भारतसरकार (GOVERNMENT OF INDIA)
रेलमंत्रालय (MINISTRY OF RAILWAYS)
रेलवेबोर्ड(RAILWAY BOARD)

EF No. 2022/CE-II/CS/IRPWM2020 New Delhi, dated 01.03.2024

The General Managers (Engg.)- CR, ER, ECR, ECoR, NR, NCR, NER, NFR, NWR, SR, SCR, SER, SECR, SWR, WR, WCR and Metro Railway/Kolkata.
The General Manager (Const.), N.F. Railway, Guwahati.
The General Manager/CORE/Prayagraj

Principal Financial Advisor, All Indian Railways
The CAO/Const. All Indian Railways.
The General Managers (Engg.) – ICF/Chennai, RCF/Kapurthla, BLW/Varanasi, CLW/Chittranjan, Rail Wheel Factory /Yelahanka, Bangalore & PLW/Patiala.

The Director General (Track), RDSO/Alambagh, Lucknow.
Chief Commissioner of Railway Safety, Lucknow.

Managing Director, IRCON, New Delhi.
Managing Director, RITES Bhawan, 1, Leisure Valley Rd, Sector 29, Gurugram, Haryana
Managing Director, DMRC, MetroBhawan, Barakhamba lane, New Delhi.
Managing Director, CONCOR, New Delhi.
Managing Director, RVNL, August KrantiBhawan, BhikajiCama Place, New Delhi.
Managing Director, DFCCIL, PragatiMaidan, Metro Station, New Delhi.
Managing Director, PIPAVAV Railway Corp. Ltd., 14th Floor, B-Wing, Statesman House 148, Barakhamba Road, Canaught Place New Delhi Central Delhi
Managing Director, MRVC, Church Gate station Building 2nd Floor, Mumbai – 400020.
Managing Director, RLDA, Unit No.702-B, 7th Floor, Konnectus Tower-2, DMRC Building, Ajmeri Gate Delhi 110002
Managing Director, Konkan Railway Corporation Ltd, BelapurBhawan, Sector-11, CBD Belapur. Mumbai. Pin - 400614.

Director General, IRICEN, Pune.
Director General, IRIEEN, Nasik.
Director, IRISET, Secunderabad.
Director, IRIMEE, Jamalpur.
Director General, IRITM, Vill. Kanausi, Hardoi, Manik Nagar, Lucknow.
Director General, NAIR, Vadodara.
Genl. Secretaries, AIRF, NFIR, IRPOF, FROA, DAI (Railways) Rail Bhawan, New Delhi.

Sub: Correction Slip No.17 to the Indian Railways Permanent Way Manual 2020.

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Ministry of Railways (Railway Board) has decided that correction/addition as indicated in the enclosed Correction Slip No.17 dated 01.03.2024, to relevant para of IRPWM-2020 be made.

Receipt of this letter may please be acknowledged.

1.3.24

(Pradeep Nagar)
Executive Director Civil Engg.(Plg.)
Railway Board

INDIAN RAILWAYS PERMANENT WAY MANUAL, 2020
ADDENDUM AND CORRIGENDUM SLIP NO. 17 DATED 01.03.2024

1. **Para 326(2)** of IRPWM-2020 shall be read as under:

Para 326(2) Alignment-

(a) LWR with 60 Kg/m rail on PSC sleeper with 1660 sleeper density may be permitted on curves upto 6.5 degree in temperature Zone-I & Zone-II and upto 6.0 degree in temperature Zone-III & Zone-IV by Principal Chief Engineer either through PCE circular or on case to case basis subject to fulfilment of all stipulations mentioned in the Instructions as per Annexure-3/19 and site specific conditions. Limits of sharpest curve and sharpest curve associated with steepest gradient for all four temperature zones are tabulated as under:

Temp. Zone	Sharpest permitted degree of curve	Sharpest permitted curve with steepest gradient
Zone-I	6.5	5 degree with 1 in 65
Zone-II	6.5	5 degree with 1 in 65
Zone-III	6.0	5 degree with 1 in 65
Zone-IV	6.0	4 degree with 1 in 80

Note: (i) Cross-bracing arrangement to drawing no. RDSO/T-8329 (Annexure-3/19A) should be provided on curves sharper than 6 degree to enhance lateral stability of LWR track.

(ii) Reduction in de-stressing temperature as stipulated under Para 335 shall not be applicable in the above case.

(b) LWR/CWR with 52 kg/m rail on PSC sleeper with 1540 sleeper density and above may be laid on curves upto 440 m radius. However, in temperature Zone-I, LWR/CWR may be laid on curves up to 350 m radius (5^0 Curve) with following additional precautions:

(i) Minimum track structure should be 52 kg/m rails on PSC sleeper 1540 sleeper density with 300 mm clean ballast cushion.

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

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

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

(c) LWR/CWR may be continued through reverse curves. Shoulder ballast of 600mm over a length of 100 m on both side of the common point of a reverse curve would be provided. In case, there is a straight track between the reverse curves, this 100m would be considered from the center of the straight track. No such measure would be required, if the length of straight track between the reverse curves is more than 50 m.

