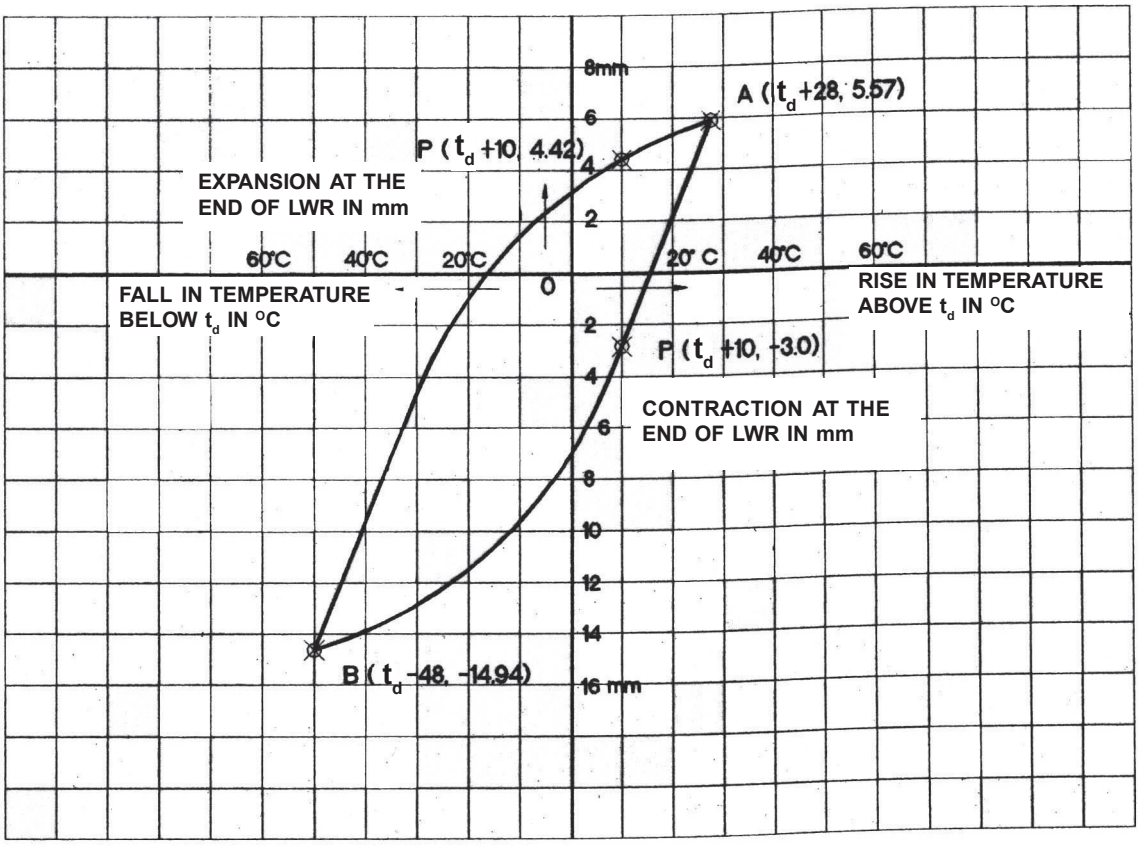

Fig.: A.5(a) HYSTERESIS CURVE SHOWING THE MOVEMENT OF ENDS OF TONGUE/STOCK RAIL OF SEJ

1. Movement of tongue/stock rail from the stage of destressing temperature (point 'O') to the stage of maximum temperature (point 'A') for rising trend of temperature will be:-

= $A E \alpha^2 t^2/2R$

= $66.15 \times 2.15 \times 10^6 \times (1.152 \times 10^{-5})^2 \times (76-48)^2 / 2 \times 13.28$

= 0.557 cm

= 5.57 mm

Hence coordinate of maximum temperature (point 'A') will be (t_d+28, +5.57).

2. Movement of tongue/stock rail from stage of maximum temperature (point 'A') to stage of minimum temperature (point 'B') for decreasing trend of temperature will be:-

= $A E \alpha^2 t^2 / 4R$

= $66.15 \times 2.15 \times 10^6 \times (1.152 \times 10^{-5})^2 \times (76)^2 / 4 \times 13.28$

= 2.052 cm

= 20.52 mm

Hence coordinate of minimum temperature (point 'B') will be

$(t_d+28 - 76,\ 5.57-20.52)$

or $(t_d - 48, -14.95)$

3. Movement of tongue/stock rail from stage of minimum temperature (point 'B') to stage of maximum temperature (point 'A') for increasing trend of temperature will be:-

= $66.15 \times 2.15 \times 10^6 \times (1.152 \times 10^{-5})^2 \times (76)^2 / 4 \times 13.28$

= 2.052 cm

= 20.52 mm

Hence coordinate of maximum temperature (point 'A') will be

$(t_d - 48+76, -14.95 + 20.52)$

or $(t_d+28, +5.57)$

Temperature at which gap at SEJ is required is 58^0C i.e. $(t_d+10)^0$C say point 'P'.

4. Value of movement of tongue/stock rail at $(t_d+10)^0$C point 'P' for falling trend of temperature will be

= $66.15 \times 2.15 \times 10^6 \times (1.152 \times 10^{-5})^2 \times (76 - 58)^2 / 4 \times 13.28$

= 0.115 cm

= 1.15 mm

Hence coordinate at point 'P' for falling trend of temperature will be:-

$(t_d+10,\ 5.57-1.15)$

or $(t_d+10, +4.42)$

5. In the same way, value of movement of tongue/stock at $(t_d+10)^0$C point 'P' for rising trend of temperature will be:-

= $66.15 \times 2.15 \times 10^6 \times (1.152 \times 10^{-5})^2 \times (58)^2 / 4 \times 13.28$

= 1.195 cm

= 11.95 mm

Hence coordinate at point 'P' for rising trend of temperature will be:-

$(t_d+10, -14.95 +11.95)$ or $(t_d+10, -3.0)$

The calculations done above indicate that at temperature $t_d + 10^0C$ i.e. at 58^0C, movement of one side of tongue/stock rail for decreasing trend of temperature is +4.42 and for increasing trend temperature is -3.0 mm.

Hence the gap between the reference mark and tongue rail tip/stock rail corner of SEJ for decreasing trend of temperatures at 58^0C shall be 20*-4.42 = 15.58 mm and for increasing trend of temperatures shall be 20* +3.0 = 23 mm. Thus theoretical range will be 15.58 mm to 23 mm.

Note: ** Value of 20 mm taken as standard gap to be provided between reference mark and tongue rail tip/stock rail corner at destressing temperature. If gap to be provided at destressing temperature is 30 mm, then these values will be (30-4.42) mm to (30+3.0) mm i.e. 25.58 mm to 33 mm respectively.*

Similarly values of gaps for various temperatures, track structures, temperature zones etc. can be calculated.

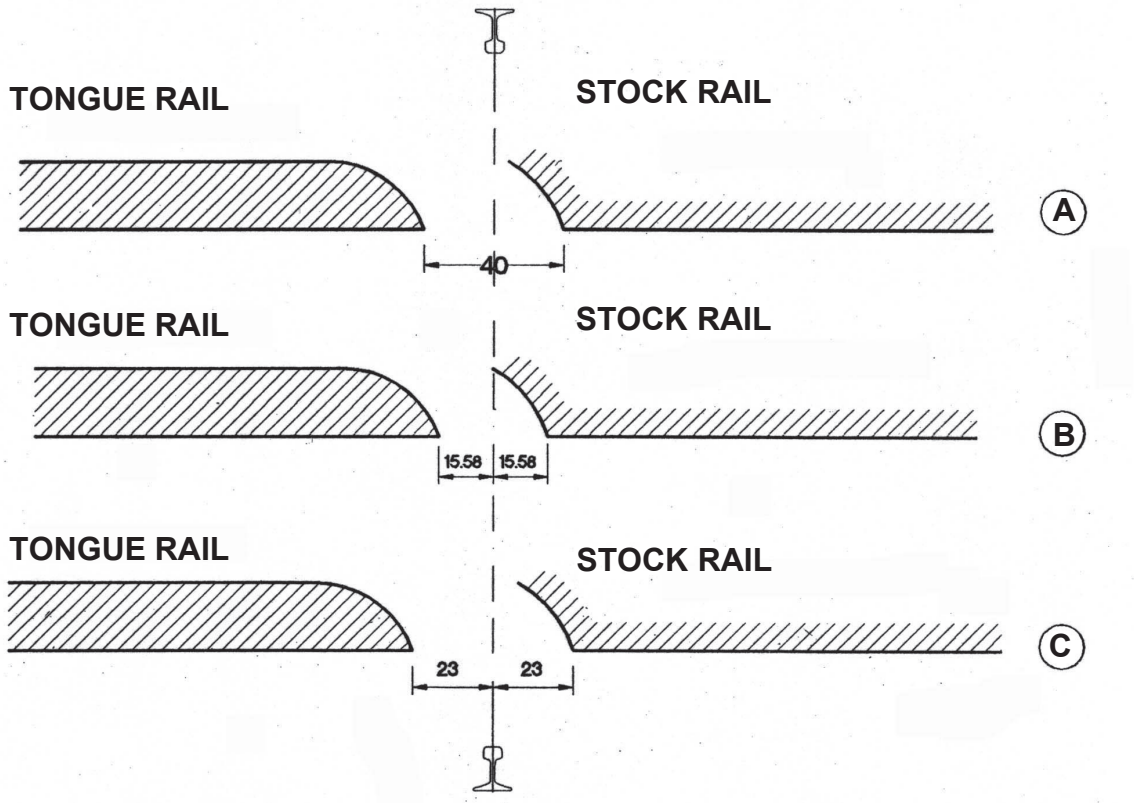

Fig.: A.5(b) GAP AT SEJ AS PER EXAMPLE GIVEN IN ANNEXURE-V

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 60kg, PRC SLEEPER, 1660 Nos/ km , VALUE OF R (BALLAST RESISTANCE) ASSUMED = 13.74 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 28	-	-	-	14
t_d + 25	-	-	15	14 to 16
t_d + 20	-	17	15 to 18	14 to 18
t_d + 15	18	17 to 19	15 to 20	14 to 21
t_d + 10	18 to 20	17 to 21	16 to 23	15 to 23
t_d + 05	19 to 22	18 to 23	17 to 25	16 to 26
t_d	19 to 23	18 to 25	18 to 27	17 to 28
t_d - 05	20 to 25	19 to 26	19 to 28	18 to 29
t_d - 10	21 to 26	20 to 28	20 to 30	20 to 31
t_d - 15	22 to 27	22 to 29	21 to 31	21 to 32
t_d - 20	23 to 27	23 to 30	23 to 32	23 to 34
t_d - 25	25 to 28	25 to 30	25 to 33	25 to 35
t_d - 30	26 to 28	27 to 31	27 to 34	27 to 36
t_d - 35	28	29 to 31	29 to 34	29 to 36
t_d - 40	-	31	32 to 34	32 to 37
t_d - 45	-	-	35	35 to 37
t_d - 48	-	-	-	37

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm. Where SEJs had initially been set with a gap of 60 mm, 10 mm should be added to each of above values for comparison of gaps at site.*

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 60 kg, PRC SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 13.28 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 28	-	-	-	13
t_d + 25	-	-	15	13 to 14
t_d + 20	-	17	15 to 18	14 to 15
t_d + 15	18	17 to19	15 to 20	14 to 18
t_d + 10	18 to 20	17 to 21	16 to 23	14 to 21
t_d + 05	19 to 22	18 to 23	16 to 25	16 to 26
t_d	19 to 23	18 to 25	17 to 27	17 to 28
t_d - 05	20 to 25	19 to 27	19 to 28	18 to 30
t_d - 10	21 to 26	20 to 28	20 to 30	20 to 31
t_d - 15	22 to 27	22 to 29	21 to 31	21 to 33
t_d - 20	23 to 28	23 to 30	23 to 32	23 to 34
t_d - 25	25 to 28	25 to 31	25 to 33	25 to 35
t_d - 30	27 to 28	27 to 31	27 to 34	27 to 36
t_d - 35	28	29 to 31	30 to 35	30 to 37
t_d - 40	-	32	32 to 35	33 to 37
t_d - 45	-	-	35	36 to 37
t_d - 48	-	-	-	37

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm. Where SEJs had initially been set with a gap of 60 mm, 10 mm should be added to each of above values for comparison of gaps at site.*

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 60kg. ST SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 12.14 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 28	-	-	-	13
t_d + 25	-	-	14	13 to 15
t_d + 20	-	16	14 to 17	13 to 18
t_d + 15	18	17 to 19	15 to 20	14 to 22
t_d + 10	18 to 20	17 to 21	15 to 23	15 to 24
t_d + 05	18 to 22	17 to 24	16 to 25	16 to 26
t_d	19 to 24	18 to 25	17 to 27	17 to 28
t_d - 05	20 to 25	19 to 27	18 to 29	18 to 30
t_d - 10	21 to 26	20 to 29	20 to 31	19 to 32
t_d - 15	22 to 27	22 to 30	22 to 32	21 to 34
t_d - 20	24 to 28	24 to 31	24 to 34	23 to 35
t_d - 25	25 to 29	26 to 32	26 to 35	25 to 36
t_d - 30	27 to 29	28 to 32	28 to 35	28 to 37
t_d - 35	29	30 to 33	31 to 36	30 to 38
t_d - 40	-	33	33 to 36	33 to 38
t_d - 45	-	-	36	36 to 38
t_d - 48	-	-	-	38

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm. Where SEJs had initially been set with a gap of 60 mm, 10 mm should be added to each of above values for comparison of gaps at site.*

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 52 kg, PRC SLEEPER, 1660 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 13.74 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 28	-	-	-	15
t_d + 25	-	-	16	15 to 16
t_d + 20	-	17	16 to 18	15 to 19
t_d + 15	18	17 to 19	16 to 20	15 to 21
t_d + 10	19 to 20	18 to 21	17 to 22	16 to 23
t_d + 05	19 to 22	18 to 23	17 to 24	16 to 25
t_d	19 to 23	19 to 24	18 to 26	17 to 27
t_d - 05	20 to 24	19 to 25	19 to 27	18 to 28
t_d - 10	21 to 25	20 to 27	20 to 28	20 to 30
t_d - 15	22 to 26	21 to 27	21 to 29	21 to 31
t_d - 20	23 to 26	23 to 28	23 to 30	23 to 32
t_d - 25	24 to 27	24 to 29	24 to 31	24 to 33
t_d - 30	25 to 27	26 to 29	26 to 32	26 to 33
t_d - 35	27	28 to 30	28 to 32	28 to 34
t_d - 40	-	30	30 to 32	31 to 34
t_d - 45	-	-	33	33 to 34
t_d - 48	-	-	-	34

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm. Where SEJs had initially been set with a gap of 60 mm, 10 mm should be added to each of above values for comparison of gaps at site.*

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 52 kg, PRC SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 13.28 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 28	-	-	-	14
t_d + 25	-	-	16	14 to 16
t_d + 20	-	17	16 to 18	15 to 19
t_d + 15	18	17 to 19	16 to 20	15 to 21
t_d + 10	1 8 to 20	18 to 21	16 to 22	16 to 23
t_d + 05	19 to 22	18 to 23	17 to 24	16 to 25
t_d	19 to 23	19 to 24	18 to 26	17 to 27
t_d - 05	20 to 24	19 to 26	19 to 27	18 to 28
t_d - 10	21 to 25	20 to 27	20 to 29	20 to 30
t_d - 15	22 to 26	22 to 28	21 to 30	21 to 31
t_d - 20	23 to 26	23 to 29	23 to 31	23 to 32
t_d - 25	24 to 27	24 to 29	24 to 32	24 to 33
t_d - 30	26 to 27	26 to 30	26 to 32	26 to 34
t_d - 35	27	28 to 30	28 to 33	29 to 34
t_d - 40	-	30	31 to 33	31 to 35
t_d - 45	-	-	33	33 to 35
t_d - 48	-	-	-	35

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm. Where SEJs had initially been set with a gap of 60 mm, 10 mm should be added to each of above values for comparison of gaps at site.*

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAILCORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 52 kg, ST SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 12.14 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 28	-	-	-	14
t_d + 25	-	-	15	14 to16
t_d + 20	-	17	15 to18	14 to 18
t_d + 15	18	17 to19	16 to 20	15 to 22
t_d + 10	18 to 20	17 to 21	16 to 22	15 to 23
t_d + 05	19 to 22	18 to 23	17 to 24	16 to 25
t_d	19 to 23	18 to 25	18 to 26	17 to 27
t_d - 05	20 to 24	19 to 26	19 to 28	18 to 29
t_d - 10	22 to 26	20 to 27	20 to 29	20 to 31
t_d - 15	22 to 26	22 to 28	21 to 31	21 to 32
t_d - 20	23 to 27	23 to 28	23 to 32	23 to 33
t_d - 25	24 to 28	25 to 30	25 to 33	25 to 34
t_d - 30	26 to 28	27 to 30	27 to 33	27 to 35
t_d - 35	28	29 to 31	29 to 34	29 to 36
t_d - 40	-	31	32 to 34	32 to 36
t_d - 45	-	-	34	35 to 36
t_d - 48	-	-	-	36

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm. Where SEJs had initially been set with a gap of 60 mm, 10 mm should be added to each of above values for comparison of gaps at site.*

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 52 kg, CST-9 SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 10.65 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 28	-	-	-	13
t_d + 25	-	-	14	13 to 15
t_d + 20	-	16	15 to 17	13 to 18
t_d + 15	18	17 to 19	15 to 20	14 to 21
t_d + 10	18 to 20	17 to 21	15 to 23	15 to 24
t_d + 05	18 to 22	17 to 23	16 to 25	15 to 26
t_d	19 to 24	18 to 25	17 to 27	17 to 28
t_d - 05	20 to 25	19 to 27	18 to 29	18 to 30
t_d - 10	21 to 26	20 to 28	20 to 31	19 to 32
t_d - 15	22 to 27	22 to 30	22 to 32	22 to 34
t_d - 20	23 to 28	24 to 31	23 to 33	23 to 35
t_d - 25	25 to 29	25 to 31	26 to 34	26 to 36
t_d - 30	27 to 29	28 to 32	28 to 35	28 to 37
t_d - 35	29	30 to 32	30 to 36	31 to 38
t_d - 40	-	32	33 to 36	34 to 38
t_d - 45	-	-	36	37 to 39
t_d - 48	-	-	-	39

