

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)**

2023/Proj./MPMRCL/C1-C2/30/59

New Delhi, dated 15.12.2023

Managing Director,
Madhya Pradesh Metro Rail Corporation Limited (MPMRCL),
2nd Floor, Smart City Development Corporation Office Building,
Kalibadi Road, BHEL, Sector-A, Berkheda,
Bhopal-462 022 (Madhya Pradesh)

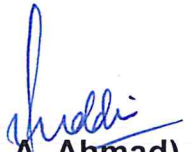
Sub: Approval of Track Structure (Annexure C-1) for Bhopal & Indore Metro Rail Projects of Madhya Pradesh Metro Rail Corporation Limited (MPMRCL).

Ref.: Track Structure (Annexure C-1) documents uploaded on RDSO's online portal by MPMRCL on 19.10.2023

Madhya Pradesh Metro Rail Corporation Limited (MPMRCL)'s request for approval of Track Structure (Annexure C-1) for Bhopal & Indore Metro Rail Projects of MPMRCL has been examined in consultation with RDSO and approval of the competent authority in hereby conveyed.

Accordingly, approved copy of Track Structure (Annexure C-1) is enclosed.

Encl: As above


(F. A. Ahmad)
Director/Gati Shakti (Civil)-IV
Railway Board
☎ 011-47845480
Email: dmtp@rb.railnet.gov.in

Copy to: (i) **Executive Director/UTHS**, RDSO, Manak Nagar, Lucknow w.r.t letter no. UTHS/MPMRCL/BMRC/P01/112020 dated 07.11.2023 & e-mail dated 30.11.2023

(ii) **OSD/UT & Ex-Officio Joint Secretary**, Ministry of Housing & Urban Affairs (MoHUA), Nirman Bhawan, New Delhi-110001

ANNEXURE – C1

Part A: Technical Standard of Track Structure for Metro Railways/MRTS

(Compliance to be given & document to be uploaded on Portal as C1.1)

1. Scope

The Scope is to formulate the Track Structure Design Basis, with broad parameters for getting the Ministry of Railways approval for the stipulated and desirable technical standards /specifications for a Metro Rail.

2. OPERATING ENVIRONMENT:

Track Structure should fulfill generally the following conditions:

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|--|---|
| 2.1 | Gauge – Broad gauge- 1676/1673mm (nominal) and standard gauge – 1435mm. | Standard Gauge-1435 mm |
| 2.2 | Rail Seat inclination (slope): 1 in 20 | 1 in 20 |
| 2.3 | Speed potential – 110 kmph (max.) | Design Speed 90 Kmph (Max) Operating Speed – 80 Kmph (Max) |
| 2.4 | Static axle loads –20 T (max.) | Maximum 16 T |
| 2.5 | Design rail temperature range – (-)10 degree Celsius to (+) 70 degree Celsius. | Comply: -10°C to 70° |
| 2.6 | Maximum Curvature and Ruling gradient- As Specified in approved SOD of the Metro Rail. | Maximum Permissible gradient on Mid-Section (Compensated): 4% Minimum Radius of Curve (Horizontal) 1) On Main Line a) Underground Section: 200 m b) Elevated at Grade Sections (Without Check Rail): >190 m c) With Check Rail: 190 m or less upto 120 m 2) Depot & Non-Passenger Lines: 100 m |

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3. TRACK STRUCTURE:

3.1 General: The track structure should fulfill following requirements:

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|--|---|
| 3.1.1 | The track structure should conform to/ satisfy Schedule of Dimension requirement and other maintenance instructions of Metro systems. | Complied. |
| 3.1.2 | Ride comfort and running safety of track vehicle dynamics should be satisfied. | Complied. |
| 3.1.3 | The track structure should be designed with Long welded / Continuously welded rail on main line track (For both the ballasted as well as ballast-less track). | Complied. |
| 3.1.4 | The horizontal alignment shall consist of a series of straights joined to circular curves generally with transition curves. Curvature and cant shall be calculated based on the train speed for each train type on the section. Compound and reverse curves are acceptable, provided they are connected by an adequate transition curve. | Complied. |
| 3.1.5 | The vertical alignment should be designed to achieve a smooth profile line with gradual changes. Changes in the profile should be connected by vertical curves, which shall be as generous in length as the location allows. Vertical curves including its transition shall not be located at stations within the length of platform. A vertical curve within the length of transition and Turnouts is also not desirable. Vertical curve radius is constrained by the need to limit the vertical acceleration for passenger ride comfort. | Complied: As per SOD  |
| 3.2 | The technical standards for track structure deals with the following components: | |
| | I. Rail and Welding | Complied |
| | II. Sleeper and fastening for ballasted track | Complied |
| | III. Track slab for ballast- less track | Complied |
| | IV. Fastening system for ballast- less track | Complied |
| | V. Insulated Glued joint | Complied |
| | VI. Turnout, scissors crossover | Complied |