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2. **Para 326 (3)** shall be read as under:

Para 326 (3) Gradient:- The steepest permitted grade for LWR/CWR shall be 1 in 100. However, LWR with 60 Kg/m rail on PSC sleeper with 1660 sleeper density may be permitted upto 1 in 65 gradient for temperature Zone-I, Zone-II & Zone-III and upto 1 in 80 gradient for Zone-IV by Principal Chief Engineer either through PCE circular or on case to case basis subject to fulfilment of all stipulations mentioned in the Instructions as per Annexure-3/19 and site specific conditions. If gradient is associated with curve, Para 326 (2) (a) shall be referred. Reduction in de-stressing temperature as stipulated under Para 335 shall not be applicable for gradient steeper than 1 in 100.

3. **Para 331(7)** of IRPWM-2020 shall be read as under:

Para 331(7)

In case of LWR is continued over bridges as per Sub Para (3) above, the measurement of gaps of stock rail/tongue rail tip of SEJ provided at bridge approach from the reference post shall be compared with the theoretical gaps as prescribed in **Annexure-3/9A** for conventional PSC sleepers and **Annexure-3/9 C** for wider base PSC sleepers.

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4. Para 335 of IRPWM-2020 shall be read as under:

Para 335 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 by:

$$P = E A \alpha t$$

Where,

P = Thermal force in the rail (Kg)

E = Modulus of elasticity of rail steel, **(2.11×10^6 Kg/cm^2)**

A = Area of cross section of the rail (cm^2)

Rail Section	Cross-sectional Area (cm^2)
60 Kg/m	76.86
52 Kg/m	66.15

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

t = Variation of rail temperature from t_d/t_0 (^{0}C)

The Range of t_d or t_0 shall be within the limits of rail temperature shown below:

Temperature Zone	Rail Section	Range
I, II, III	All Sections	t_m to t_m+5^0C
IV	52 kg/m & heavier	t_m+5^0C to t_m+10^0C

However, laying of LWR on wider base sleeper with 60 Kg rail and sleeper density of 1660 nos. per Km may be permitted with reduced de-stressing temperature range as under:

Temperature Zone	Range of de-stressing temperature	Permitted Degree of Curve (Max.)	Permitted steepest Gradient
Zone-I	t_m-5 to t_m	5°	1 in 100
Zone-II	t_m-5 to t_m	4°	1 in 100
Zone-III	t_m-5 to t_m	4°	1 in 100
Zone-IV	t_m to t_m+5	4°	1 in 100

Note: Above provisions of reduced de-stressing temperature for LWR with wider sleepers shall not be applicable for LWR continued on sharp curves (sharper than 5 degree in Zone-I and sharper than 4 degree in Zone-II, III and IV) and steep gradients (steeper than 1 in 100) as per provisions mentioned under Paras 326 (2)(a) & 326 (3).

Usual breathing lengths on PSC sleepers for different temperature zones and density is shown in **Annexure-3/16.**

The level of maximum thermal stresses in LWR depends upon variation of rail temperature from the stress free temperature. The thermal force diagram in LWR is shown as under **(Fig 3.5)**:

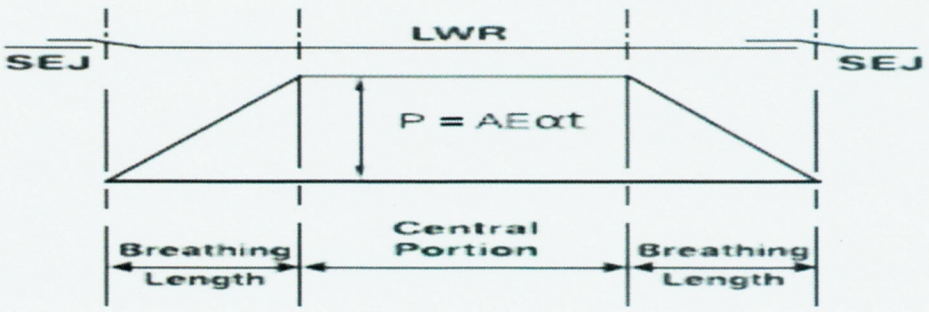

Fig. 3.5: Force Diagram in LWR / CWR

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5. Para 338(2)(b) of IRPWM-2020 shall be read as under:

Para 338(2) (b)
The gaps between the reference mark and tongue rail tip/stock rail corner, which is attached to the LWR/CWR side at various rail temperatures, shall not differ by more than ±10 mm from the theoretical range as shown in **Annexure-3/9** for conventional PSC sleepers and **Annexure- 3/9B** for wider base PSC sleepers.

6. Para 345 (1) (a) of IRPWM-2020 shall be read as under:

Para 345 (1) (a)
The regular track maintenance in LWR/CWR shall be confined to hours when the rail temperature is between t_d+10°C and t_d-30°C and shall be completed well before on set of summer. However, for LWR on wider base sleepers, regular track maintenance shall be confined to hours when the rail temperature is between t_d+15°C and t_d-30°C.

7. Para 345(1)(b) of IRPWM-2020 shall be read as under:

Para 345 (1) (b)
If rail temperature after the maintenance operation exceeds t_d+20°C for conventional PSC sleeper and t_d+25°C for wider base sleepers during period of consolidation, then the speed restriction of 50 Km/h shall be imposed.