Note: *The above values have been calculated with initial setting of gaps at SEJ as 40 mm. Where SEJs had initially been set with a gap of 60 mm, 10 mm should be added to each of above values for comparison of gaps at site.*

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 90R, PRC SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 13.28 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-sIV
t_d + 33	-	-	-	23
t_d + 30	-	-	24	23 to 25
t_d + 25	-	26	25 to 27	24 to 27
t_d + 20	28	26 to 28	25 to 28	24 to 29
t_d + 15	28 to 29	26 to 30	25 to 30	24 to 31
t_d + 10	28 to 30	27 to 31	26 to 32	25 to 32
t_d + 05	28 to 31	27 to 32	26 to 33	26 to 34
t_d	29 to 32	28 to 33	27 to 35	27 to 35
t_d - 05	29 to 33	29 to 34	28 to 36	28 to 37
t_d - 10	30 to 34	30 to 35	29 to 37	29 to 38
t_d - 15	31 to 35	31 to 36	31 to 38	30 to 39
t_d - 20	32 to 35	32 to 37	32 to 38	32 to 39
t_d - 25	34 to 35	34 to 37	34 to 39	34 to 40
t_d - 30	35	35 to 37	35 to 39	35 to 40
t_d - 35	-	37	37 to 39	37 to 41
t_d - 40	-	-	39	40 to 41
t_d - 43	-	-	-	41

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 90R, ST SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 12.14 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 33	-	-	-	23
t_d + 30	-	-	24	23 to 24
t_d + 25	-	26	24 to 26	23 to 27
t_d + 20	27	26 to 28	24 to 28	23 to 29
t_d + 15	27 to 29	26 to 30	25 to 30	24 to 31
t_d + 10	28 to 30	27 to 31	25 to 32	24 to 33
t_d + 05	28 to 32	27 to 33	26 to 34	25 to 34
t_d	29 to 33	28 to 34	27 to 35	26 to 36
t_d - 05	29 to 34	29 to 35	28 to 36	28 to 37
t_d - 10	30 to 34	30 to 36	29 to 37	29 to 38
t_d - 15	31 to 35	31 to 37	31 to 38	30 to 39
t_d - 20	33 to 35	33 to 37	32 to 39	32 to 40
t_d - 25	34 to 36	34 to 38	34 to 40	34 to 41
t_d - 30	36	36 to 38	36 to 40	36 to 41
t_d - 35	-	38	38 to 40	38 to 42
t_d - 40	-	-	40	40 to 42
t_d - 43	-	-	-	42

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAILTIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR BG, 90R, CST-9 SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 10.65 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 33	-	-	-	22
t_d + 30	-	-	23	22 to 23
t_d + 25	-	25	23 to 26	22 to 26
t_d + 20	27	25 to 27	24 to 28	22 to 29
t_d + 15	27 to 29	26 to 29	24 to 30	23 to 31
t_d + 10	27 to 30	26 to 31	25 to 32	24 to 33
t_d + 05	28 to 32	27 to 33	26 to 34	25 to 35
t_d	28 to 33	28 to 34	27 to 36	26 to 37
t_d - 05	29 to 34	29 to 36	28 to 37	27 to 38
t_d - 10	30 to 35	30 to 37	29 to 38	29 to 40
t_d - 15	32 to 36	31 to 37	31 to 39	30 to 41
t_d - 20	33 to 36	33 to 38	33 to 40	32 to 42
t_d - 25	35 to 36	35 to 39	35 to 41	35 to 42
t_d - 30	36	37 to 39	37 to 41	37 to 43
t_d - 35	-	39	39 to 42	39 to 43
t_d - 40	-	-	42	42 to 44
t_d - 43	-	-	-	44

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR MG, 90R, ST SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 3.86 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 33	-	-	-	7
t_d + 30	-	-	11	7 to 12
t_d + 25	-	17	11 to 18	8 to 19
t_d + 20	22	17 to 23	12 to 25	9 to 26
t_d + 15	22 to 27	18 to 28	13 to 31	10 to 32
t_d + 10	23 to 31	19 to 33	15 to 36	13 to 38
t_d + 05	24 to 35	21 to 38	18 to 41	15 to 44
t_d	26 to 38	23 to 42	21 to 46	19 to 48
t_d - 05	28 to 41	26 to 45	24 to 50	22 to 53
t_d - 10	31 to 44	30 to 48	28 to 53	27 to 56
t_d - 15	34 to 46	34 to 51	32 to 56	31 to 60
t_d - 20	38 to 47	38 to 52	37 to 58	37 to 62
t_d - 25	43 to 48	43 to 54	43 to 60	42 to 64
t_d - 30	48	49 to 54	49 to 62	49 to 66
t_d - 35	-	55	56 to 62	56 to 67
t_d - 40	-	-	62	63 to 68
t_d - 43	-	-	-	68

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR MG, 90R, CST-9 SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 3.47 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 33	-	-	-	5
t_d + 30	-	-	9	5 to 10
t_d + 25	-	15	9 to 17	5 to 18
t_d + 20	22	16 to 22	10 to 24	7 to 26
t_d + 15	22 to 26	17 to 28	12 to 31	8 to 33
t_d + 10	22 to 31	18 to 34	14 to 37	11 to 39
t_d + 05	23 to 36	20 to 39	16 to 43	14 to 45
t_d	25 to 39	23 to 43	19 to 48	17 to 50
t_d - 05	28 to 43	26 to 47	23 to 52	21 to 55
t_d - 10	31 to 45	30 to 50	28 to 56	26 to 59
t_d - 15	35 to 47	34 to 53	33 to 59	32 to 63
t_d - 20	39 to 49	39 to 55	38 to 62	37 to 66
t_d - 25	44 to 50	45 to 56	44 to 64	44 to 68
t_d - 30	50	51 to 67	51 to 65	51 to 70
t_d - 35	-	58	58 to 66	59 to 71
t_d - 40	-	-	66	67 to 72
t_d - 43	-	-	-	72

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR MG, 75R, ST SLEEPER, 1540 Nos/km, VALUE OF R (BALLAST RESISTANCE) ASSUMED = 3.86 kg/cm/rail AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 33	-	-	-	11
t_d + 30	-	-	14	11 to 15
t_d + 25	-	19	14 to 20	11 to 21
t_d + 20	23	19 to 24	15 to 26	12 to 27
t_d + 15	23 to 27	20 to 29	16 to 31	14 to 32
t_d + 10	24 to 31	21 to 33	18 to 35	16 to 37
t_d + 05	25 to 34	23 to 37	20 to 39	18 to 41
t_d	26 to 37	25 to 40	22 to 43	20 to 45
t_d - 05	28 to 39	27 to 43	25 to 46	24 to 49
t_d - 10	31 to 41	30 to 45	28 to 49	27 to 54
t_d - 15	34 to 43	33 to 47	32 to 52	31 to 55
t_d - 20	37 to 44	37 to 49	36 to 54	36 to 57
t_d - 25	41 to 45	41 to 50	41 to 55	40 to 59
t_d - 30	45	46 to 50	46 to 56	46 to 60
t_d - 35	-	51	51 to 57	51 to 61
t_d - 40	-	-	57	58 to 61
t_d - 43	-	-	-	62

ANNEXURE-V

GAPS BETWEEN THE REFERENCE MARK AND TONGUE RAIL TIP/STOCK RAIL CORNER OF SEJ FOR VARIOUS TEMPERATURES IN mm FOR MG, 75R, CST-9 SLEEPER, 1540 Nos/kms VALUE OF R (BALLAST RESISTANCE) ASSUMED = 3.47 kg/cm/rall AND t_d AS PER PARA 1.11:-

Temperature	Zone-I	Zone-II	Zone-III	Zone-IV
t_d + 33	-	-	-	9
t_d + 30	-	-	12	9 to 13
t_d + 25	-	18	13 to 19	9 to 20
t_d + 20	22	18 to 23	13 to 25	10 to 26
t_d + 15	22 to 27	19 to 29	15 to 31	12 to 32
t_d + 10	23 to 31	20 to 33	16 to 36	14 to 38
t_d + 05	24 to 35	22 to 37	19 to 40	16 to 43
t_d	26 to 38	24 to 41	24 to 45	19 to 47
t_d - 05	28 to 40	27 to 44	24 to 48	23 to 51
t_d - 10	31 to 43	30 to 47	28 to 51	27 to 54
t_d - 15	34 to 44	33 to 49	32 to 54	31 to 57
t_d - 20	38 to 46	38 to 51	37 to 56	36 to 60
t_d - 25	42 to 46	42 to 52	42 to 58	42 to 62
t_d - 30	47	47 to 53	48 to 59	47 to 63
t_d - 35	-	53	54 to 60	54 to 65
t_d - 40	-	-	60	61 to 65
t_d - 43	-	-	-	65

ANNEXURE-VI

WORK CHART AND AUTHORISED LEVEL OF SUPERVISION

Sl. No.	Nature of work	Details of work	Lowest level of staff/Supervisor incharge of work
1	2	3	4
1.	**Maintenance operation**		
	a) Mechanised		
	Tamping		PWI,JE/SSE(P.Way)
	Lifting (general lift) Alignment		
	Minor alignment of curves Deep screening		
	b) Manual		Gangmate
	Packing		
	Alignment		
	c) (i) Lifting/Lowering of track (done in normal maintenance of track		PWM,JE(P. Way)
	(ii) Lifting/Lowering of track (beyond that is done in normal maintenance of track)		PWM,JE(P. Way) (Competency certificate should be issued by Chief Track Engineer) ACS 14
	d) Lifting, aligning, packing etc., in case of emergencies at temperatures higher than those permitted		PWI,JE/SSE(P.Way)
2.	**Rails, sleepers and fastenings**	a) Ensuring that all creep anchors butt against sleepers during daily rounds	Keyman
		b) Packing or renewal of single isolated sleeper not requiring lifting or slewing of track	Gangmate
		c) Renewal of fastenings not requiring lifting	Keyman
		d) Renewal/recoupement of fastenings requiring lifting	Gangmate

1	2	3	4
		e) Casual renewal of sleepers and fastenings over long stretches	PWM,JE(P. Way)
		f) Renewal of defective rails	PWM,JE/SSE(P. Way) PWI
		g) Carrying out welding of rail joints at site	Gangmate
3.	**Ballast**	a) Making up shortage of ballast in shoulders at isolated places	PWI,JE/SSE(P.Way)
		b) Replenishment of ballast & checking ballast section before the onset of summer	Gangmate
		c) Screening of ballast other than deep screening	PWM,JE(P. Way)
		d) Deep screening	(Competency certificate should be issued by Chief Track Engineer)
			ACS 14
4.	**Curve realignment**	a) Minor realignment of curves	PWM,JE(P. Way)
		b) Major realignment of curves under special instructions from AEN	PWI, JE/SSE(P.Way)
5.	**Hot weather work**	a) Imposing speed restriction if the temperature exceeds t_d+20^{0}C after maintenance work is completed, manually or by machines	Gangmate
		b) Organising hot weather patrolling during summer months	PWI,JE/SSE(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^{0}C	Gangmate

1	2	3	4
		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	PWI,JE/SSE(P.Way)
6.	**Cold weather patrolling**	Cold weather patrolling	Cold weather patrolman
7.	**Destressing**	All operations regarding destressing	PWI,JE/SSE(P.Way)
8.	**Rail fracture**	a) Emergency repairs	Keyman/Gangman
		b) Temporary repairs	PWM,JE(P. Way)
		c) Permanent repairs	PWI,JE/SSE(P.Way)
9.	**Buckling**	a) Protection of track and secure safety of trains in case of buckling, rail fractures, or any abnormal behavior of track	Patrolman/Gangman/ Gangmate
		b) Emergency repairs	PWI,JE/SSE(P.Way)
		c) Permanent repairs	PWI,JE/SSE(P.Way)
10.	**Emergencies**	Action in case of damage to track following derailments, breaches etc.	Keyman
11.	**Inspection & checking**	a) Checking of SEJ, oiling and greasing and re-tightening/ renewal of fittings once a fortnight	PWI,JE/SSE(P.Way)
		b) Inspection of SEJ	

Note: *Hot and Cold Weather Patrolmen should be aware of their duties and should be drawn, as far as possible, from Gangs.*

ANNEXURE-VII

(Para 5.7.2 & 5.7.3)

EXTENSION TABLE

Extensions in mm, based on formula $e = L \alpha (t_o - t_p)$

(^oC)	L in metres													
$t_o - t_p$	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

ANNEXURE-VIII
(Para 5.7.4)

DESTRESSING OPERATION OF LWRs/CWRs PANELS WITHOUT THE USE OF RAIL TENSOR

1. 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 in para 1.11 during the fastening down operations. The entire work shall be done under personal supervision of the PWI,JE/SSE(P.Way).

2. Before the block is actually taken, a speed restriction of 30 km/h should be imposed and fastenings on alternate sleepers loosened.

3. When the block is taken, the closure rails shall be removed, the SEJs adjusted as per para 5.6 and fastened.

4. The remaining sleepers 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. 5.3 (viii) (a)) at every 15th sleeper to permit the rails to move freely. While destressing on curved track, provision of side rollers as per note of para 5.7.2 (v) may be adopted. The rails shall be struck horizontally with heavy wooden mallets to assist in their longitudinal movement.

5. 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 as specified in para 1.11. The actual range of temperature during the period of tightening shall be recorded by PWI,JE/SSE(P.Way) along with the time and date.

6. Simultaneously with the tightening of fastening, arrangements for insertion of cut rails 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 metre on each end of the LWR shall be removed before welding. Joints shall be clamped for 20 minutes after welding.

ANNEXURE-IX
(Para 1.6)

INSTRUCTIONS FOR LAYING AND MAINTENANCE OF BUFFER RAILS AT THE END OF LWRs/CWRs

1. Buffer Rails may be provided subject to conditions laid down in para 1.6.

2. In rail temperature zones I & II, 3 buffer rails, while in zones III & IV, 4 buffer rails shall be provided. On BG, buffer rails would be 6.5 metre long and while for MG 6.0 metre long.

3. Buffer rails may be laid on PRC sleepers with J-clips or on wooden sleepers with M.S. canted bearing plate and rail screws. Standard fishplates shall be used at the joints. However, for effective tightness of bolts, bolt to drawing No. T-11599 may be used in lieu of that of drawing No. RDSO/T-1899. The number, type and spacing of sleepers for buffer rail assembly shall be as indicated in Fig. A.9(a) and Fig. A.9(b) for BG & MG respectively.

4. A gap of 7.5 mm shall be provided at each of fishplated joints of buffer rail assembly at the time of initial laying/destressing.

5. The fishplated joints of buffer rails shall be accurately fabricated. In case pre-drilled rails and standard fishplates are used, the dimensions and squareness of rail ends shall conform to the tolerances stipulated in the specifications IRS T-12 for rails and IRS T-1 for fishplates. Holes drilled at site shall also conform to the above specifications. All holes in buffer rails shall be chamfered.

6. In the case of buffer rails laid between conventional track and LWR, the former shall be box-anchored for 3 rail lengths.

7. Special and prompt attention shall be paid to the alignment and levels of track in the buffer rail portions. Buffer rails shall be free of kinks and hogs. The inspecting officials shall critically examine the buffer rails each time they pass over the same.

8. The fish-bolts shall be kept tight at all times.

9. Joints in buffer rails shall be lubricated twice in a year when the rail temperature is between t_d+15^{0}C and t_d-15^{0}C and when the average gap value is between 3 mm and 12 mm. The rail ends shall be examined at the time of lubrication for any crack around bolt-holes. Bent fish-bolts, if any, shall be replaced. General instructions for lubricating fishplated joints as laid down in para 241 of Indian Railways Permanent Way Manual shall be followed.

10. a) The individual gaps in the buffer rail portion may vary and no attempt to equalise them need be made.

b) The gap of buffer rails shall be measured as per schedule laid down for SEJs as per para 8.1.5. In addition to above schedule, the gaps shall also be carefully inspected during regular inspections. In rail temperature zones III & IV, if all the gaps are found to close at a temperature lower than $t_d + 30^0C$ and/or to fully open to 15 mm at a temperature higher than $t_d - 30^0C$, it indicates one or more of the following:-

i) Defective initial gaps

ii) Inadequate packing in breathing length

iii) Relative movement of rail over sleepers in breathing lengths

iv) Creep of LWR

For rail temperature zones I & II the lower limit of temperature for gap closing and the upper limit of temperature for fully opening of gaps shall be taken as $t_d + 25^0C$ and $t_d - 25^0C$.

c) Rectification shall be done by destressing the LWRs/CWRs and by restoring initial gaps as 7.5 mm. Breathing lengths shall be well packed. Other remedial measures for proper functioning of LWRs/CWRs will also be taken.

11. Details of buffer rails and gap measurement of fishplated joints shall be recorded at the time of initial laying/subsequent inspections as per proforma given below.

Proforma for register of maintenance of buffer rails

LWR No. _____

Kilometrage _____

No. and lengths of buffer rails _____

Type of sleepers and fastenings _____

Date of commissioning _____

Destressing temperature (t_d) _____

Initial gap provided while commissioning _____

1. Date of measurement/destressing
2. Rail temperature at the time of measurement/destressing
3. Gap measurements/Gaps restored
   - a) Left side
     - i) Individual gaps
     - ii) Average gap
   - b) Right side
     - i) Individual gaps
     - ii) Average gap
4. Condition of bolts
5. Track parameters in buffer rail zone (ground measurement)
   - i) Maximum gauge variation
   - ii) Maximum twist over 3.6 m
   - iii) Unevenness over 3.6 m
   - iv) Misalignment over 3.2 m
6. Remarks regarding retentivity of packing
7. Signature of PWI,JE/SSE(P.Way) Incharge/JE/ SSE(P.Way) Sub-sectional PWI

ANNEXURE-X A
(Para 9.1.2 (i))
HOT WEATHER PATROLLING

Period for hot weather patrolling shall be laid down by the Chief Engineer for each section and patrol charts prepared where necessary. Patrolling shall be organised by PWI,JE/SSE(P.Way) accordingly. In addition, the PWI/PWM,JE(P. Way) and the Gangmate shall be vigilant during summer and on hot days. Patrolling will also be introduced, when the rail temperature rises above:

(i) Td + 25 deg C on PSC sleeper track with sleeper density 1540 nos. Per km and above.