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8. Annexure-3/9 shall be read as under:

Annexure - 3/9 (Para 338, 347, 350)

Gaps at SEJ for various Rail Temperatures and Conventional PSC Sleeper (RDSO/T-2495 & 2496) Track in mm

Zone-I				
Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
t_d + 25°	15	14	16	15
t_d + 20°	15 to 17	14 to 17	16 to 18	15 to 17
t_d + 15°	15 to 19	15 to 19	16 to 19	15 to 19
t_d + 10°	16 to 21	15 to 21	16 to 21	16 to 21
t_d + 05°	16 to 22	16 to 23	17 to 22	17 to 22
t_d	17 to 24	17 to 24	18 to 23	18 to 24
t_d - 05°	19 to 25	18 to 25	19 to 24	19 to 25
t_d - 10°	20 to 26	20 to 26	20 to 25	20 to 26
t_d - 15°	21 to 27	22 to 27	21 to 26	21 to 26
t_d - 20°	23 to 27	24 to 28	23 to 26	23 to 27
t_d - 25°	25 to 27	26 to 28	24 to 26	25 to 27
t_d - 30°	27	28	26	27

Zone-II				
Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
t_d + 30°	13	12	14	13
t_d + 25°	13 to 15	12 to 15	14 to 16	13 to 15
t_d + 20°	13 to 18	12 to 17	14 to 18	13 to 18
t_d + 15°	13 to 20	13 to 20	14 to 20	14 to 20
t_d + 10°	14 to 22	14 to 22	15 to 22	14 to 22
t_d + 05°	15 to 24	15 to 24	16 to 23	15 to 23
t_d	16 to 25	16 to 26	17 to 24	16 to 25
t_d - 05°	18 to 26	17 to 27	18 to 26	18 to 26
t_d - 10°	19 to 28	19 to 28	19 to 27	19 to 27
t_d - 15°	21 to 28	21 to 29	21 to 27	21 to 28
t_d - 20°	23 to 29	23 to 30	22 to 28	23 to 29
t_d - 25°	25 to 30	26 to 31	24 to 28	25 to 29
t_d - 30°	27 to 30	28 to 31	26 to 29	27 to 30
t_d - 35°	30	31	28 to 29	29 to 30
t_d - 40°	-	-	-	-

Note: The above values have been calculated with initial setting of gaps at SEJ as 40 mm.

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Gaps at SEJ for various Rail Temperatures and Conventional PSC Sleeper (RDSO/T-2495 & 2496)
Track in mm

Zone-III				
Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
t_d + 35°	10	9	11	10
t_d + 30°	10 to 13	9 to 12	11 to 14	10 to 13
t_d + 25°	10 to 16	9 to 15	12 to 16	11 to 16
t_d + 20°	11 to 18	10 to 18	12 to 19	11 to 18
t_d + 15°	12 to 21	11 to 21	13 to 21	12 to 21
t_d + 10°	12 to 23	12 to 23	13 to 22	13 to 23
t_d + 05°	14 to 25	13 to 25	14 to 24	14 to 25
t_d	15 to 27	14 to 27	16 to 26	15 to 26
t_d - 05°	16 to 28	16 to 29	17 to 27	17 to 28
t_d - 10°	18 to 30	18 to 31	18 to 28	18 to 29
t_d - 15°	20 to 31	20 to 32	20 to 29	20 to 30
t_d - 20°	22 to 32	23 to 33	22 to 30	22 to 31
t_d - 25°	25 to 32	25 to 34	24 to 31	25 to 32
t_d - 30°	27 to 33	28 to 34	26 to 31	27 to 32
t_d - 35°	30 to 33	31 to 35	29 to 31	30 to 33
t_d - 40°	33	34 to 35	31	32 to 33
t_d - 45°	-	-	-	-

Zone-IV				
Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
t_d + 33°	11	10	12 to 13	11 to 12
t_d + 30°	11 to 13	10 to 13	12 to 14	11 to 14
t_d + 28°	11 to 15	10 to 15	12 to 16	12 to 15
t_d + 25°	11 to 17	10 to 17	12 to 17	12 to 17
t_d + 20°	12 to 20	11 to 20	13 to 20	12 to 20
t_d + 15°	12 to 23	12 to 23	13 to 22	13 to 23
t_d + 10°	13 to 25	12 to 26	14 to 24	14 to 25
t_d + 05°	14 to 27	14 to 28	15 to 26	15 to 27
t_d	15 to 30	15 to 31	16 to 28	16 to 29
t_d - 05°	17 to 31	17 to 33	17 to 30	17 to 31
t_d - 10°	19 to 33	18 to 34	19 to 31	19 to 32
t_d - 15°	21 to 35	21 to 36	20 to 33	20 to 34
t_d - 20°	23 to 36	23 to 37	22 to 34	22 to 35
t_d - 25°	25 to 37	25 to 39	24 to 35	25 to 36
t_d - 30°	27 to 38	28 to 40	26 to 35	27 to 37
t_d - 35°	30 to 38	31 to 40	29 to 36	29 to 37
t_d - 40°	33 to 39	34 to 41	31 to 36	32 to 38
t_d - 43°	34 to 39	36 to 41	32 to 36	34 to 38
t_d - 45°	36 to 39	37 to 41	33 to 36	35 to 38
t_d - 48°	37 to 39	39 to 41	35 to 36	37 to 38

Note: The above values have been calculated with initial setting of gaps at SEJ as 40 mm.

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9. Annexure-3/9A shall be read as under:

ANNEXURE - 3/9A (PARA 331 (7))

Gaps at SEJ provided at the Far end approach of Bridge using Rail Free Fastenings Over Girder Bridge and Conventional PSC Sleepers (RDSO/T-2495 & 2496) at Approaches for Various Rail Temperatures in mm

Zone-I								
Rail	60 kg/m				52 kg/m			
Sleeper Density	1660		1540		1660		1540	
Ballast Resistance (Kg/cm/rail)	12.98		11.76		12.98		11.76	
Initial gap at SEJ (mm)	65	40	65	40	65	40	65	40
t_d + 25°	(-19)-(-19)	0-1	(-19)-(-19)	0-1	(-18)-(-19)	1-1	(-19)-(-19)	1-1
t_d + 20°	(-7)-(-9)	3-6	(-8)-(-10)	3-5	(-7)-(-9)	4-6	(-7)-(-9)	4-6
t_d + 15°	0-4	7-10	0-4	6-10	0-4	7-11	0-4	7-10
t_d + 10°	10-15	10-15	9-15	10-15	10-15	10-15	10-15	10-15
t_d + 05°	20-26	14-20	19-26	13-20	20-25	14-19	20-26	14-19
t_d	30-36	17-24	30-37	17-24	30-36	17-23	30-36	17-24
t_d - 05°	40-47	21-28	40-47	21-28	40-46	21-27	40-46	21-28
t_d - 10°	51-57	26-32	51-57	26-32	50-56	25-31	51-56	26-31
t_d - 15°	62-67	30-35	62-67	30-36	61-66	29-34	61-66	30-35
t_d - 20°	73-76	35-39	73-77	35-39	72-75	34-38	72-76	35-38
t_d - 25°	84-86	39-42	84-87	40-43	83-85	38-41	83-86	39-41
t_d - 30°	95	44-45	96	45-46	94	43-44	94-95	44

Zone-II								
Rail	60 kg/m				52 kg/m			
Sleeper Density	1660		1540		1660		1540	
Ballast Resistance (kg/cm/rail)	12.98		11.76		12.98		11.76	
Initial gap at SEJ (mm)	65	40	65	40	65	40	65	40
t_d + 30°	(-13)-(-20)	(-2)-(6)	(-14)-(-22)	(-3)-(5)	(-12)-(-18)	0-7	(-13)-(-20)	(-1)-6
t_d + 25°	(-4)-(-11)	2-9	(-4)-(-13)	1-9	(-3)-(-10)	4-10	(-4)-(-11)	3-10
t_d + 20°	(-2)-(5)	6-13	(-3)-(5)	5-13	(-1)-(5)	7-13	(-2)-(5)	6-13
t_d + 15°	7-13	10-16	6-13	9-16	8-13	11-16	7-13	10-16
t_d + 10°	16-22	14-19	15-22	13-20	16-21	14-19	16-22	14-19
t_d + 05°	25-30	18-22	25-30	17-23	25-29	18-22	25-30	18-22
t_d	34-38	21-25	34-38	21-26	34-37	21-24	34-37	21-25
t_d - 05°	43-45	25-28	43-46	26-28	42-44	25-27	43-45	25-27
t_d - 10°	52-53	29-30	53-54	30-31	51-52	28-29	52-52	29-29
t_d - 15°	60-61	32-33	61-62	33-34	59-60	31-32	60-60	32-32
t_d - 20°	67-70	34-37	68-71	35-38	66-68	33-35	67-69	33-36
t_d - 25°	74-79	36-41	75-81	37-42	73-77	34-39	73-78	35-40
t_d - 30°	81-88	37-44	82-90	38-46	79-86	36-42	80-87	36-43
t_d - 35°	87-97	38-48	88-99	39-50	86-94	37-45	87-96	38-47

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ANNEXURE-3/9A (PARA 331 (7))

Gaps at SEJ provided at the Far End Approach of Bridge using Rail Free Fastenings Over Girder Bridge and Conventional PSC Sleepers (RDSO/T-2495 & 2496) at Approaches for Various Rail Temperatures in mm

Zone-III				
Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
Initial gap at SEJ (mm)	70	70	70	70
t_d + 35°	(-3)-(-3)	(-4)-(-4)	(-2)-(-2)	(-3)-(-3)
t_d + 30°	1-4	0-3	2-5	1-4
t_d + 25°	5-11	4-10	6-11	6-11
t_d + 20°	10-17	9-17	11-17	10-17
t_d + 15°	14-24	14-24	16-24	15-24
t_d + 10°	19-30	19-30	20-29	20-30
t_d + 05°	25-36	24-36	25-35	25-36
t_d	30-42	29-42	31-41	30-41
t_d - 05°	36-47	35-48	36-46	36-47
t_d - 10°	41-53	41-54	42-51	41-52
t_d - 15°	47-58	47-59	47-56	47-57
t_d - 20°	54-63	54-64	53-61	53-62
t_d - 25°	60-67	60-69	59-66	60-67
t_d - 30°	67-72	67-73	66-70	66-71
t_d - 35°	73-76	74-78	72-75	73-76
t_d - 40°	80-81	81-82	78-79	79-80