(ii) Td + 20 deg C on PSC sleeper track with sleeper density less than 1540 nos. Per km and track other than PSC sleeper.

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1. Hot weather patrolling will be carried out 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.

2. The hot weather patrolman should always carry the following equipments:-

HS Flags - Red	2
Staff for Flags	1
Detonators	10
Canne-a-boule	1

3. Duties of hot weather patrolman are as follows:-

   He will walk over his beat slowly over one rail in one direction and on the other 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 days. 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 sounding will be done by dropping a canne-a-boule on each end of the sleeper to determine the extent of void under the sleeper. Should the sounding 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 Gangmate, PWM,JE/SSE(P Way), PWI of his apprehension of a buckle/actual buckle.

4. 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 tool. **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 PWM, JE/SSE(P Way)/PWI. 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 upto the level of rail head on the outside by ballast or leaves etc. to bring down the temperature of the rail.

ANNEXURE-X B
(Para 9.1.2 (ii))

COLD WEATHER PATROLLING

Cold weather patrolling shall be introduced when rail temperature is less than t_d - 30^0C. Period and section where cold weather patrolling is to be done shall be laid down by the Chief Engineer and patrol charts prepared where necessary. Patrolling shall be organised by PWI-SSE(P.Way)-Incharge accordingly. Following guidelines may be followed for issuing detailed guidelines by the Chief Engineer.

1. Cold weather patrolling shall be carried out as follows:-

   i) On single line or where only one road in a double section is having LWR/CWR - One patrolman for two kilometre.

   ii) On double line section when LWR/CWR rest on both road - One patrolman for one kilometre length of UP and DN road.

   iii) Changes in beat length and man power deployment as given above if found necessary, may be decided by the Chief Engineer depending on prevailing local conditions, frequency of train service, weather conditions etc.

2. Cold weather patrolman should carry the following equipments: -

   a) 10 fog signals in a tin case

   b) Two tri-colour hand signal lamps

   c) One match box

   d) Two red flags and one green flag

   e) One three-cell electric torch

   f) One staff

   g) Number plate

3. Duties of cold weather patrolman are as follows:-
   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. After protecting the track the patrolman will arrange to report to Keyman/ Gangmate/PWM,JE/SSE(P Way)/ PWI, who shall arrange for making emergency repairs to pass the traffic immediately.

ANNEXURE-X C
(Para 9.1.2)

MOBILE WATCHMAN

1. Mobile watchman shall be posted, till period of consolidation is over, on stretches where after maintenance operation, rail temperature has exceeded t_d+20^{0}C during the period of consolidation as given in para 1·18. They would be withdrawn when the period of consolidation is over and the track behaves satisfactorily.

2. Number of Mobile watchman required to be posted would depend upon the length of track attended by manual or by tampers. Normally one Mobile watchman would be sufficient for one kilometre of track.

3. Mobile watchman will be provided with all equipments as per para 2 of Annexure-X A or X B as the case may be.

4. Mobile watchman posted on these sites would patrol the section, which has been freshly packed and for which period of consolidation is not over. He shall be vigilant and will look out for incipient buckles and kinks in the rails. He will also observe for rail/weld failures and gaps at SEJs.

5. When a kink is observed, he will take action as specified in Para 3 of Annexure - X A.

6. If a rail/weld failure is observed or gaps at SEJs become more than the designed maximum gap of the SEJ, action as specified in Para 3 of Annexure - X B will be taken.

ANNEXURE - XI
(Para 8.2.1)

DIVISION:

SUB - DIVISION:

PWI-SSE(P.Way)-Incharge:

LWR/CWR No.:

DETAILS OF STRUCTURE OF LWR/CWR AS LAID:

1. GENERAL

i) Kilometers to

ii) Between stations and

iii) Up/Down/Single line

iv) Date of laying

2. TRACK STRUCTURE

2.1 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/Gas pressure

vii) Length welded into panels at depot

viii) Whether fish-bolt holes provided Yes/No

(ix) Thermit welding done in-situ/on cess by ordinary alumino-thermic process/ quick alumino-thermic process/SKV/ FB by Mobile plant

2.2 Sleepers

i) Type

ii) Density or No. per km.

iii) Type of fastenings

iv) Rail anchors if in use

v) Details of sleepers anchored

vi) Lengths of track box-anchored, location, reasons

2.3 Ballast and Sub-Ballast

i) Size (mm)

ii) Depth of cushion (mm)

iii) Date of last deep screening of ballast

2.4 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 by machined, insulated or welded joint

2.5 Girder Bridges

i) Location and No.

ii) Lengths and spans of bridges with LWR/CWR

iii) Type of fastenings used

iv) Any other remarks

2.6 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-XII
(Para 8.2.1)

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 5.2

ii) Max. rail temperature ^{0}C

iii) Max. ambient temperature ^{0}C

iv) Minimum rail temperature ^{0}C

v) Minimum ambient temperature ^{0}C

3. Details of Installation, Destressing etc.

Items (i) to (iv) to be entered soon after LWR is laid and destressed for the first time.

i) Installation temperature

ii) Mean rail temperature for the locality

iii) Temperature at the time of destressing t_d

iv) Reasons for carrying out the destressing

v) Subsequent destressing 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

i) Any trouble subsequent to laying and the treatment given

ANNEXURE-XIII 'A'

(PARA 8.2.1)

CHART OF MOVEMENT OF LWR/CWR No_____

SEJs at the ends of this LWR : SEJ No_____at Km_____; SEJ No_____at Km_____

Date of meas-urement	Time of meas-urement	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 (b)	Permissible Range	At SEJ No:___	At SEJ No:__		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 will 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. 5.6.1 & 5.6.3), 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. 5.6.2), distance shall be measured between tongue rail & reference line in the gap adjacent to LWR , the movement of which is being recorded. Please refer to Fig. 8.2.1 for illustration.
3. Permissible range for IRS Design SEJ and Improved SEJ of both SG80 & DG65 designs shall be governed by para 5.6.
4. Left and right rails on double lines are determined looking in the direction of traffic.
5. Left and right rails on single lines are determined, looking in the direction of increasing kilometrage.
6. If centre to centre spacing of two central sleepers of IRS Design i.e. Conventional SEJ differ by more than 700 $\pm$ 10 mm, immediate rectification will be made.

ANNEXURE-XIII B
(Para 8.2.1)
CHART OF MOVEMENT IN CENTRAL PORTION OF LWR/CWR No. .....

Right or Left Rail	Distance (mm) between Ref. mark & mark on Rail at various Ref. Pillars in non-B.L. 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 traffic on double lines and in the direction of heavier traffic on single lines which shall be specified.

ANNEXURE-XIV
(Para 9.3)

DOs OF LWR FOR PWM,JE(P Way), MATES & KEYMAN

1. Check and carry LWR/CWR equipment daily. Each Gangmate/PWM, JE(P. Way) should keep two sets of joggled fishplates, 2 clamps, one rail thermometer, special 1m long fishplates, rail closure pieces, one straight edge and one feeler-gauge. The thermometer should be regularly checked with that of standard thermometer kept in PWI-SSE(P.Way)-Incharge office.
2. Know the t_d of your section/panels.
3. Keep the ballast section full and in compacted condition particularly in cribs and shoulders. Deficiency in ballast shall be brought to the notice of PWI,JE/ SSE(P.Way).
4. Keep close watch on pedestrian and cattle crossings, where the ballast is always disturbed. Make up ballast deficiency promptly.
5. Get your SEJs oiled and greased once in a fortnight.
6. Check the gaps of SEJ at extremes of temperatures.
7. Train men in detecting buckling, rail fractures etc. and protection of the trains in such cases.
8. Keep the patrolling equipments always handy and start patrolling of track as soon as temperature exceeds t_d+20^0C which is marked on the thermometer in red.
9. Commence patrolling as per laid down schedule for the prescribed periods.
10. Keep sharp look out for severe alignment defects in summer. Protect the trains and report to supervisors.
11. Keep the anchors wherever provided always butting against the sleepers.
12. Renew fittings only on one sleeper at a time.
13. Ensure that fittings are tightly fitted at proper places at all times.
14. Pack loose sleepers without lifting or opening track in summer .
15. Attend only one or two sleepers at a time for adjusting fittings while removing a kink.
16. Confine essential maintenance to period when the temperature is below t_d+10^0C.
17. Impose speed restriction if temperature exceeds t_d+20^0C during consolidation period.

18. Pay special attention to SEJs, breathing lengths, curves, approaches to level crossings, unballasted bridges, horizontal and vertical curves.

19. Keep the rail thermometer with proper markings with limiting temperature ranges thereon in proper working order. Learn the limits of temperature restrictions as marked on thermometers for various operations.

20. Check that reference posts at SEJ and at centre of LWR/CWR are correctly maintained.

21. Pay special attention for crib and shoulder packing of ballast on CST-9 road.

22. Learn the six items (i) missing and loose fastenings, (ii) shortage of ballast, (iii) misalignment, (iv) slewing, (v) lifting (vi) improper packing, about which you should be very careful to avoid buckling.

23. Learn what to do when there is buckling or fracture in the track.

24. Ensure that all bridges and its approaches have all fittings at all times and are regularly tightened.

DON'Ts of LWR for PWM, JE(P. Way), Mates & Keyman

1. Do not touch the track unnecessarily unless specifically instructed by PWI,JE/ SSE(P.Way).

2. Do not undertake through packing after the onset of summer months.

3. Do not open shoulder and crib ballast at one and the same time.

4. Do not try to lift the track while packing sleepers for replacement of fastenings and slewing with crow bars.

5. Do not open the track for more than 30 sleepers in a stretch. Keep at least 30 fully boxed sleeper between adjacent lengths opened out.

6. Do not open the adjacent length till the passage of 20,000 tonnes of traffic or two days, whichever is later.

7. Do not renew more than one sleeper within 30 sleepers at a time.

8. Do not renew fastenings not requiring lifting on more than one sleeper within 15 sleepers at a time.

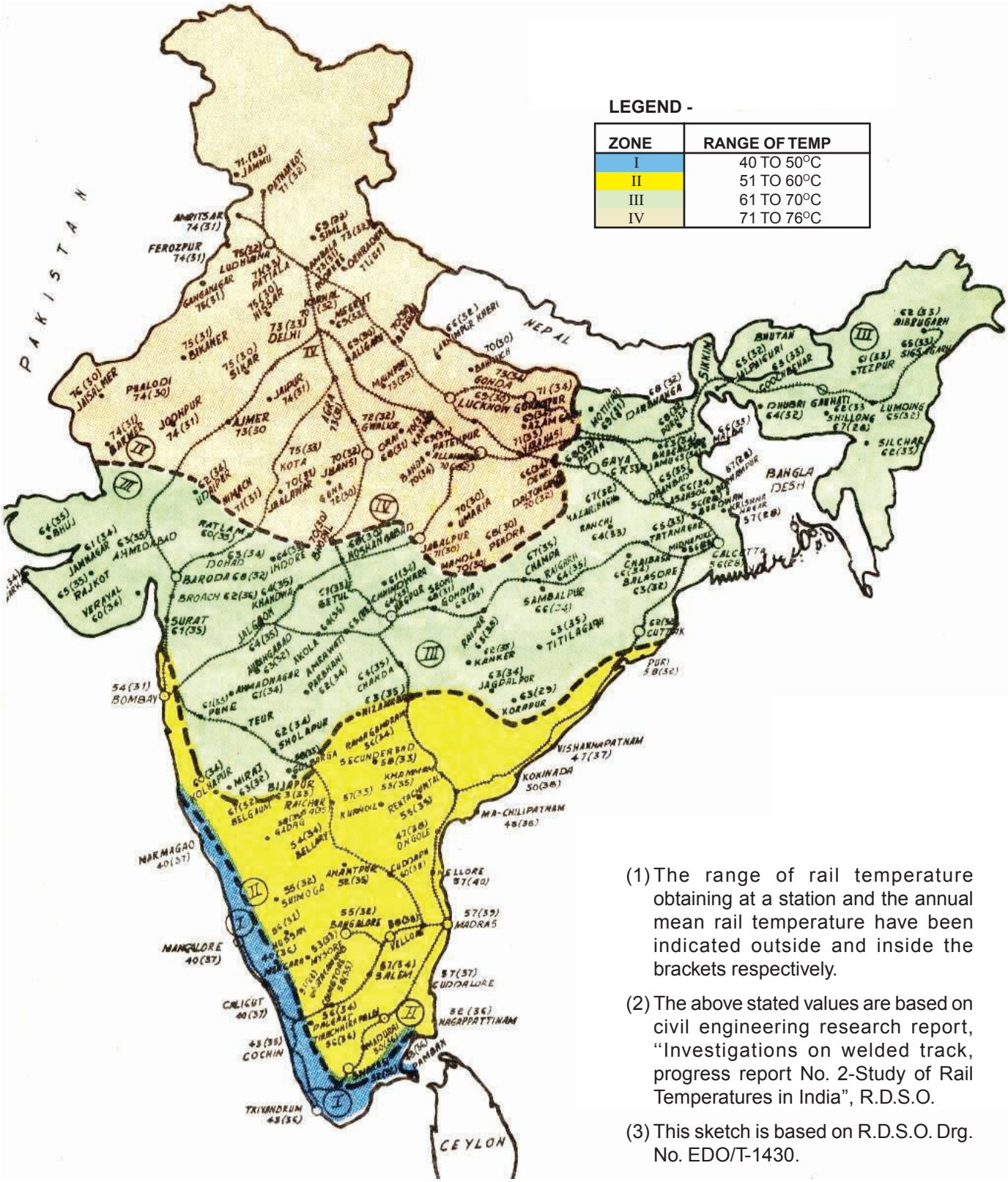
9. Do not renew fastenings requiring lifting on more than one sleeper within 30 sleepers at a time.

10. Do not allow loose, missing or ineffective fastenings to remain in track.

11. Do not neglect checking and attending to the breathing lengths of LWR/CWR in a fortnight.

12. Do not lift track by more than 50 mm even if temperature is within t_d.

MAP OF INDIA SHOWING RAIL TEMPERATURE ZONES

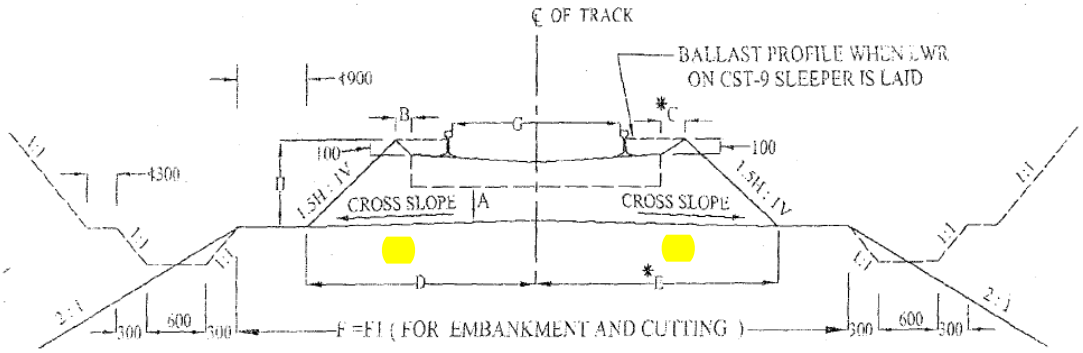


(1) The range of rail temperature obtaining at a station and the annual mean rail temperature have been indicated outside and inside the brackets respectively.

(2) The above stated values are based on civil engineering research report, ''Investigations on welded track, progress report No. 2-Study of Rail Temperatures in India", R.D.S.O.

(3) This sketch is based on R.D.S.O. Drg. No. EDO/T-1430.

BALLAST PROFILE (SINGLE LINE BG) | Fig: 4.2.1(a)



G GAUGE	TYPE OF SLEEPER	A	B	*C	D	*E	F	F1	H
1676	WOODEN	250	350	500	2270	2420	7850	7850	540
		300	350	500	2270	2420	7850	7850	590
		200 OVER 150 SUB-BALLAST	350	500	2270	2420	7850	7850	640
	STEEL TROUGH	250	350	500	2280	2430	7850	7850	550
		300	350	500	2280	2430	7850	7850	600
		200 OVER 150 SUB-BALLAST	350	500	2280	2430	7850	7850	650
	PRC	250	350	500	2525	2675	7850	7850	640
		300	350	500	2525	2675	7850	7850	690
		200 OVER 150 SUB-BALLAST	350	500	2525	2675	7850	7850	740

ACS 16

NOTE :

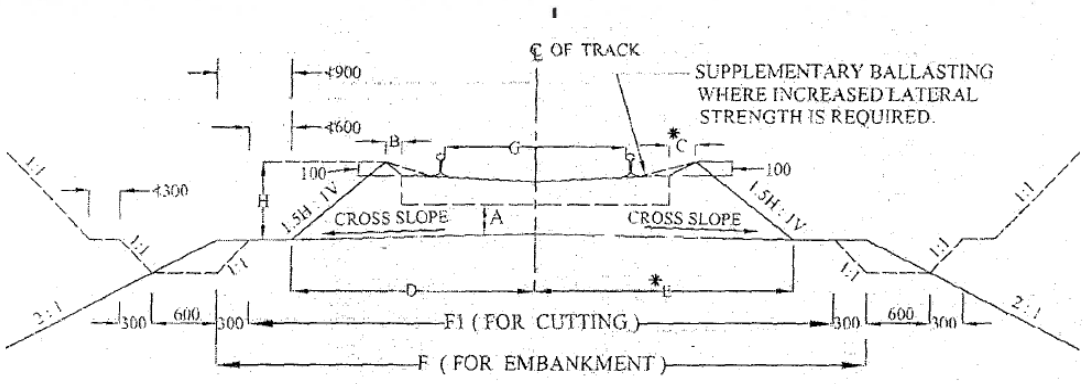
1. THE MINIMUM CLEAN STONE BALLAST CUSHION BELOW THE BOTTOM OF SLEEPER ie A = 250 mm
2. FOR ROUTES WHERE SPEEDS ARE TO BE MORE THAN 130 kmph, A = 300 mm OR 200 mm ALONG WITH 150 mm OF SUB-BALLAST
3. * ON OUTER SIDE OF CURVES ONLY
4. 4 Ballast side slope shall be 1.5 H : 1 V ACS 16
5. DIMENSIONS FOR FORMATION WIDTH (F AND F1) ARE GIVEN FOR STRAIGHT PORTION ONLY THIS SHOULD BE SUITABLY INCREASED TAKING INTO ACCOUNT EXTRA BALLAST SHOULDER ON OUTSIDE OF CURVES AND FOR SUPER-ELEVATION
6. ALL DIMENSIONS ARE IN MILLIMETRES

7. Cross slope of 1 in 40 mentioned above is replaced with 1 in 30 for construction works. However, existing formation need not be disturbed."