Zone-IV				
Rail	60 kg/m		52 kg/m	
Sleeper Density	1660	1540	1660	1540
Ballast Resistance (kg/cm/rail)	12.98	11.76	12.98	11.76
Initial gap at SEJ (mm)	70	70	70	70
t_d + 33°	5	4-5	6-7	6-6
t_d + 30°	7-9	6-9	8-10	7-10
t_d + 28°	8-12	7-12	10-13	9-13
t_d + 25°	10-16	9-16	12-17	11-16
t_d + 20°	14-22	13-22	15-22	14-22
t_d + 15°	18-28	17-28	19-28	18-28
t_d + 10°	22-34	21-34	23-33	22-34
t_d + 05°	26-39	25-40	27-38	26-39
t_d	30-45	30-46	31-43	31-44
t_d - 05°	35-50	35-51	36-48	35-49
t_d - 10°	40-54	40-56	40-53	40-54
t_d - 15°	45-59	45-61	45-57	45-58
t_d - 20°	50-64	51-65	50-61	50-63
t_d - 25°	56-68	56-70	55-65	56-67
t_d - 30°	61-72	62-74	60-69	61-71
t_d - 35°	67-76	68-77	65-73	67-75
t_d - 40°	73-79	74-81	71-77	72-78
t_d - 43°	77-81	78-83	75-79	76-80
t_d - 48°	83-85	85-86	80-82	82-84

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10. Annexure-3/9B shall be added as under:

ANNEXURE 3/9 B (Para 338, 347, 350)

Gaps at SEJ for Various Rail Temperatures and Wider Base PSC Sleeper (RDSO/T-8527 & 8746) Track in mm

Rail	60 Kg/m			
Sleeper Density	1660			
Ballast Resistance	12.77 Kg/cm/rail			
Temp. Zone	**Zone-I**	**Zone-II**	**Zone-III**	**Zone-IV**
Range of t_d (°C)	T_m-5 to T_m	T_m-5 to T_m	T_m-5 to T_m	T_m to T_m+5
t_d+40	-	-	7-7	-
t_d+38	-	-	-	8-8
t_d+35	-	10-10	7-10	8-10
t_d+33	-	-	-	8-11
t_d+30	12-13	10-13	7-13	8-13
t_d+28	-	-	-	8-14
t_d+25	13-15	10-15	7-15	9-16
t_d+20	13-17	11-17	8-18	9-19
t_d+15	13-19	11-19	9-20	10-21
t_d+10	14-20	12-21	10-22	11-24
t_d+5	15-21	13-22	12-24	12-26
t_d	16-23	15-24	13-25	14-28
t_d-5	18-24	16-25	15-27	16-29
t_d-10	19-24	18-26	17-28	18-31
t_d-15	21-25	20-27	19-29	20-32
t_d-20	23-25	22-27	22-29	22-33
t_d-25	25	25-27	24-30	25-34
t_d-30	-	28	27-30	27-35
t_d-35	-	-	30	30-35
t_d-38	-	-	-	32-35
t_d-40	-	-	-	33-36
t_d-43	-	-	-	35-36

Note- The above values have been calculated with initial setting of gaps at SEJ as 40mm.

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11. Annexure-3/9C shall be added as under:

ANNEXURE 3/9 C (PARA 331 (7))

Gaps at SEJ provided at the Far End Approach of Bridge using Rail Free Fastenings Over Girder Bridge and Wider Base PSC sleepers at Approaches (RDSO/T-8527 & 8746) for Various Rail Temperatures in mm

Rail	60 Kg/m					
Sleeper Density	1660					
Ballast Resistance	12.77 Kg/cm/rail					
Temp. Zone	**Zone-I**		**Zone-II**		**Zone-III**	**Zone-IV**
Initial gap at SEJ (mm)	**65**	**40**	**65**	**40**	**70**	**70**
t_d+35°	-	-	-	-	(-4)-(-4)	-
t_d+33°	-	-	-	-	-	5-5
t_d+30°	-	-	(-21)-(-13)	(-2)-6	1-4	7-9
t_d+28°	-	-	-	-	-	8-12
t_d+25°	(-19)-(-19)	0-1	(-12)-(-4)	2-9	5-11	10-16
t_d+20°	(-10)-(-7)	3-6	(-2)-5	6-13	9-17	14-22
t_d+15°	0-4	7-10	7-13	10-16	14-24	18-28
t_d+10°	10-15	10-15	16-22	14-19	19-30	22-34
t_d+05°	20-26	14-20	25-30	17-22	24-36	26-39
t_d	30-36	17-24	34-38	21-25	30-42	30-45
t_d-05°	40-47	21-28	43-45	25-28	35-47	35-50
t_d-10°	51-57	26-32	52-53	29-30	41-53	40-55
t_d-15°	62-67	30-35	60-61	32-33	47-58	45-59
t_d-20°	73-77	35-39	67-70	34-37	54-63	50-64
t_d-25°	84-86	40-42	74-79	36-41	60-68	56-68
t_d-30°	95-95	44-45	81-88	37-45	67-72	62-72
t_d-35°	-	-	87-97	38-48	73-77	67-76
t_d-40°	-	-	-	-	80-81	73-79
t_d-43°	-	-	-	-	-	77-82
t_d-48°	-	-	-	-	-	83-85