ACS 15

BALLAST PROFILE (SINGLE LINE MG)

Fig: 4.2.1(b)



G GAUGE	TYPE OF SLEEPER	A	B	*C	D	*E	F	F1	H
1000	WOODEN	250	350	500	1760	1930	5850	5250	510
		300	350	500	1760	1930	5850	5250	560
		200 OVER 150 SUB-BALLAST	350	500	1760	1930	5850	5250	610
	STEEL TROUGH	250	350	500	1790	1940	5850	5250	520
		300	350	500	1790	1940	5850	5250	570
		200 OVER 150 SUB-BALLAST	350	500	1790	1940	5850	5250	620
	PRC	250	350	500	2025	2175	5850	5250	510
		300	350	500	2025	2175	5850	5250	560
		200 OVER 150 SUB-BALLAST	350	500	2025	2175	5850	5250	610
	CST-9	250	350	500	1730	1880	5850	5250	510
		300	350	500	1730	1880	5850	5250	560
		200 OVER 150 SUB-BALLAST	350	500	1730	1880	5850	5250	610

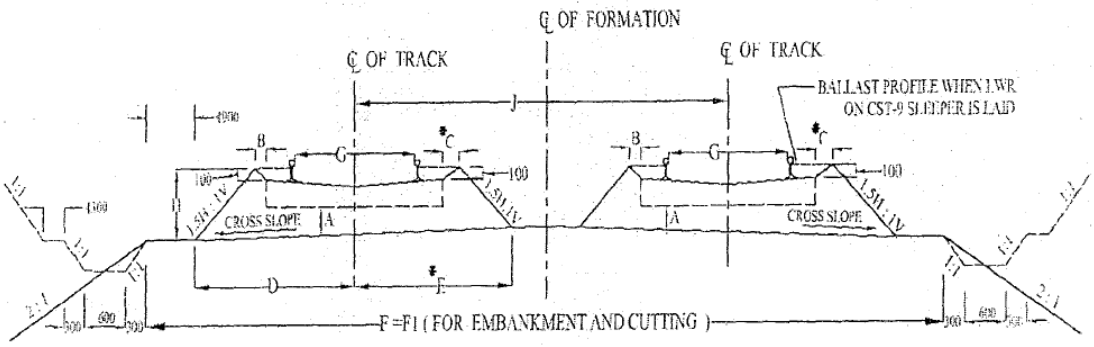
NOTE :

1. THE MINIMUM CLEAN STONE BALLAST CUSHION BELOW THE BOTTOM OF SLEEPER ie A = 250 mm
2. FOR ROUTES WHERE SPEEDS ARE TO BE MORE THAN 100 kmph, A = 300 mm OR 200 mm ALONG WITH 150 mm OF SUB-BALLAST
3. * ON OUTER SIDE OF CURVES ONLY **4 Ballast side slope shall be 1.5 H : 1 V ACS 16**
4. [illegible]
5. DIMENSIONS FOR FORMATION WIDTH (F AND F1) ARE GIVEN FOR STRAIGHT PORTION ONLY THIS SHOULD BE SUITABLY INCREASED TAKING INTO ACCOUNT EXTRA BALLAST SHOULDER ON OUTSIDE OF CURVES AND FOR SUPER-ELEVATION
6. ALL DIMENSIONS ARE IN MILLIMETRES

7. Cross slope of 1 in 40 mentioned above is replaced with 1 in 30 for construction works. However, existing formation need not be disturbed."

ACS 15

BALLAST PROFILE (DOUBLE LINE BG) | Fig: 4.2.1(c)



G GAUGE	TYPE OF SLEEPER	A	B	*C	D	*E	F	F1	H	J
1676	WOODEN	250	350	500	2300	2340	13160	13160	570	5300
		300	350	500	2300	2340	13160	13160	620	5300
		200 OVER 150 SUB-BALLAST	350	500	2300	2340	13160	13160	670	5300
	STEEL TROUGH	250	350	500	2310	2350	13160	13160	580	5300
		300	350	500	2310	2350	13160	13160	630	5300
		200 OVER 150 SUB-BALLAST	350	500	2310	2350	13160	13160	680	5300
	PRC	250	350	500	2525	2460	13160	13160	700	5300
		300	350	500	2525	2460	13160	13160	750	5300
		200 OVER 150 SUB-BALLAST	350	500	2525	2460	13160	13160	800	5300

ACS 16

NOTE :

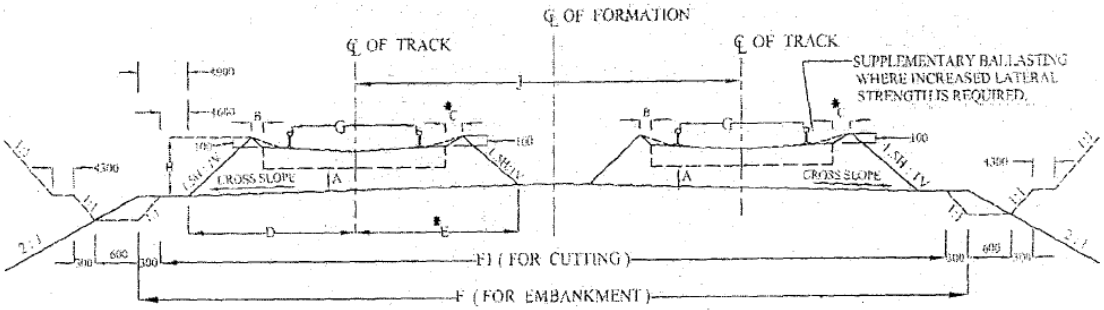
1. THE MINIMUM CLEAN STONE BALLAST CUSHION BELOW THE BOTTOM OF SLEEPER ie A = 250 mm
2. FOR ROUTES WHERE SPEEDS ARE TO BE MORE THAN 130 kmph, A = 300 mm OR 200 mm ALONG WITH 150 mm OF SUB-BALLAST
3. * ON OUTER SIDE OF CURVES ONLY
4. 4 Ballast side slope shall be 1.5 H : 1 V ACS 16
5. DIMENSIONS FOR FORMATION WIDTH (F AND F1) ARE GIVEN FOR STRAIGHT PORTION ONLY THIS SHOULD BE SUITABLY INCREASED TAKING INTO ACCOUNT EXTRA BALLAST SHOULDER ON OUTSIDE OF CURVES AND FOR SUPER-ELEVATION
6. ALL DIMENSIONS ARE IN MILLIMETRES

7. Cross slope of 1 in 40 mentioned above is replaced with 1 in 30 for construction works. However, existing formation need not be disturbed."

ACS 15

BALLAST PROFILE (DOUBLE LINE MG)

Fig: 4.2.1(d)



G GAUGE	TYPE OF SLEEPER	A	B	*C	D	*E	F	F1	H	J
1676	WOODEN	250	350	500	1790	1850	9810	9210	535	3960
		300	350	500	1790	1850	9810	9210	585	3960
		200 OVER 150 SUB-BALLAST	350	500	1790	1850	9810	9210	635	3960
	STEEL TROUGH	250	350	500	1810	1860	9810	9210	540	3960
		300	350	500	1810	1860	9810	9210	590	3960
		200 OVER 150 SUB-BALLAST	350	500	1810	1860	9810	9210	640	3960
	PRC	250	350	500	2025	1970	9810	9210	595	3960
		300	350	500	2025	1970	9810	9210	645	3960
		200 OVER 150 SUB-BALLAST	350	500	2025	1970	9810	9210	695	3960
	CST-9	250	350	500	1750	1810	9810	9210	535	3960
		300	350	500	1750	1810	9810	9210	585	3960
		200 OVER 150 SUB-BALLAST	350	500	1750	1810	9810	9210	635	3960

NOTE :

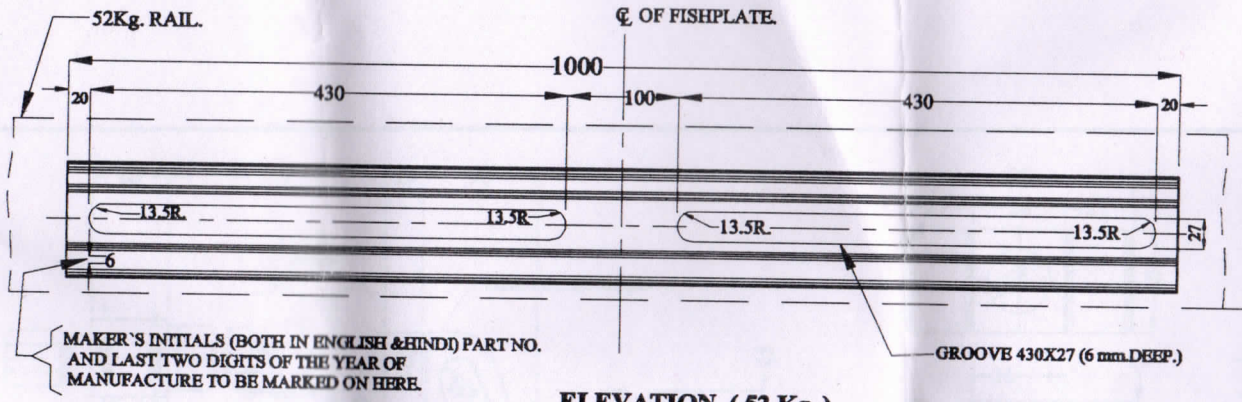
1. THE MINIMUM CLEAN STONE BALLAST CUSHION BELOW THE BOTTOM OF SLEEPER ie A = 250 mm
2. FOR ROUTES WHERE SPEEDS ARE TO BE MORE THAN 100 kmph, A = 300 mm OR 200 mm ALONG WITH 150 mm OF SUB-BALLAST
3. * ON OUTER SIDE OF CURVES ONLY **4 Ballast side slope shall be 1.5 H : 1 V ACS 16**
4. [illegible]
5. DIMENSIONS FOR FORMATION WIDTH (F AND F1) ARE GIVEN FOR STRAIGHT PORTION ONLY THIS SHOULD BE SUITABLY INCREASED TAKING INTO ACCOUNT EXTRA BALLAST SHOULDER ON OUTSIDE OF CURVES AND FOR SUPER-ELEVATION
6. ALL DIMENSIONS ARE IN MILLIMETRES

7. Cross slope of 1 in 40 mentioned above is replaced with 1 in 30 for construction works. However, existing formation need not be disturbed."

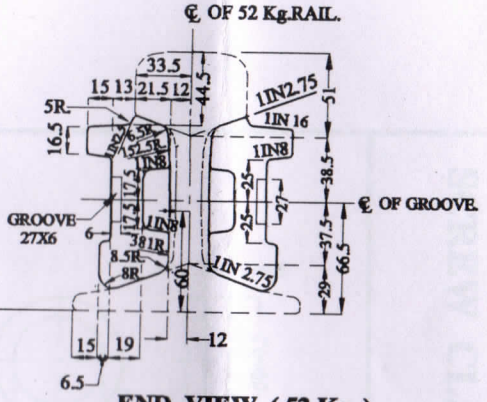
ACS 15

1 m LONG SLOTTED FISHPLATE FOR CLAMPED JOINTS (B. G.) FOR 52 Kg AND 60 Kg (UIC)

Fig. 4.4.3 (a)

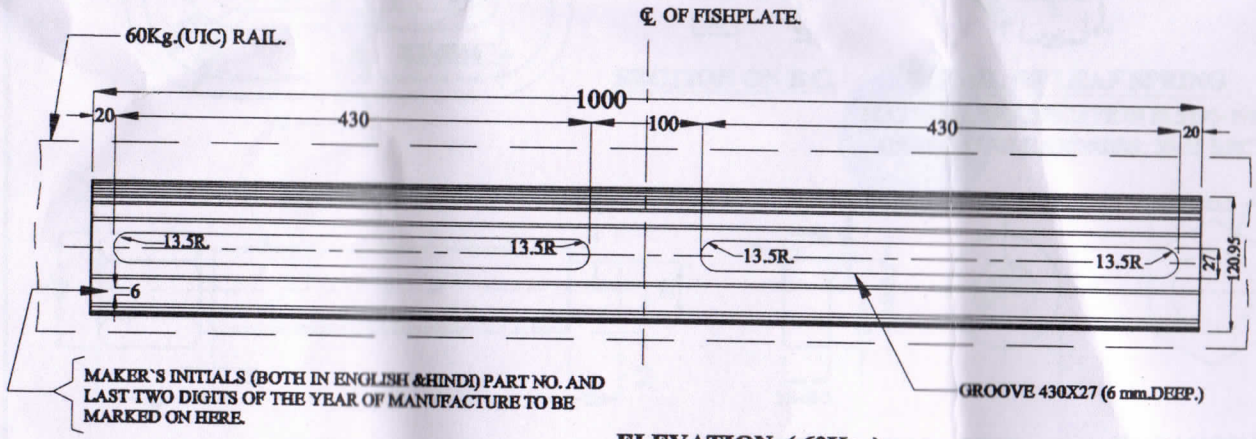


ELEVATION (52 Kg.)

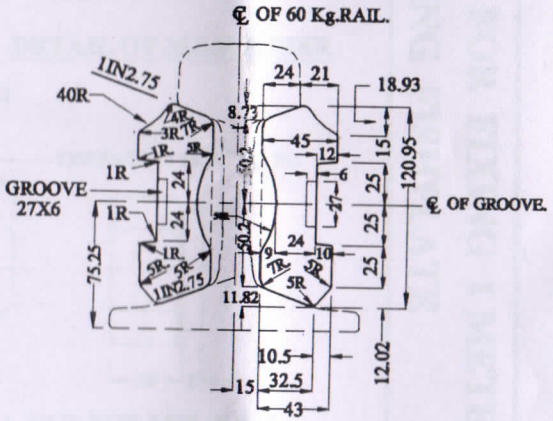


END VIEW (52 Kg.)

(END SECTION OF THIS FISHPLATE IS SAME AS THAT OF T-090(M).)



ELEVATION (60Kg.)



END VIEW 60 Kg.)

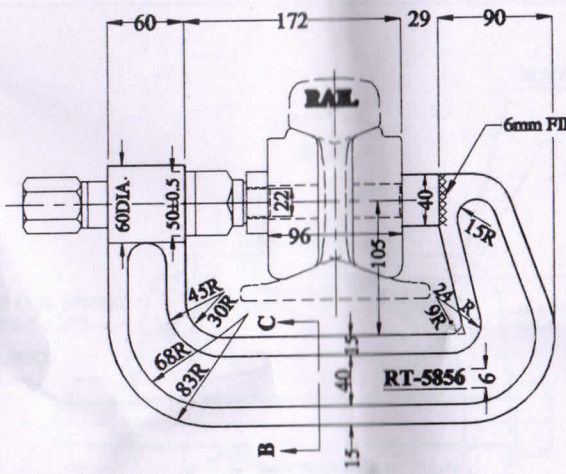
(END SECTION OF THIS FISHPLATE IS SAME AS THAT OF RDSO/T-1898).

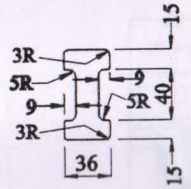
NOTE :

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 REFERRED TO.
5. WHEN THESE FISHPLATES ARE USED A SPEED RESTRICTION OF 20Kmph SHALL BE IMPOSED. HOWEVER , SPEED RESTRICTION MAY BE RELAXED TO 30Kmph IF THERE IS A 24hrs. WATCH.

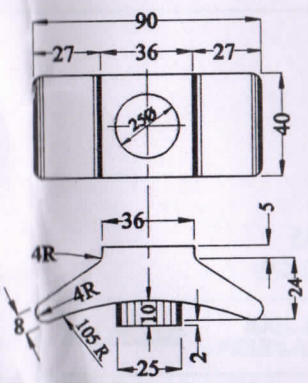
SCREW CLAMP FOR FIXING 1 METER LONG FISHPLATE

Fig. 4.4.3 (b1)



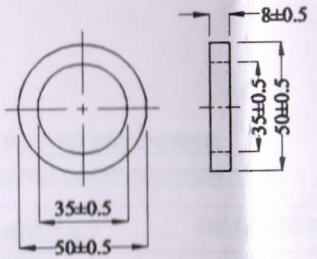


SECTION ON B.C.