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12. Annexure-3/16 shall be read as under:

ANNEXURE- 3/16 (Para 335)

Zone	Sleeper Density	Breathing Length (in meters)		
		60 Kg/m, Conventional PSC sleeper	52 Kg/m, Conventional PSC sleeper	60 Kg/m, Wider PSC sleeper
I	1540	60	52	-
	1660	58	50	44
II	1540	69	59	-
	1660	66	57	52
III	1540	74	64	-
	1660	77	66	59
IV	1540	82	71	-
	1660	79	68	56

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

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13. A new Annexure-3/19 shall be added as under:

ANNEXURE-3/19 (Para 326)

Instructions for Continuation of LWR on Sharp Curves and Steep Gradients on Indian Railways

A. General Instructions:

Continuation of LWR on sharp curves and steep gradients upto limits stipulated in the table below for all four temperature zones shall be permitted by Principal Chief Engineer either through PCE circular or on case to case basis subject to fulfilment of all stipulations mentioned herein and in IRPWM considering the site specific conditions:

Temp. Zone	Sharpest permitted degree of curve	Steepest permitted gradient	Sharpest permitted degree of curve with steepest gradient
Zone-I	6.5	1 in 65	5 degree with 1 in 65
Zone-II	6.5	1 in 65	5 degree with 1 in 65
Zone-III	6.0	1 in 65	5 degree with 1 in 65
Zone-IV	6.0	1 in 80	4 degree with 1 in 80

Head Hardened rails should preferably be used whenever available in future to reduce the lateral and vertical wear for longer life of rails on wear account.

B. Continuation of LWR on curves sharper than 4^0 (& upto 5^0)

Following shall be ensured before laying LWR on curves sharper than 4^0 (upto 5^0):-

1.0 **Track structure-**

1.1 Track structure consists of minimum 60 Kg 90 UTS rails, PSC sleepers with elastic fastening (ERC/MK-V) and density 1660 nos. per Km.

1.2 Full ballast cushion as per provisions of IRPWM.

1.3 Full component of fittings in track.

1.4 Joggling of all good AT and Flash Butt Welds with four clamps.

1.5 Joggling of all defective AT and Flash Butt Welds should be done with two clamps and two far end bolts in terms of Para 307 of IRPWM.

2.0 **Pre-requisites-**

2.1 Pre-conditions for laying of LWR in Para 336(1) (b) of IRPWM is strictly followed especially the work of realignment of curve, lifting or lowering of track to eliminate sags and humps, introduction and improvement of vertical curves, stabilization of troublesome formation shall be completed before laying LWR.

2.2 Precautions laid in Para 326(2) (b) of IRPWM before laying LWR.

3.0 **Other stipulations –**

3.1 Vertical and lateral wear shall not be allowed to exceed 8 mm and 6 mm respectively.

3.2 Alignment defects on curves and its approaches should be within 10 mm over 10m chord.

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3.3 Creep shall be measured regularly at least once a month and total creep at any point of time shall not exceed 50 mm per track Km. If so, creep shall be adjusted through de-stressing process. Creep post shall be provided at regular interval for its monitoring.

3.4 ERC Mark-V and composite rubber pads shall be used with full ballast as per the stipulated profile to ensure the effective toe load and adequate creep resistance. However, toe load of such ERCs shall not be less than 600kg in any case.

3.5 Gauge face lubrication shall preferably be done using automatic track mounted mechanized lubricators as per IRS:T-48, 2022.

3.6 USFD testing at curve portion of proposed LWR shall be done as under:

3.6.1 USFD testing of inner rail shall be continued as per existing provisions of "Manual for Ultrasonic Testing of Rails and Welds", Revised-2022 with latest addendum and corrigendum.

3.6.2 To detect development of fast fatigue on non-gauge side of outer rail, ultrasonic testing shall be done as under:

3.6.2.1 USFD testing of outer rail shall be done as per procedure given in "Manual for Ultrasonic Testing of Rails and Welds", Revised-2022 with latest addendum and corrigendum with increased frequency of 4 GMT.

3.6.2.2 If loss of back wall echo is more than 20% of full screenheight, additional testing of non-gauge side of head of outer rail shall be done by hand probing and the acoustic coupling needs to be ensured under all circumstances to detect the flaws.

C. Continuation of LWR on curves sharper than 5^0:

LWR on curves sharper than 5^0 as mentioned in the Table given in Para (A) above, shall be permitted after ensuring following **additional** measures over those mentioned under Para (B) above.

1.0 On curves sharper than 5 degree, slack gauge sleepers shall be used.

2.0 Creep shall be measured regularly at least once a month and total creep at any point of time shall not exceed 50 mm per track km. If so, creep shall be adjusted through de-stressing process. Creep post shall be provided at regular interval for its monitoring.

3.0 SSE/P.Way (In-charge) once in a month and ADEN once in three months shall monitor the behavior of LWR and track conditions with respect to the parameters mentioned in Para F. In hottest and coldest months, inspection of LWR on sharp curves and steep gradients shall be done as per schedule prescribed in IRPWM.