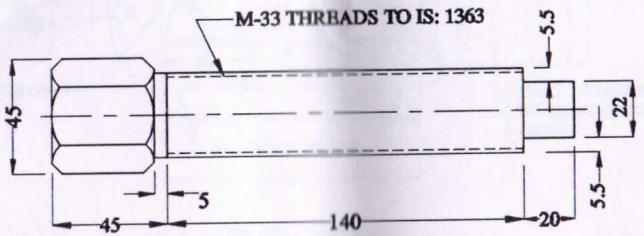


DETAIL OF LEAF SPRING

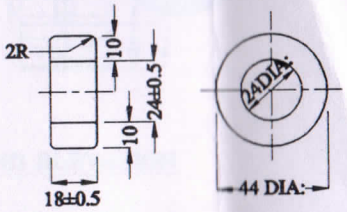
MATERIAL SPECIFICATION IS:3195-1992
GRADE 55 Si7 HARDNESS: 30-35 HRC



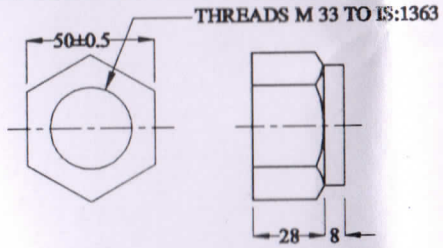
DETAIL OF M.S.WASHER



DETAIL OF HEXAGONAL BOLT



DETAIL OF M.S.RING

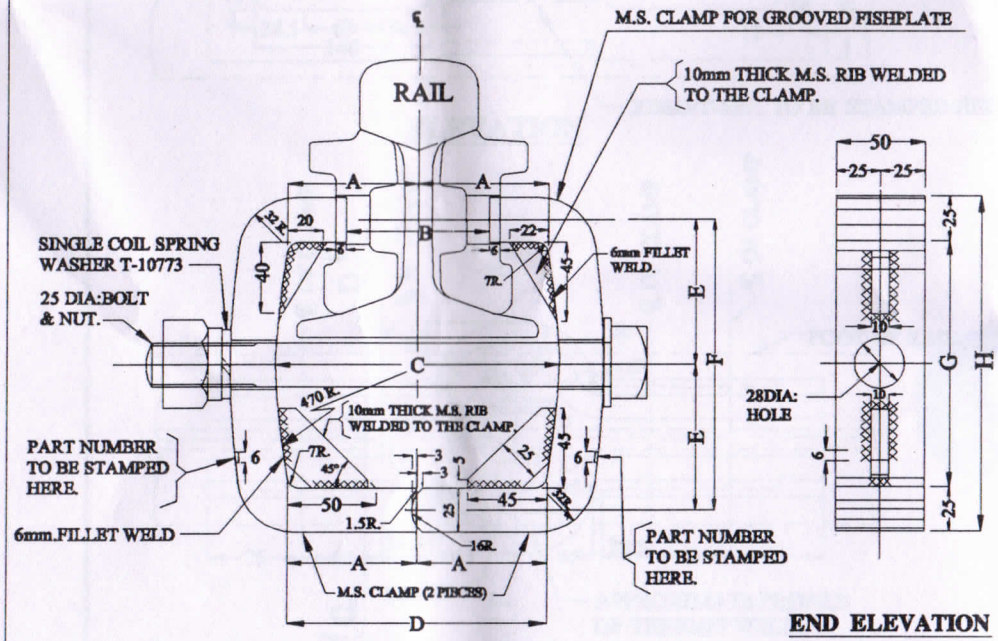


HEXAGONAL NUT FOR M33 BOLT TO IS:1363

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 MATERIAL 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 20 Kmph SHOULD BE IMPOSED. HOWEVER, SPEED RESTRICTION MAY BE RELAXED TO 30Kmph IF THERE IS A 24hrs WATCH.

M. S. CLAMP FOR FIXING 1 METER LONG FISHPLATE



ELEVATION

END ELEVATION

PART Nos.AND DIMENSIONS

(M.S. CLAMP FOR GROOVED FISHPLATE)

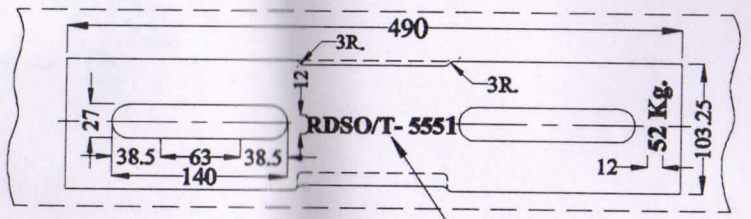
M.S.CLAMP	RAIL & FISHPLATE	BOLT & NUT	DIMENSIONS							
			A	B	C	D	E	F	G	H
RDSO/T-5854& RDSO/T-5854/1	60 Kg. RDSO/T-5851	T-11523	80	84	172	160	91.5	183	158	208
RDSO/T-5855& RDSO/T-5855/1	52 Kg. RDSO/T-5850	T-11522	73	81	160	146	82	164	139	189

NOTE :

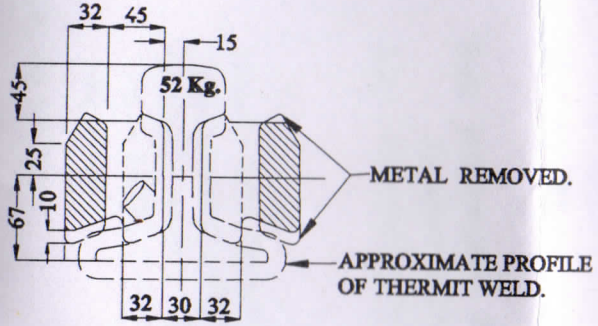
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. SALIENT FEATURES / DIMENSIONS HAVE BEEN SHOWN IN THE SKETCH. FOR DETAILS DRAWING No.RDSO/T-5852 TO RDSO/T-5855/1 WOULD BE REFERRED TO.
3. FOR BETTER EFFECTIVENESS OF THESE CLAMPS SINGLE COIL SPRING WASHER TO DRG.No.T-10773 MAY BE USED AND THIS SINGLE COILSPRING WASHER SHOULD BE REPLACED BY DOUBLE COIL SPRING WASHER WHEN AVAILABLE.
4. THESE CLAMPS CONSIST OF TWO PARTS, ONE OF 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 20Kmph SHOULD BE IMPOSED. HOWEVER, SPEED RESTRICTION MAY BE RELAXED TO 30Kmph IF THERE IS A 24hrs WATCH.

Fig. 4.4.3 (b2)

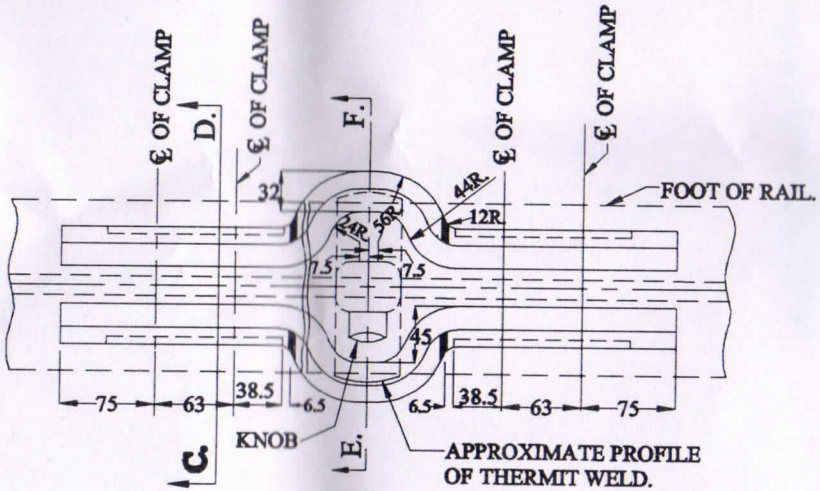
DETAIL OF JOGGLED FISHPLATE AND POSITION OF CLAMP



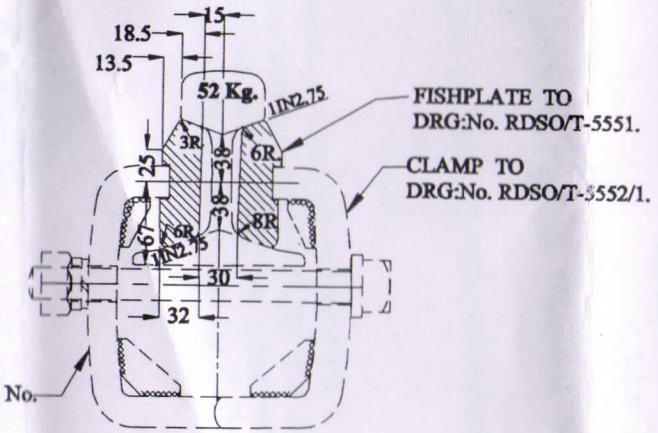
ELEVATION



SECTION ON E. F.



PLAN

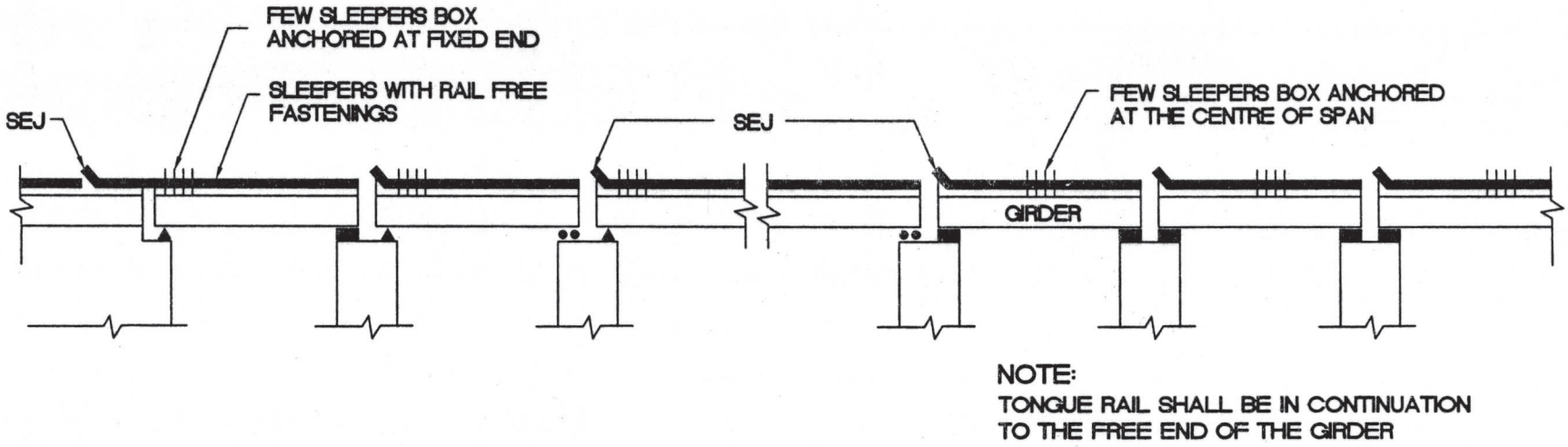


SECTION ON C. D.

NOTE :

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. SALIENT FEATURES / DIMENSIONS HAVE BEEN SHOWN IN THE SKETCH. FOR DETAILS, DRAWING NO. RDSO/T-5551 AND RDSO/T-5552 TO RDSO/T-5552/1 WOULD BE REFERRED TO.
3. FOR THE PURPOSE OF TEMPORARY JOINING OF RAILS WITHOUT ANY WELD ORDINARY FISHPLATES WITH M.S. CLAMPS MAY BE USED.
4. THE JOINT SLEEPER SPACING MAY BE SUITABLY ALTERED TO ACCOMODATE 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.

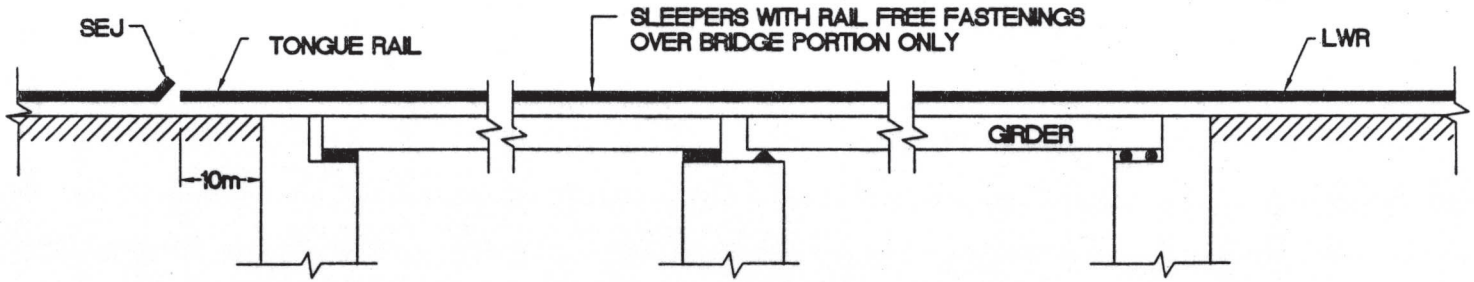
Fig. 4.4.3 (c)



NOTE:
TONGUE RAIL SHALL BE IN CONTINUATION
TO THE FREE END OF THE GIRDER

WELDED RAILS ON BRIDGE (PIER TO PIER)

Fig. 4.5.7.1(iii)



LWR/CWR ON BRIDGE WITH SEJ AT THE FAR END APPROACH OF THE BRIDGE

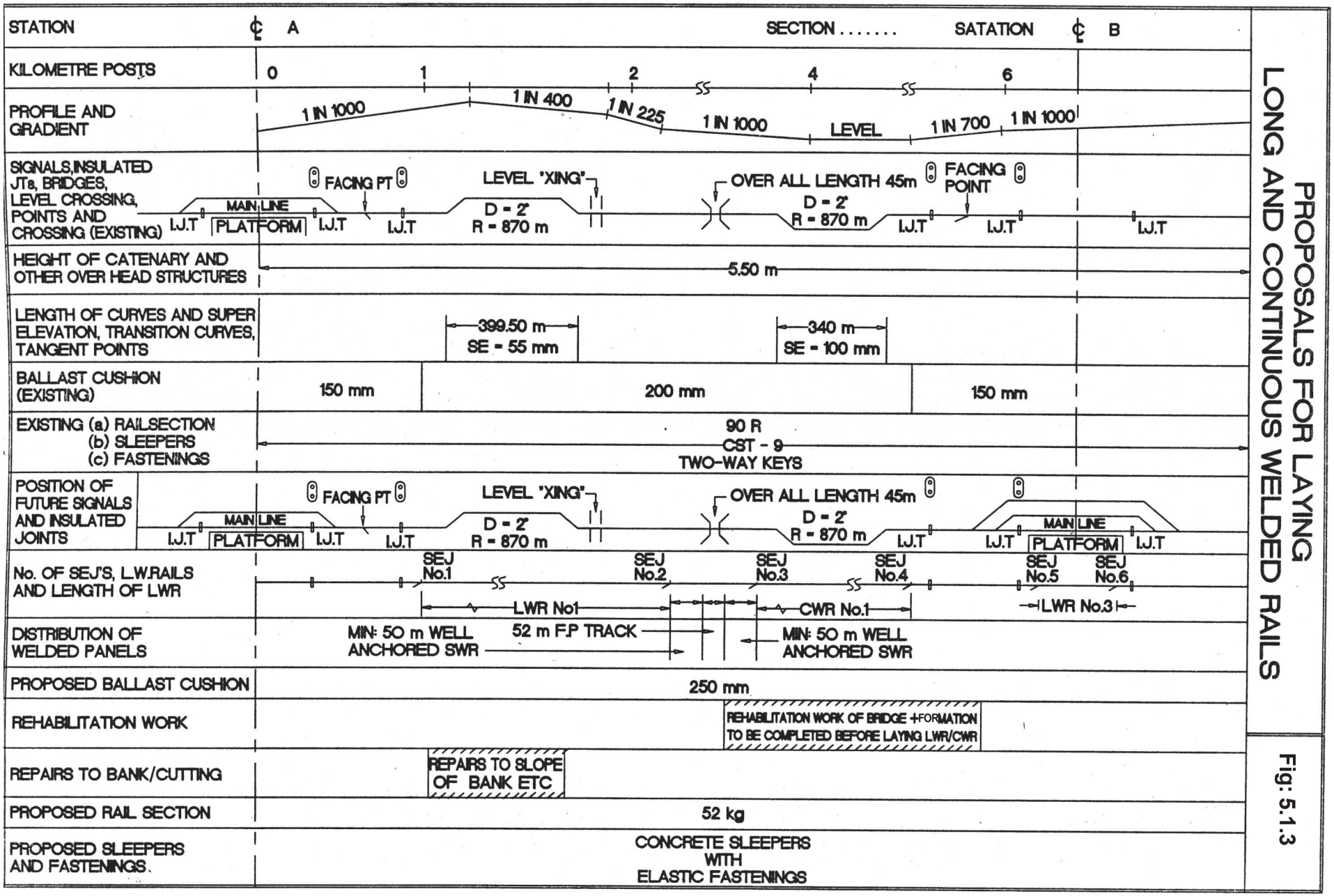
Fig. 4.5.7.1 (iv)

LEGEND

- ▲ ROCKER BEARING
- ●● ROLLER BEARING
- ▬ SLIDING BEARING

NOTE:
SEJ TO BE INSTALLED 10 m AWAY FROM ABUTMENTS

Fig: 4.5.7.1(iii+iv)

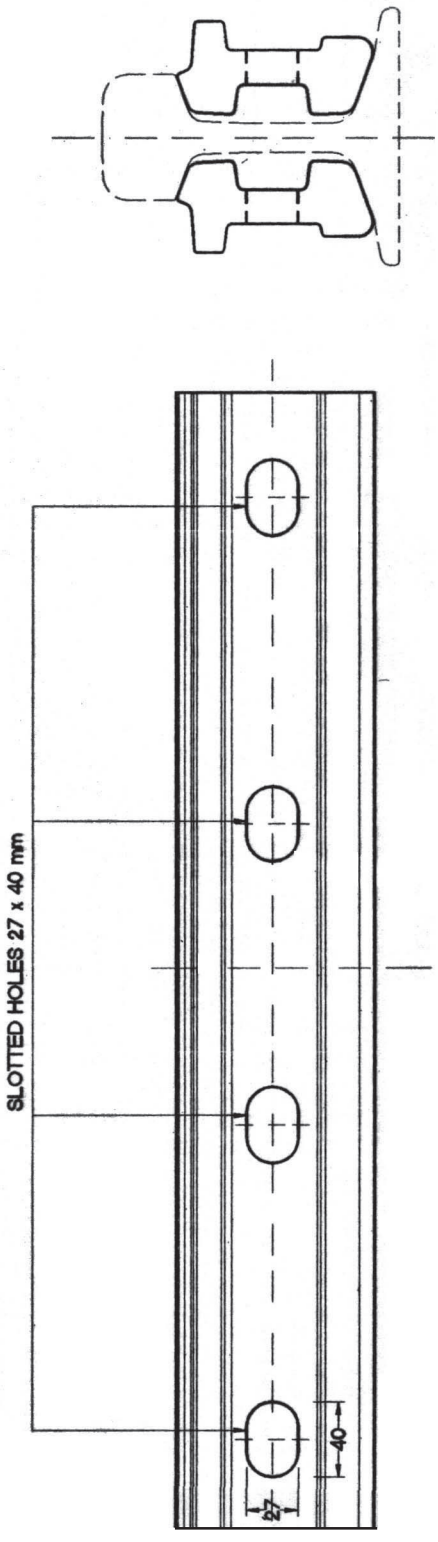


PROPOSALS FOR LAYING
LONG AND CONTINUOUS WELDED RAILS

Fig: 5.1.3

SLOTTED FISHPLATE

Fig: 5.3(iii)

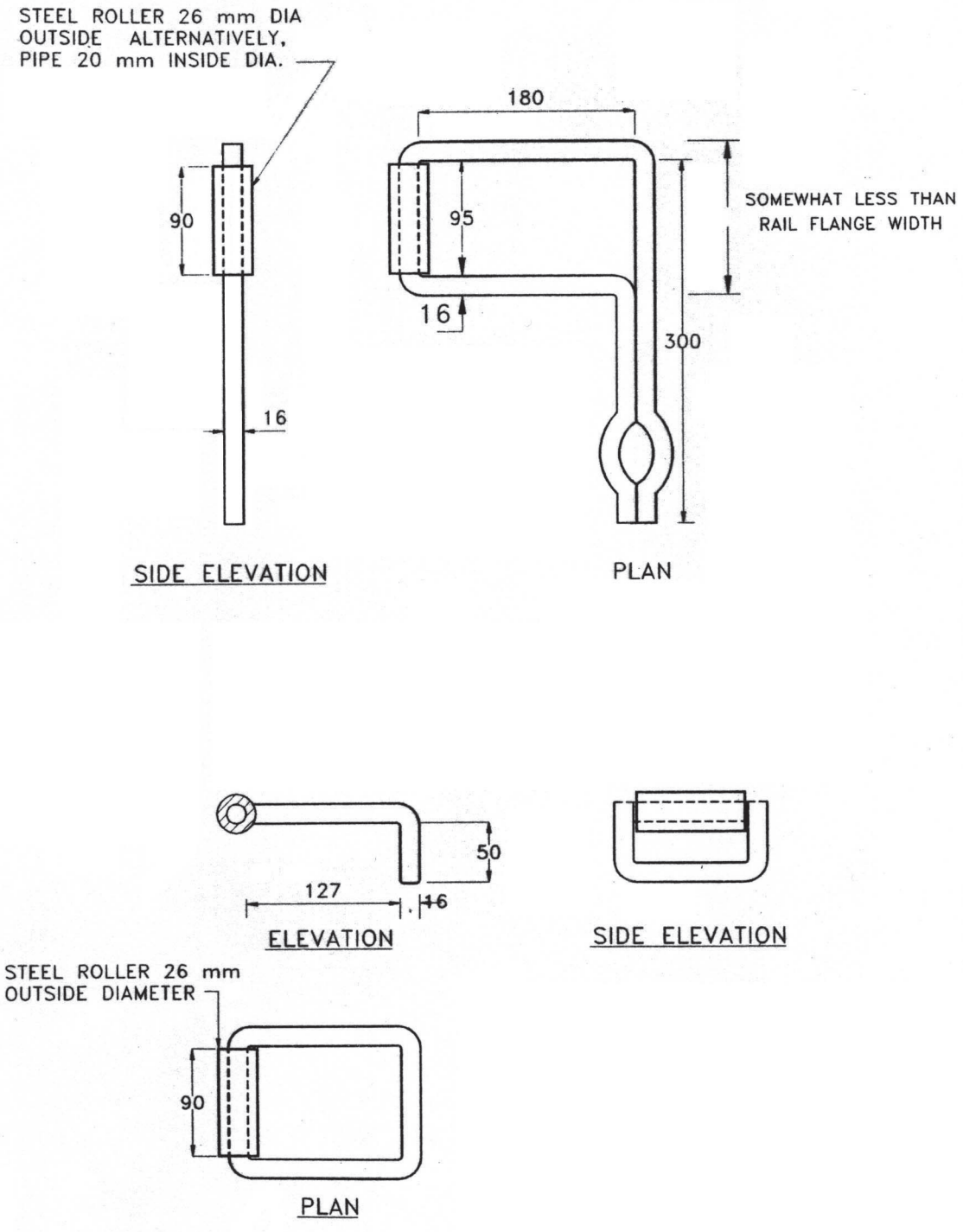


NOTE:

FISHPLATE SECTION AND LENGTH IS SAME AS THAT OF STANDARD FISHPLATE FOR THE RAIL SECTION

ROLLERS FOR BG

Fig: 5.3(viii)(a)



NOTE:

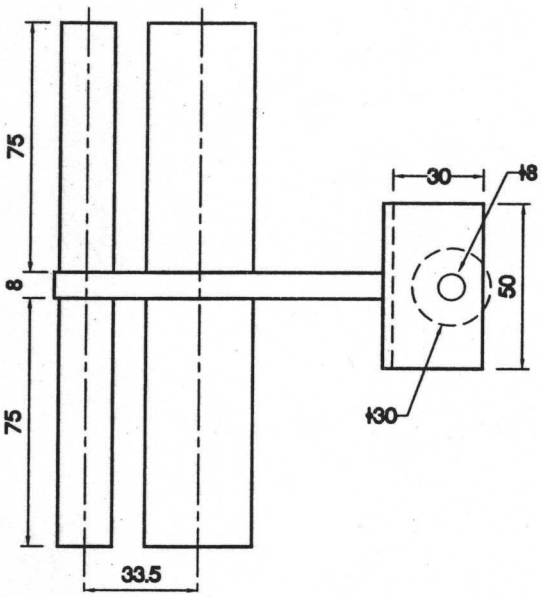
1 ALTERNATIVE DESIGNS OF ROLLERS FOR SUPPORTING RAILS DURING DESTRESSING

2 ALL DIMENSIONS ARE IN MILLIMETRES

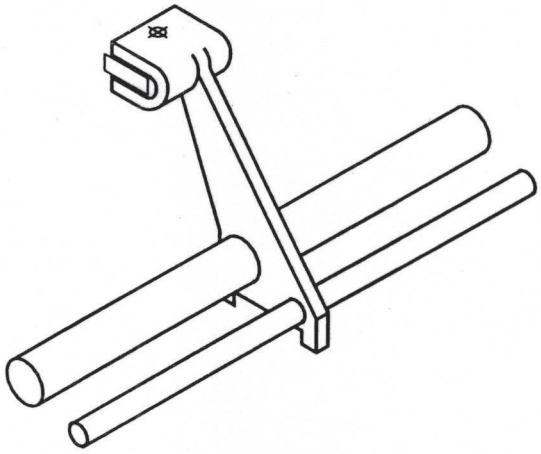
SIDE ROLLER/SUPPORT ARM	Fig: 5.3(viii)(b1)

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

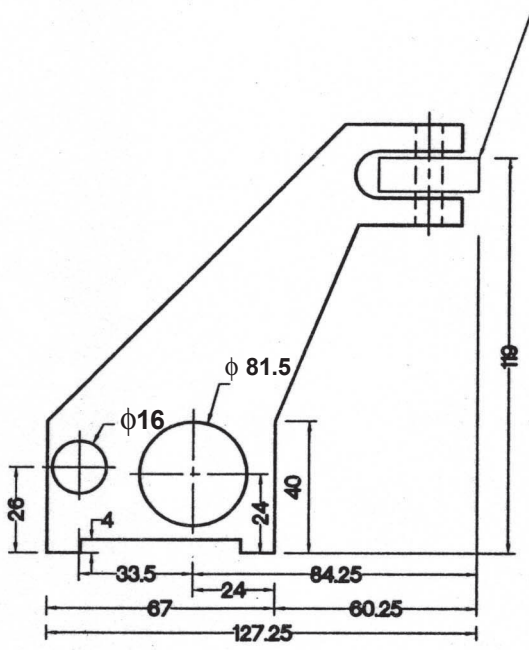
FOR USE ON CONCRETE SLEEPERS OR STEEL TROUGH SLEEPERS WITH MODIFIED LOOSE JAW OR FOR WOODEN SLEEPERS FITTED WITH PANDROL BEARING PLATES



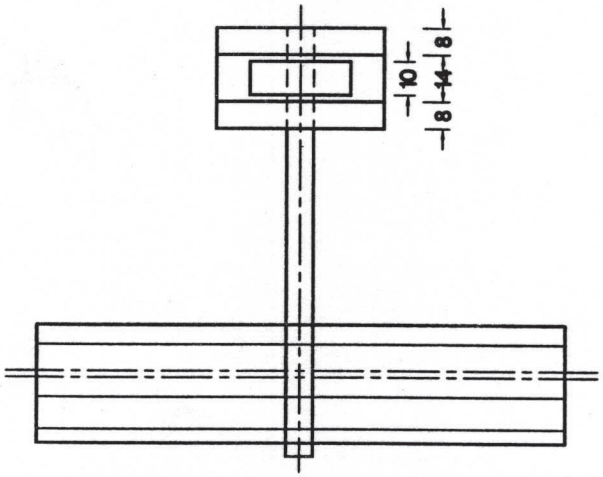
TOP VIEW



ISOMETRIC VIEW



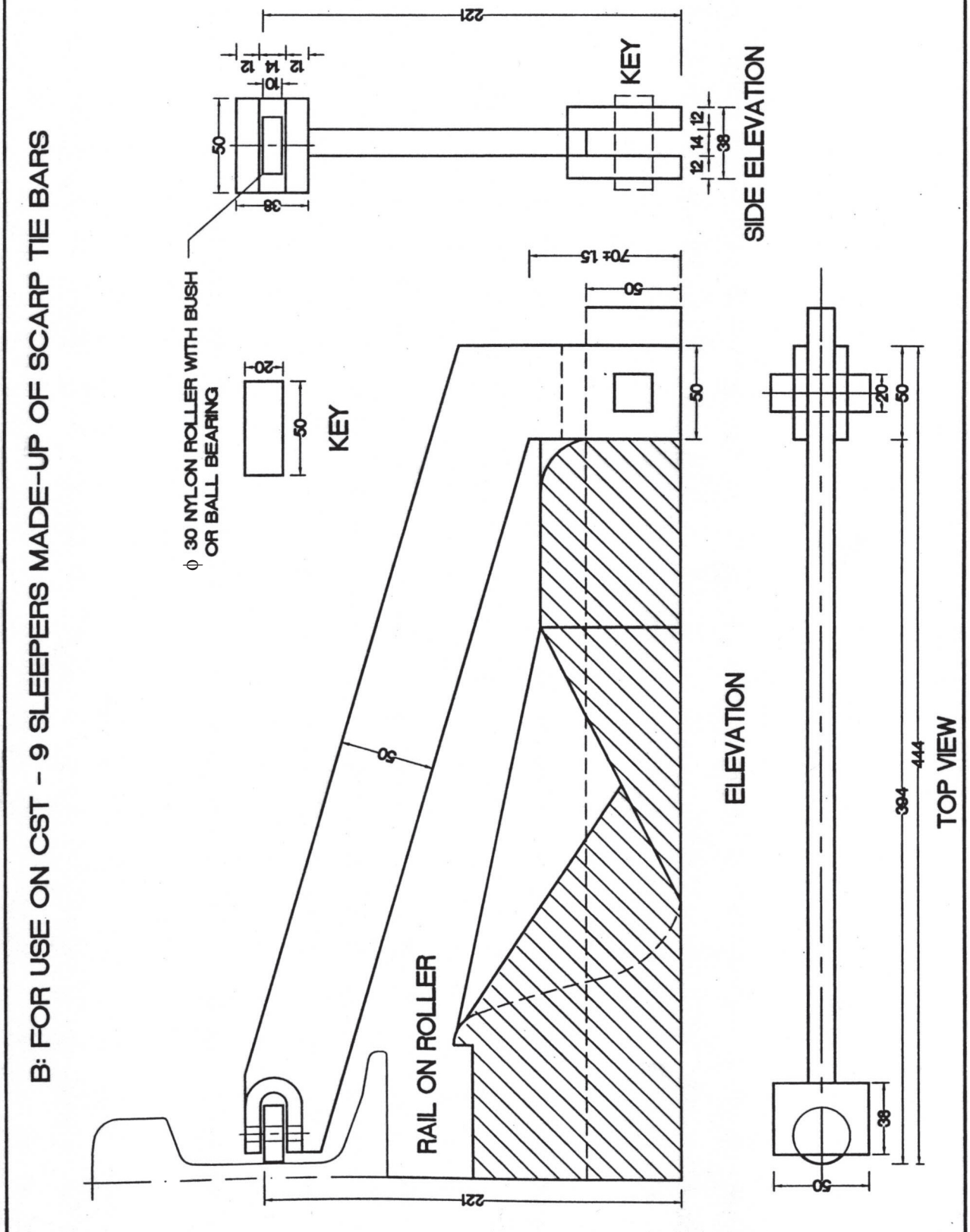
ELEVATION



SIDE ELEVATION

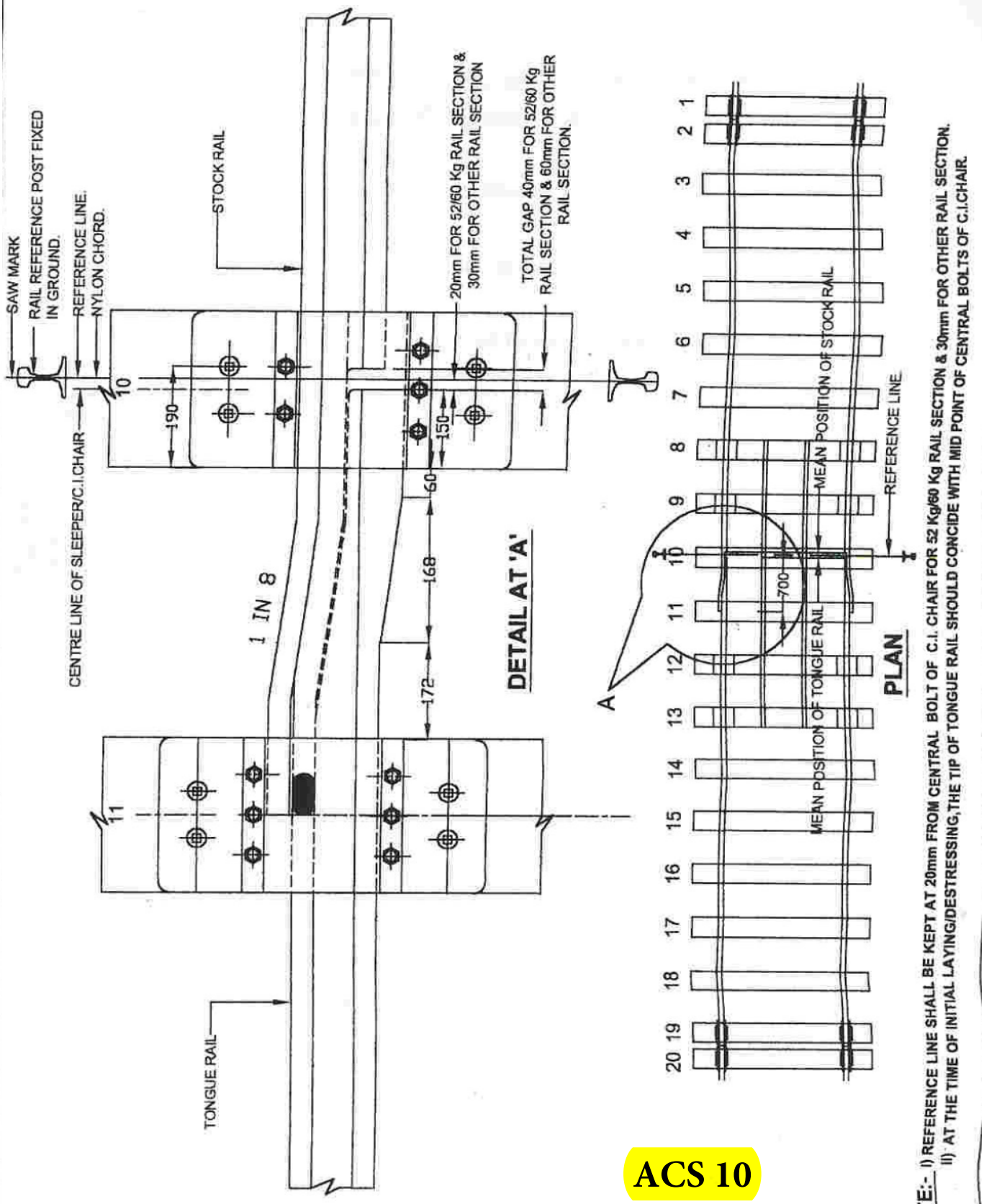
SIDE ROLLER/SUPPORT ARM	Fig: 5.3(viii) (b2)

USED FOR CURVED TRACK TO MINIMISE FRICTION AND GIVE EVEN EXTENSION TO THE RAILS AND PREVENT RAILS FROM BOW STRINGING OUT OF THE FASTENING POSITION



SE TTING OF GAP AT SEJ
AT DESTRESSING TEMPERATURE(td)