4.0 Rail temperature records shall be maintained and scrutinized for any significant change in values of mean rail temperature (t_m) and range. It is imperative to compile temperature records of such section for 5-10 years to plan maintenance activities and deployment of patrolling.

Sectional Sr. DEN/DEN shall ensure that temperature records are properly maintained, particularly for area where LWR has been permitted on sharp curves and steep gradients. He should analyze the rail temperature data at least twice in a year (in hottest and coldest months) at his level for cross verification of Temperature data with those considered for LWR stability analysis.

5.0 On curves sharper than 6 degree, slack gauge sleepers shall be used and inter-braced as per arrangement contained in RDSO's drawing no. RDSO/T-8329 (Annexure-'3/19A'). Such slack gauge sleepers shall be provided with additional dowels for fixing angle section to cross brace the successive sleepers in curves.

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D. Continuation of LWR on gradients steeper than 1:100

LWR on gradients steeper than 1:100 as mentioned in the Table given in Para (A) above, shall be permitted, after ensuring following additional measures:-

1.0 Track Structure –

1.1 Track structure consists of minimum 60 Kg 90 UTS rails, PSC sleepers with elastic fastening (ERC/MK-V) and density 1660 nos. per Km.

1.2 Full ballast cushion as per provisions of IRPWM.

1.3 Full component of fittings in track.

1.4 Joggling of all good AT and Flash Butt Welds with four clamps.

1.5 Joggling of all defective AT and Flash Butt Welds should be done with two clamps and two far end bolts in terms of Para 307 of IRPWM.

2.0 Pre-requisites –

2.1 Pre-conditions for laying of LWR in Para 336(1) (b) of IRPWM should be strictly followed especially the work of realignment of curve, lifting or lowering of track to eliminate sags and humps, introduction and improvement of vertical curves, stabilization of troublesome formation shall be completed before laying LWR.

2.2 Precautions laid in Para 326(2) (b) of IRPWM shall be taken before laying LWR.

2.3 LWR on gradients steeper than 1:100 shall be considered only in sections where surface damage to rails in the form of wheel burn, scabs etc., are not prevalent. The surface damage on Rails in the form of wheel burns, scabs etc., can be controlled by adequate powering of freight trains.

3.0 Other stipulations –

3.1 Vertical and lateral wear shall not be allowed to exceed 8 mm and 6 mm respectively.

3.2 Alignment defect on curves and its approaches should be within 10 mm over 10 m chord.

3.3 Creep shall be measured regularly at least once a month and total creep at any point of time shall not exceed 50 mm per track km. If so, creep shall be adjusted through de-stressing process. Creep post shall be provided at regular interval for its monitoring.

3.4 ERC Mark-V and composite rubber pads shall be used with full ballast as per the stipulated profile to ensure the effective toe load and adequate creep resistance. However, toe load of such ERCs shall not be less than 600kg in any case.

3.5 Gauge face lubrication shall preferably be done using automatic track mounted mechanized lubricators as per IRS:T-48, 2022.

3.6 SSE/P.Way (In-charge) once in a month and sectional ADEN once in three months shall monitor the behavior of LWR and track conditions with respect to the parameters mentioned in Para-F. In hottest and coldest months, inspection of LWR on sharp curves and steep gradients shall be done as per schedule prescribed in IRPWM.

3.7 Rail temperature records shall be maintained and scrutinized for any significant change in values of mean rail temperature (t_m) and range. It is imperative to compile temperature records of such section for 5-10 years to plan maintenance activities and deployment of patrolling.

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Sectional Sr. DEN/DEN shall ensure that temperature records are properly maintained, particularly for area where LWR has been permitted on sharp curves and steep gradients. He should analyze the rail temperature data at least twice in a year (in hottest and coldest months) at his level for cross verification of Temperature data with those considered for LWR stability analysis.

E. Continuation of LWR at sharp curves associated with steep gradients:

Continuation of LWR on sharp curves (more than 4^0) associated with steeper gradients (steeper than 1:100) as mentioned in the Table given in Para (A) above, shall be permitted after ensuring following measures:-

1.0 All the measures indicated separately for sharp curves and steep gradients under Para (B) or (C) as the case may be and (D) above, shall be taken before laying LWR.

2.0 In Temperature Zone-III, De-stressing temperature may be raised by 5^0C to improve the level of factor of safety against static buckling keeping in view the rail/weld fracture history and temperature records.

F. In addition to the regular inspections and duties, following shall also be monitored **by SSE/P.Way (In-charge) once in a month and by ADEN once in three months** for proper behavior of LWR and track conditions.

a. Availability of full ballast as per stipulated profile. In case, loosening of ballast is noticed, suitable speed restriction should be imposed.

b. Alignment defect of curves and approaches.

c. Measurement of total creep and its timely adjustment through de-stressing process.

d. Requirement of de-stressing of LWR for other than creep adjustment.

e. Vertical and lateral wear of rails.

f. Condition of joggled fish plates with clamps.

g. Condition and functioning of arrangement for inter-bracing of sleepers, where provided.

h. Gauge face lubrication.

i. Completeness of fittings and measurement of toe load of sample ERCs as per site conditions.

j. USFD testing of non-gauge face at prescribed frequency as mentioned in Para B (3.6).

k. Repairs to surface defects on rails.

l. Looking for signs of out of squaring of sleepers, if any, and taking immediate remedial measures of recoupment of ballast in deficient areas.