Fig 5.6

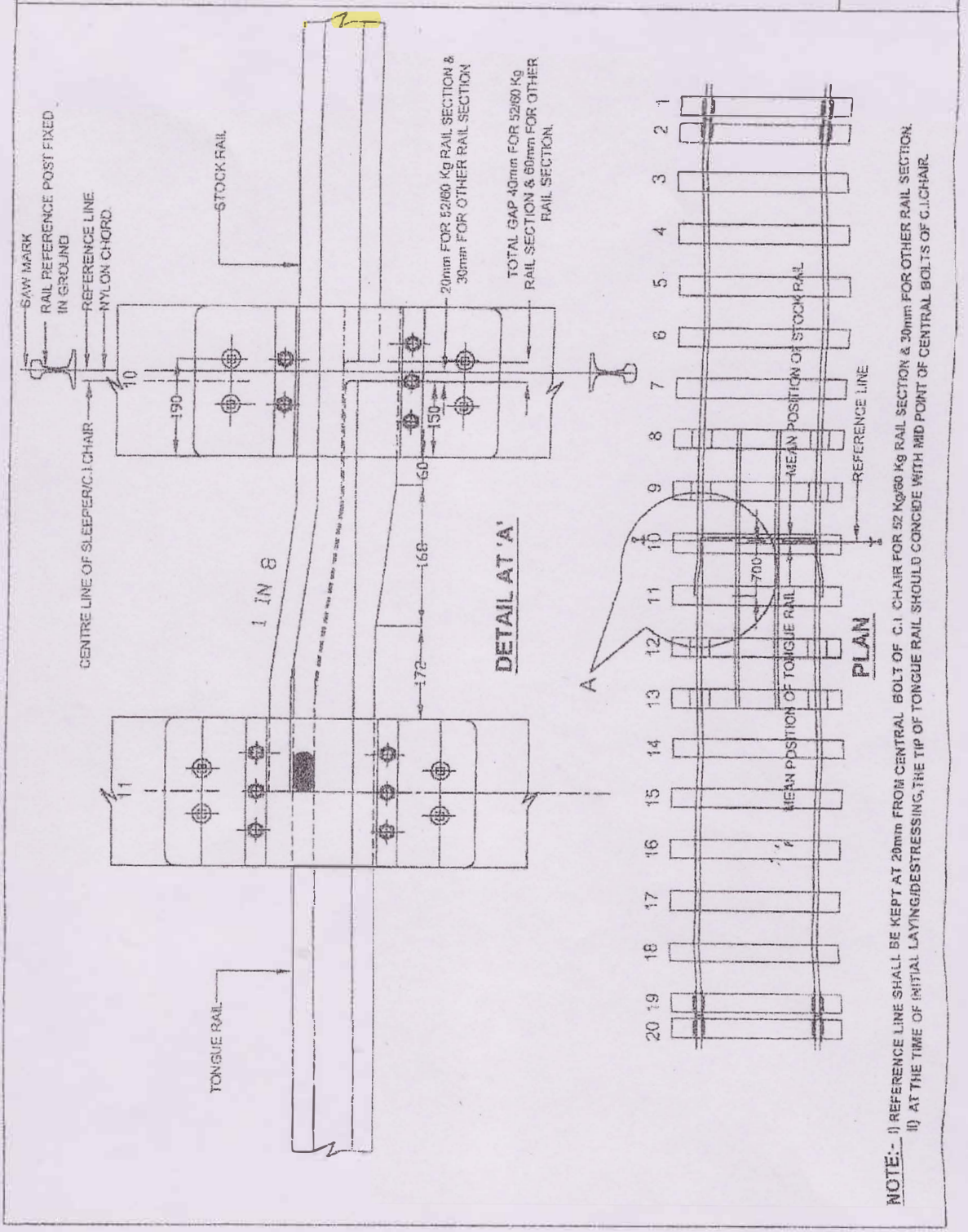


NOTE:- I) REFERENCE LINE SHALL BE KEPT AT 20mm FROM CENTRAL BOLT OF C.I. CHAIR FOR 52 Kg/60 Kg RAIL SECTION & 30mm FOR OTHER RAIL SECTION.
II) AT THE TIME OF INITIAL LAYING/DESTRESSING, THE TIP OF TONGUE RAIL SHOULD CONCIDE WITH MID POINT OF CENTRAL BOLTS OF C.I.CHAIR.

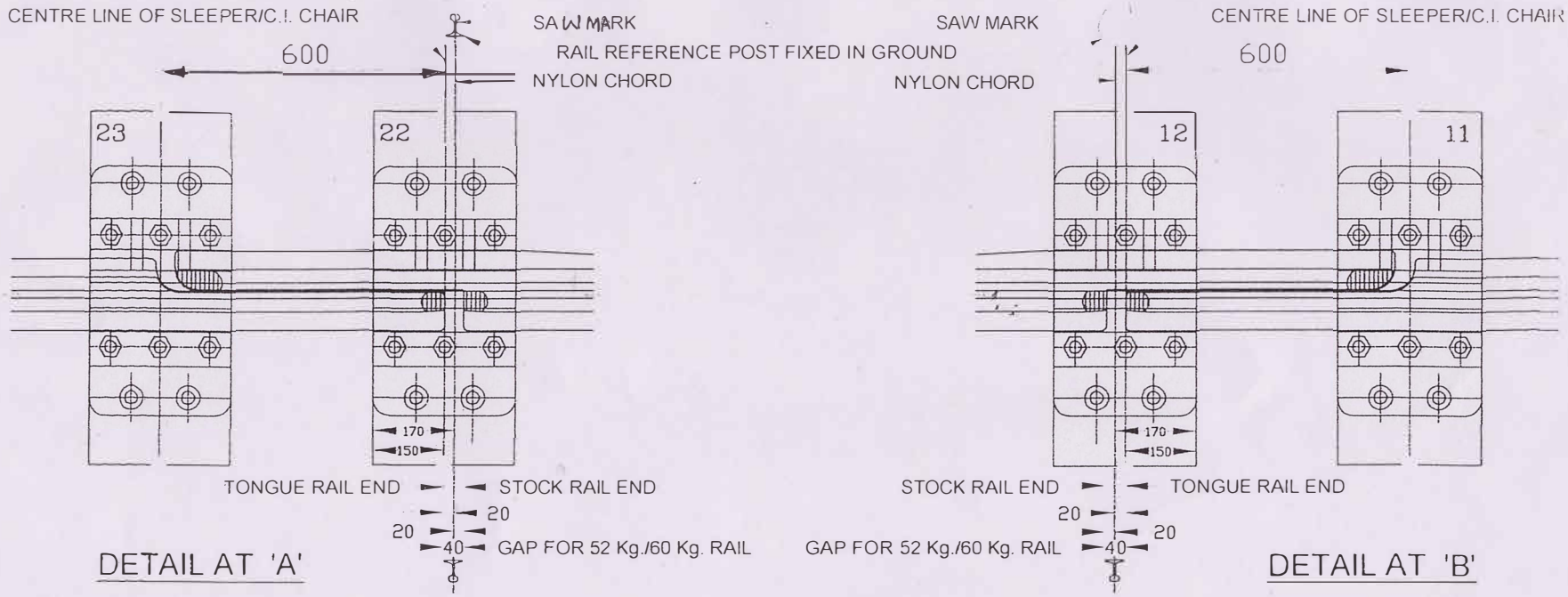
ACS 10

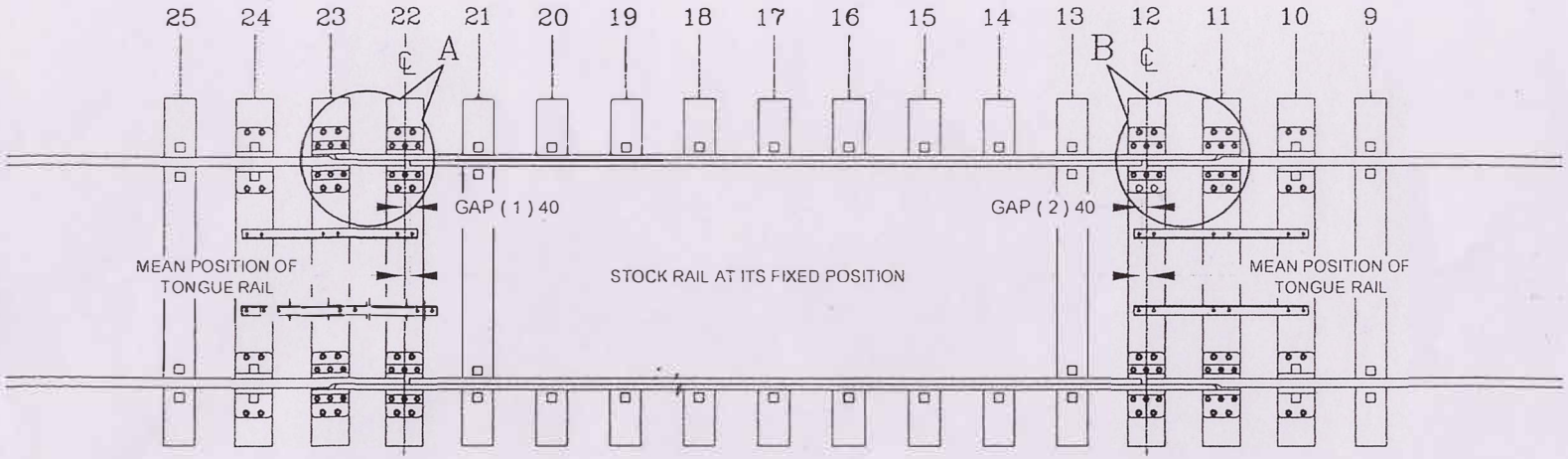
SETTING OF GAP AT SEJ (IRS DESIGN) TO DRAWING NOS. RDSO/T-412,RDSO/T-4160,RDSO/T-4165,RDSO/T-5478,RDSO/T-5586,RDSO/T-5748,RDSO/T-6257,RDSO/T-6782 AT DESTRESSING TEMPERATURE (td)

Fig 5.6.1



SETTING OF GAP AT IMPROVED SEJ WITH DOUBLE GAP OF MAX. 65 mm EACH UG 65 DESIGN) TO DRAWING NO. RDSO/T- 6922 (60Kg) & RDSO/T- 6930 (52 Kg) (APPLICABLE FOR BOTH RAILS) AT DESTRESSING TEMPERATURE (t d)





PLAN

NOTE:-

III). REFERENCE LINE SHALL BE KEPT AT 20 mm FROM CENTRAL BOLT OF C.I. CHAIR.

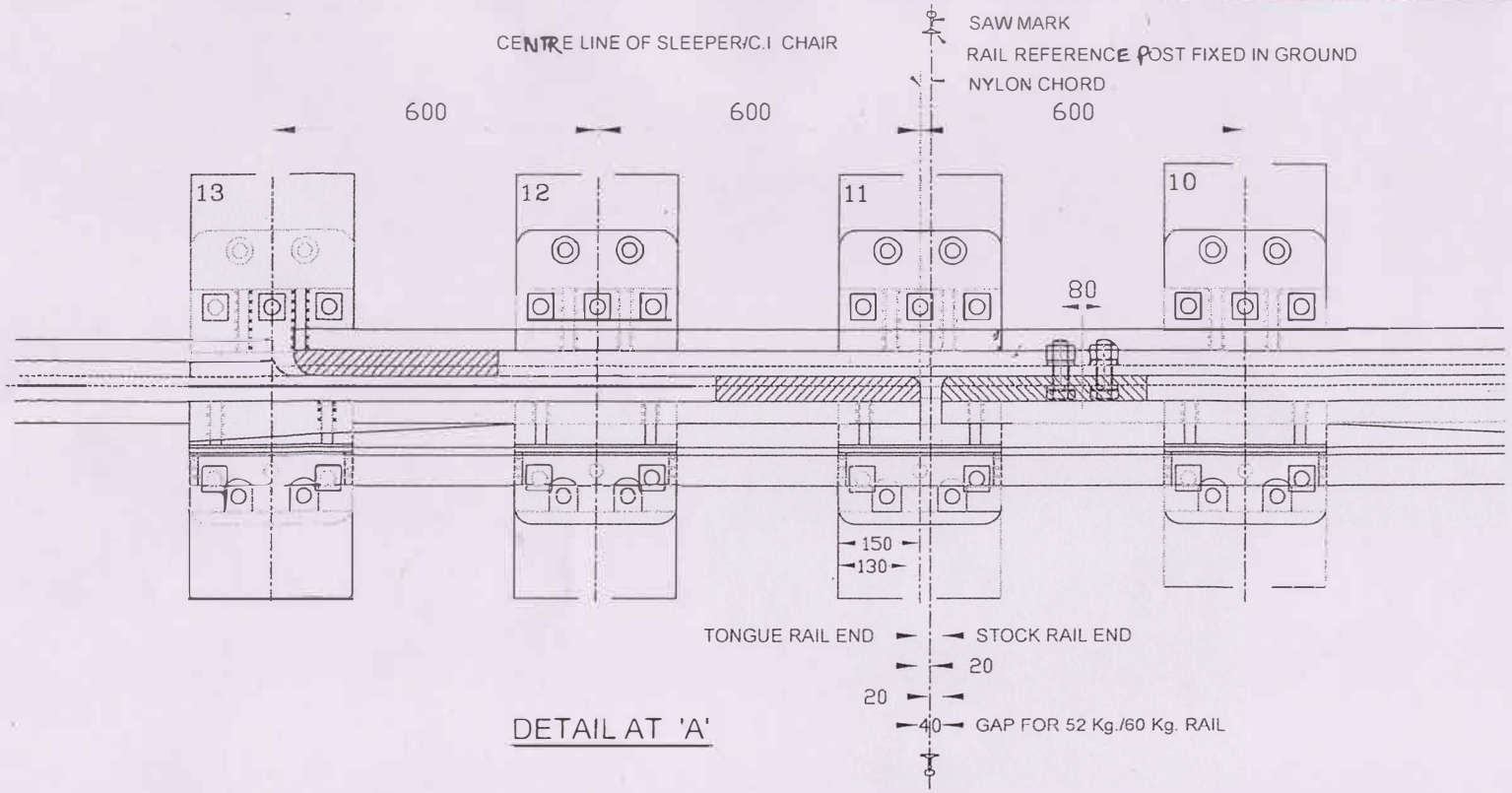
II). AT THE TIME OF INITIAL LAYING/DESTRESSING, THE TIP OF TONGUE RAIL SHOULD COINCIDE WITH MID POINT OF CENTRAL BOLTS OF C.I. CHAIR.

I). ALL DIMENSIONS ARE IN MILLIMETERS.

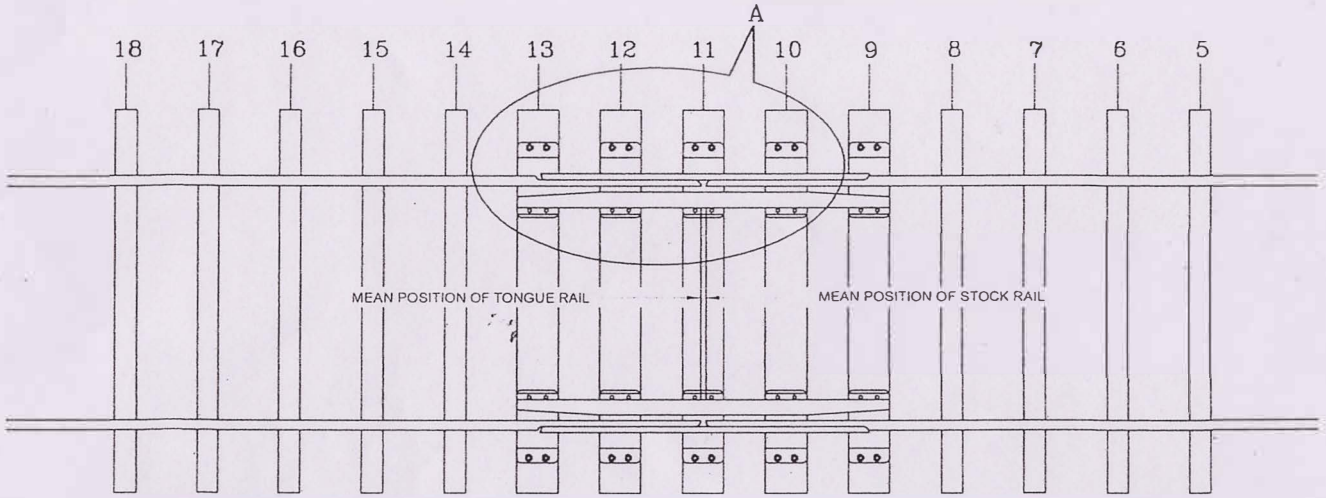
Fig. 5.6.2

SETTING OF GAP AT IMPROVED SEJ WITH SINGLE GAP OF MAX. 80 mm (SG 80 DESIGN) TO DRAWING NO. RDSO/T- 6902 (60 Kg) & RDSO/T- 6914 (52 Kg) (APPLICABLE FOR BOTH RAILS) AT DESTRESSING TEMPERATURE (t d)

Fig. 5.6.3



DETAIL AT 'A'



PLAN

NOTE:-

III). REFERENCE LINE SHALL BE KEPT AT 20 mm FROM CENTRAL BOLT OF C.I. CHAIR.

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.

I). ALL DIMENSIONS ARE IN MILLIMETERS.