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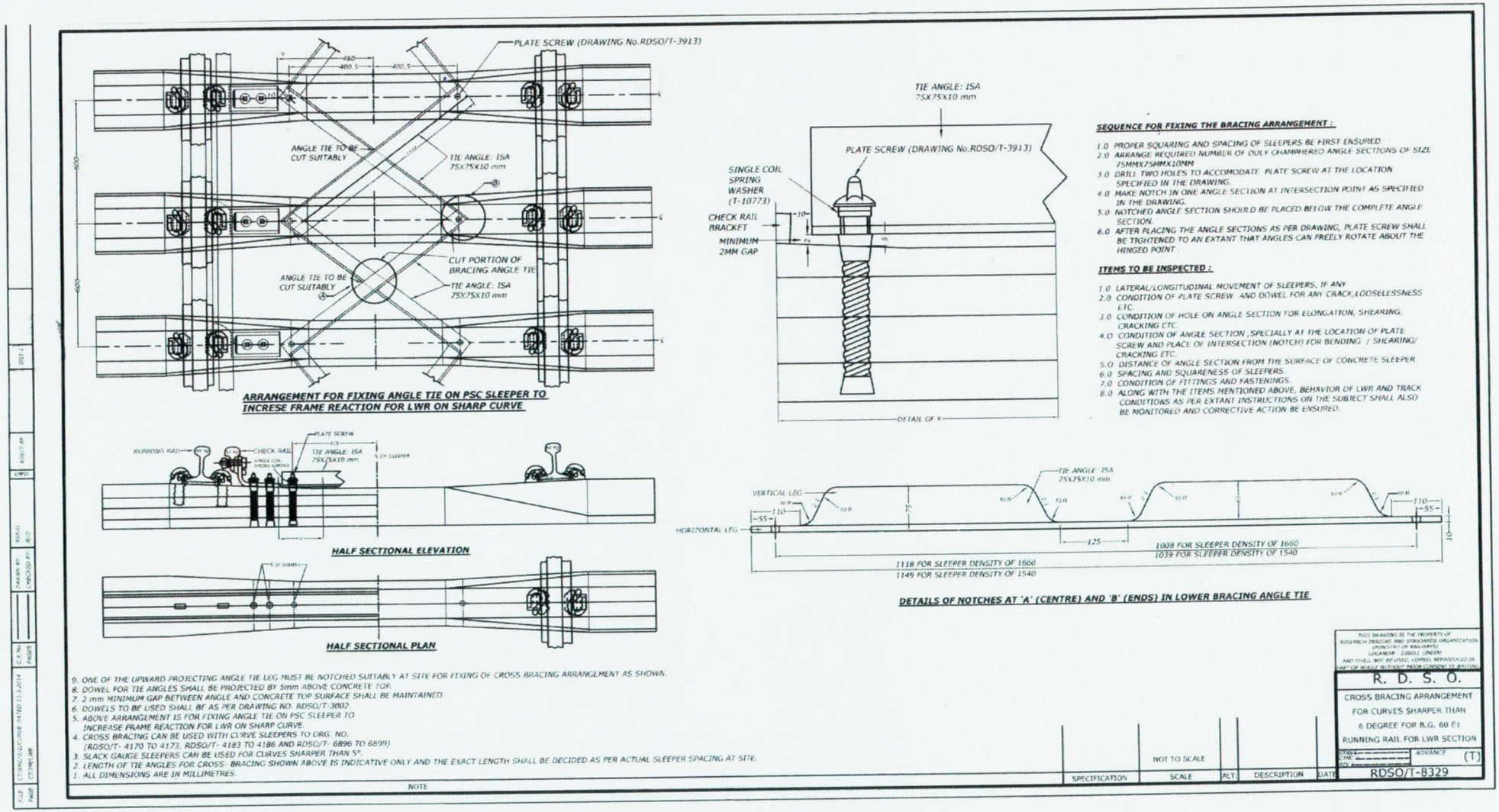
14. Annexure-3/19A has been newly added.

ANNEXURE-3/19A (Para 326)



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15. The existing Para 650 (2) "Fouling Mark" of IRPWM, 2020 shall be read as under:

Para 650 (2)

a) Fouling Mark should be placed at a location where track centre begins to reduce to:

   i. 4.265 m in existing works where normal track centre is between 4.265 m and 4.725m.

   ii. 4.725 m in existing works or new works or alteration to existing works where normal track centre is 4.725 m or more.

b) While placing FM between two berthing lines (main and loops line or between two loop line) where points are involved, it must be ensured that glued joint is placed 3.35m inside FM for ensuring safety.

c) It should be ensured that chainages of FM are written on ESP along with the mention of CSR (FM to FM) and CSL (from track circuit termination glued joint in rear to signal in front).

16. Para 1005 (1)(a) of IRPWM-2020 shall be read as under:

Para 1005(1)(a)

(i) t_d + 30°C on Wider base PSC sleeper track with sleeper density 1660 nos. per km.

(ii) t_d + 25°C on PSC sleeper track with sleeper density 1540 nos. per km and above.

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