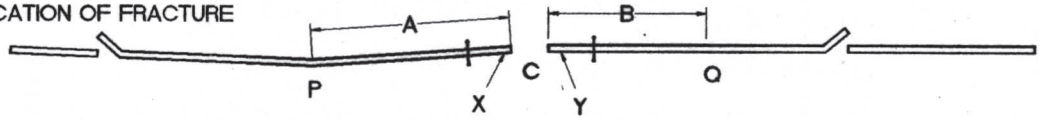
DESTRESSING OF LWR WITH THE USE OF RAIL TENSOR
Fig: 5.7.3(b)
DURING 1st TRAFFIC BLOCK
(a)
SEJ
TRANSFER W0 MARK ON RAIL FOOT
1m GAP CREATED AND TEMPORARILY CLOSED
SEJ
A1
A2
ta
W0
W1
W2 etc
C2
C1
CLOSURE RAIL
ABOUT HALF THE LENGTH OF LWR
etc
W2
W1
W0
ta
TRANSFER W0 MARK ON RAIL FOOT
DURING 2nd TRAFFIC BLOCK (OBTAINED WHEN tp ≥ ta)
(b)
RAIL MADE FREE
B
PAINT MARK MADE AFTER FULL TENSIONING
Wa Wb
Yo
W0
(c)
1m GAP TEMPORARILY CLOSED AFTER FASTENING DOWN AND REMOVING TENSOR
THIS JOINT IS FASTENED BY SPECIAL FISHPLATES + CLAMPS
DURING 3rd TRAFFIC BLOCK
(d)
RAIL CUT AT PUNCH MARK
THIS JOINT IS WELDED
RAIL OF 6.5m (EXACT) INTRODUCED
DURING SUBSEQUENT TRAFFIC BLOCKS
(e)
WELD IF 25mm GAP IS AVAILABLE DURING THE SAME BLOCK
OBTAIN 25mm GAP BY OPERATING RAIL TENSOR + JOINT WELDED
OR
RAIL TENSOR TO BE RELEASED 20 MINUTES AFTER POURING WELD METAL
RAIL MADE FREE TO THE REQUIRED EXTENT
(f)
RAIL MADE FREE TO EQUALISE THE FORCES, TAPPED WITH WOODEN MALLETS etc. AND FASTENED DOWN.
100 m
100 m
CLOSURE RAIL WELDED ENSURING SETTING OF SEJ AT OR NEAR MEAN POSITION
BREATHING LENGTH DESTRESSED AND CLOSURE RAIL WELDED AT BOTH SEJs
DURING FINAL TRAFFIC BLOCK
(g)
100 m BREATHING LENGTH
LWR
LEGEND
FISHPLATED JOINT
CLAMPED JOINT
SEJ ALREADY SET
SEJ SET DURING OPERATION
PAINT MARK
WELDED JOINT
ANCHOR LENGTH
RAIL FASTENED
RAIL FREE

CONVERSION OF EXISTING LWRs INTO CWR
Fig: 5.8
PRELIMINARY WORKS (a)
LWR 1
2 TEMPORARY RAILS ABOUT 6m LONG INTRODUCED AND FISHPLATED ON THE SAME TYPE OF SLEEPERS AS IN LWR's. WELD OTHER RAILS
LWR2
EXISTING SEJ / BUFFER RAILS HERE REMOVED
l_1(≃ 12m)
WELD
TO REPLACE TEMPORARY RAILS KEEP READY STANDARD RAILS OF LENGTH 'l'
100m
100m
TRANSFER Wo MARK ON RAIL FLANGE
Wo
MARKER PILLAR
Wo
MARKER PILLAR
L = 200m
PAINT MARK MADE
DURING 1st TRAFFIC BLOCK (OBTAINED WHEN $t_p > t_o$)
(b)
LWR 1
LWR2
ANCHOR LENGTH l_a MARKED
(RAIL MADE FREE HERE)
ANCHOR LENGTH l_a MARKED
Wo
Yo
MOVEMENT OF RAIL NOTED AS THE RAIL MADE FREE
FOR BG l_a=2.5(to-tp)METRES
FOR MG l_a=4.5(to-tp)METRES
Wo
Yo
MOVEMENT OF RAIL NOTED AS THE RAIL MADE FREE
PAINT MARK
LWR2
(c)
LWR 1
CLOSURE PIECES INTRODUCED IF NECESSARY
(RAIL FASTENED HERE)
THIS JOINT IS WELDED
THIS JOINT IS FASTENED BY FISHPLATES AND CLAMPS
DURING 2nd TRAFFIC BLOCK
RAIL OF LENGTH 'l' INTRODUCED
RAIL CUT AT PAINT MARK
THIS JOINT IS WELDED WHEN 25mm GAP IS AVAILABLE
DURING 3rd TRAFFIC BLOCKS
(e)
OR
RAIL TENSOR OPERATED TO BRING ABOUT 25mm GAP HERE AND WELDED
RAIL MADE FREE TO THE REQUIRD EXTENT
RAIL TENSOR TO BE RELEASED 20mts AFTER POURING WELD METAL
(f)
l_a
l_a
L
RAIL MADE FREE TO EQUALISE THE FORCES, WITH WOODEN MALLETS AND FASTENED DOWN
DURING 4th AND FINAL TRAFFIC BLOCK (OBTAINED WHEN $t_p > t_o$)
LEGEND
FISHPLATED JOINT
CLAMPED JOINT
SEJ ALREADY SET
SEJ SET DURING OPERATION
PAINT MARK
WELDED JOINT
ANCHOR LENGTH
RAIL FASTENED
RAIL FREE

TEMPORARY AND PERMANENT REPAIRS OF RAIL FRACTURES WITH THE USE OF RAIL TENSOR

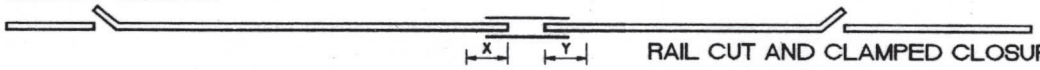
Fig: 7.2.4, 7.2.5

1. LOCATION OF FRACTURE



2. TEMPORARY REPAIRS

2.1 BY WIDE GAP WELDING



RAIL CUT AND CLAMPED CLOSURE PIECE USED IF REQUIRED
X+Y WIDE GAP WELDING

2.2 BY CLOSURE RAIL

2.2.1

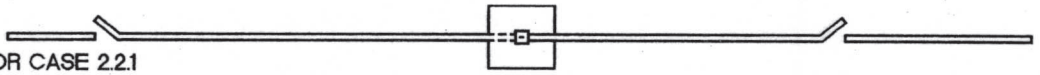
RAIL CLOSURE = A+B+C

2.2.2

RAIL CLOSURE = A+B-50mm

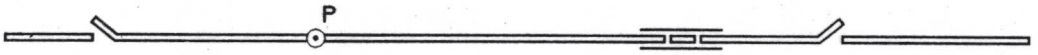
3. PERMANENT REPAIRS

3.1 FOR WIDE GAP



3.2 FOR CASE 2.2.1

3.2.1

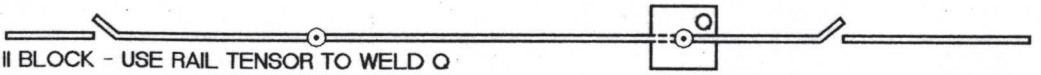


I BLOCK - RAIL CLOSURE CUT TO HAVE LENGTH OF A+B-50mm. JOINT AT P ADJUSTED AND WELDED. JOINT Q CLAMPED. RAIL PIECE USED IF REQUIRED.

II BLOCK - USE TENSOR TO WELD JOINT Q

3.3 FOR CASE 2.2.2

3.3.2



II BLOCK - USE RAIL TENSOR TO WELD Q

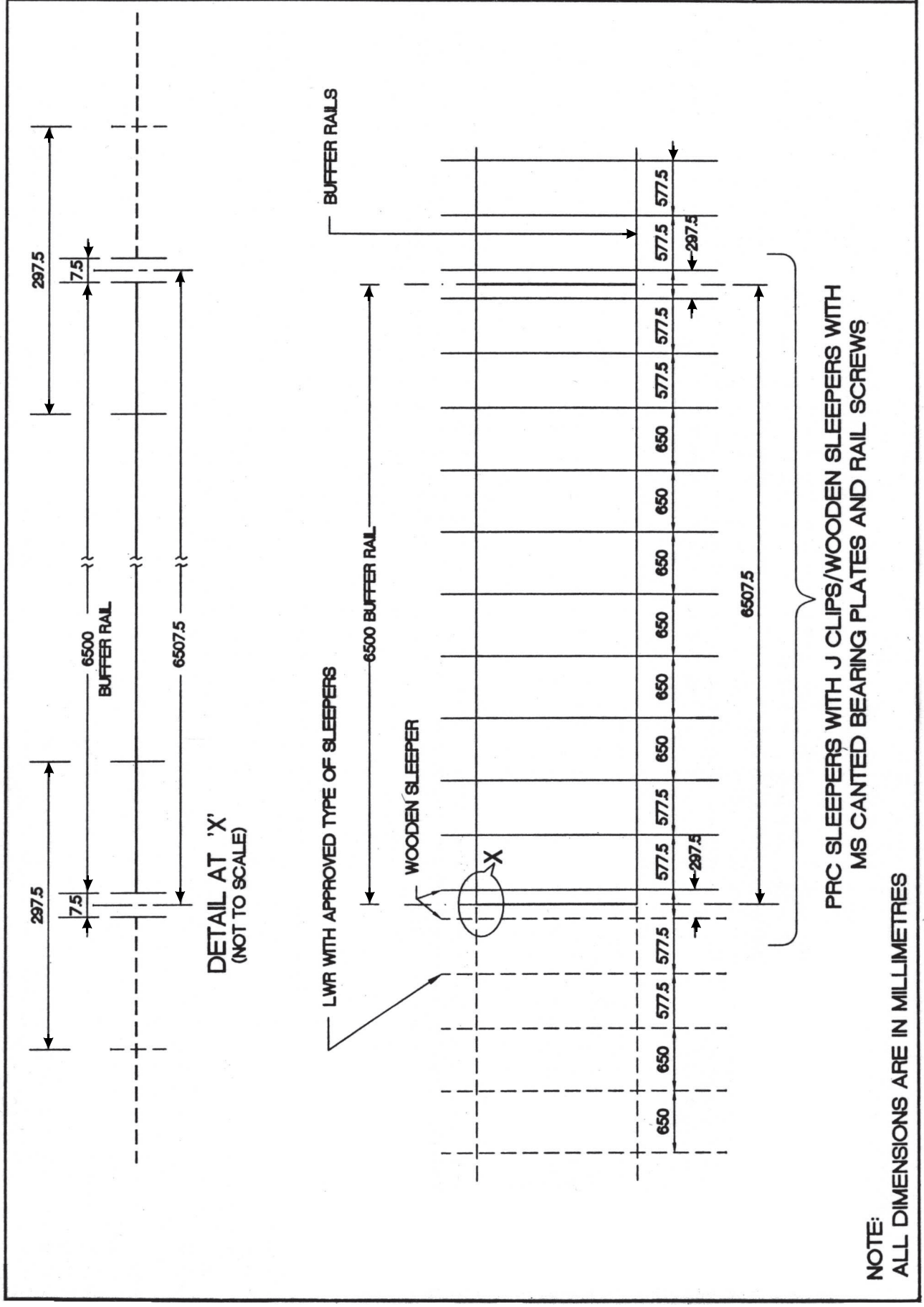
NOTE

1. FASTENING OF 125 m ON EITHER SIDE OF JOINTS REMOVED, RAIL TAPPED AND FASTENING PROVIDED WHEN t_p IS LESS THAN t_o.
2. USE RAIL TENSOR TO MAINTAIN GAP.

LEGEND

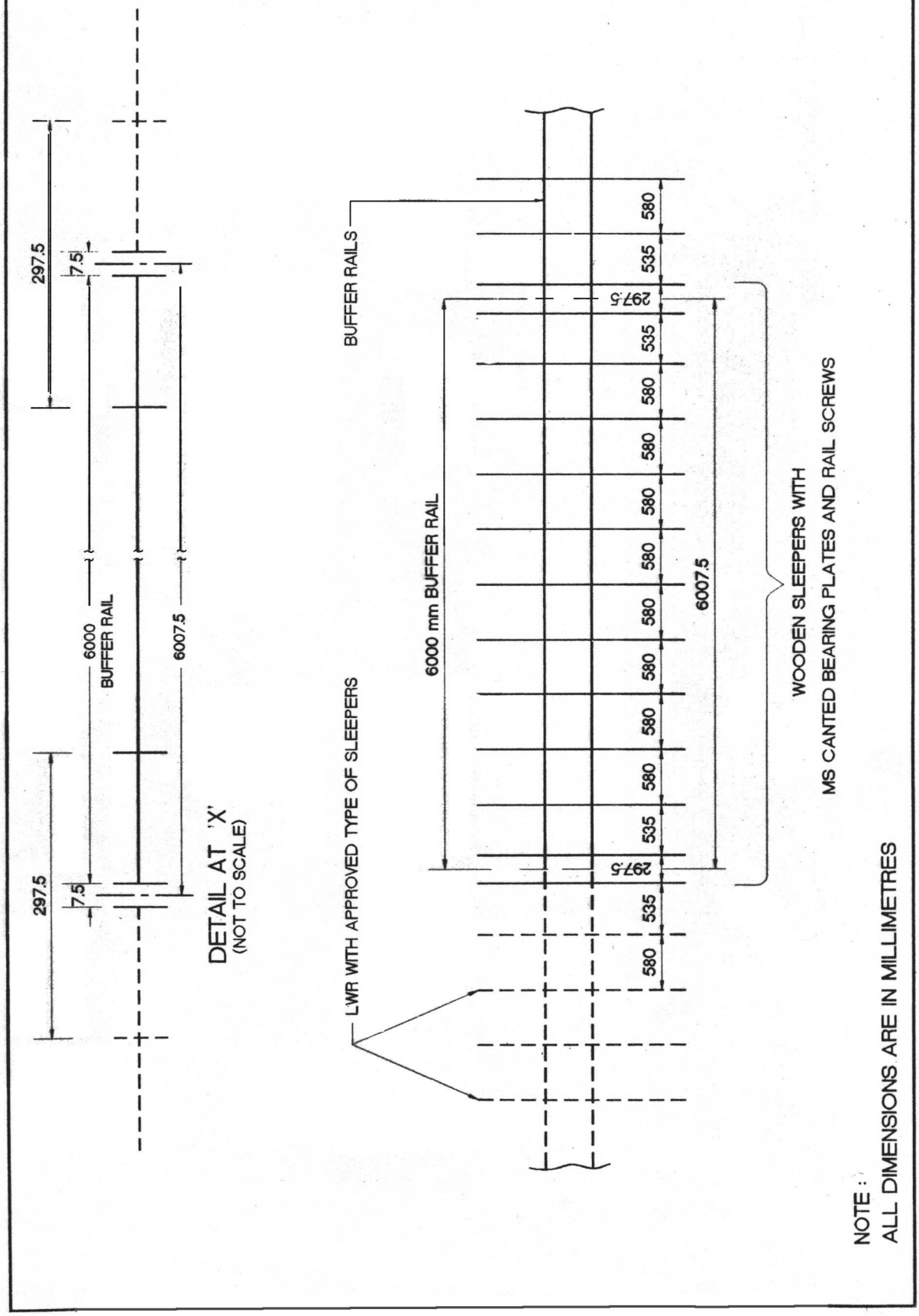
- ☐ DENOTES USE OF TENSOR TO MAINTAIN GAP FOR AT WELDING
- ═ DENOTES USE OF CLAMPS AND 1 m FISHPLATE
- ⊟ DENOTES USE OF CLAMPS AND1 m FISHPLATE WITH RAIL CLOSURE PIECE, IF REQUIRED
- ⊙ JOINTS WELDED BY AT WELDING.
- ⊡ JOINT WELDED BY WIDE GAP AT WELDING.

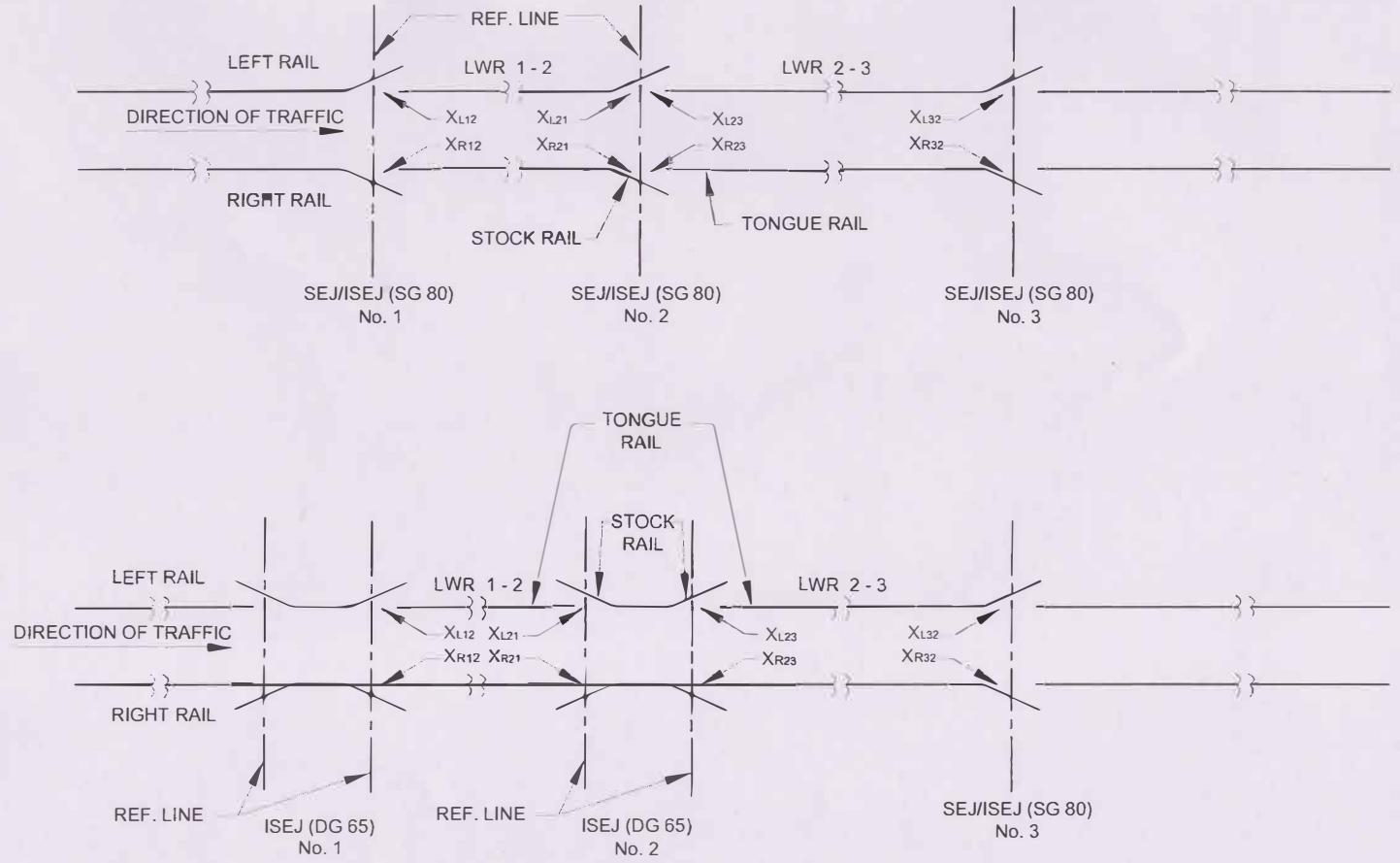
SLEEPER SPACINGS UNDER 6.5 m BUFFER RAILS (BG) | **Fig: A.9 (a)**



SLEEPER SPACINGS UNDER 6.0 m BUFFER RAILS (MG)

Fig: A.9(b)





	LWR No. 1 - 2		LWR No. 2 - 3	
LEFT/RIGHT RAIL	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

ILLUSTRATION FOR MEASUREMENT OF GAP AT SEJ FOR OBSERVATION OF MOVEMENT OF LWR/CWR

Fig. 8.2.1

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