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3


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| VII. | Switch Expansion Joints | N.A |
| VIII. | Gradients | Complied |

4. Rail and Rail Welding

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|---|--|
| 4.1 | Rails: | |
| 4.1.1 | For Main line Track: | |
| 4.1.1.1 | The rail used on main line on curves and approaches of Stations shall be 60E1, 1080 grade Head Hardened. | Complied. |
| 4.1.1.2 | At other locations on straight line of main line, the use of 60E1, 1080 grade HH / 60E1, 880 grade/ 60E1, R260 rail shall be decided by Metro Railway depending upon speed, axle load and other factors pertaining to safety and life of rail. However, on curves with small straight track in between, the 60E1, 1080 grade Head hardened rail should be continued on straight patches also. | Complied. On complete Main line – 1080 Grade HH 60E1 Rails will be provided. |
| 4.1.1.3 | It is essential to have preventive rail grinding arrangements in case 60E1, 1080 HH rails are used. | Complied The Rail grinding machine shall be used for preventive rail grinding of track periodically as and when required. |
| 4.1.2 | For Depot Lines: | |
| | The rail used on depot lines can be non- head hardened and shall be 60E1, 880 grade/60E1, R260 grade. | Complied |
| 4.1.3 | Specifications: | |
| 4.1.3.1 | The rail shall be class 'A' rails as per IRS-T-12-2009 specification with latest amendments. However, any suitable length of rail more than 13 m considered appropriate by metro on consideration of transportation and handling can be adopted, provided the rails are ultimately welded into long welded rails. | Complied.  |
| 4.1.3.2 | The rail shall be manufactured and tested in accordance with IRS-T-12-2009 (with latest amendment). The chosen manufacturers shall be required to submit their inspection and test plan for approval by Metro railway as per IRS-T-12- | Complied. Inspection and Test Plan of 1080 HH & 880 Gr Rails enclosed as Annexure-5 |

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| | 2009. Metro railways will ensure that the inspection and test plan approved by them strictly conforms to the requirement of IRS specifications. | |
| 4.2 | Welding of Rails: | |
| 4.2.1 | The welding of rails should conform to Indian Railway specifications and technical instructions issued from time to time. | Complied. |
| 4.2.2 | The present instructions are contained in following documents: | |
| 4.2.2.1 | Alumino Thermic Welding: | |
| (i) | Indian Railway Standard specifications for Fusion Welding of Rails by Alumino -Thermic Process, (IRS/T-19-2020 with latest amendments. | Complied. |
| (ii) | Manual For Fusion Welding of Rails By The Alumino-Thermic Process: Revised-2012 with latest amendments. | |
| 4.2.2.2 | Flash Butt Welding: | |
| | Manual for Flash Butt welding of rails, (Revised January 2012) with latest amendments. | Complied. QAP of Flash butt welding enclosed as Annexure-6. |
| 4.2.2.3 | Special attention is required by metros for provision of these instructions regarding procurement, execution of works and areas requiring prior approval / standardization by RDSO. | Complied. Flash Butt Welding of 1080 & 880 grade rails have been done using Flash Butt Welding Machine, having the approval for welding from RDSO. |
| 4.3 | Ultrasonic Testing of Rail and Welds: | |
| | The rails and welds shall be ultrasonically tested in field as per requirement of concerned specification/manual/ instructions. The testing shall be ensured as per provisions of "Manual for Ultrasonic Testing of Rail and Welds- Revised 2012" with latest amendments. The provisions, as given in the "IRS specification for Ultrasonic testing of Rails/Welds, Revised-2020 (Document no: T-53)" shall also be followed. | <ol style="list-style-type: none"> 1. T-53: Indian Railway Standard Specification for Ultrasonic Testing of Rails/Welds- Revised – 2020 with latest amendments will be followed. 2. Manual for Ultrasonic Testing of Rail and welds-Revised 2022 with latest amendments will also be followed |



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5. Sleeper and fastening for Ballasted track

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|---|---|
| 5.1 | Sleepers: | |
| 5.1.1 | Broad Gauge The PSC sleepers shall be used in accordance with RDSO drawing no. T-2496 and specification IRS-T-39 (revised from time to time). | NA |
| 5.1.2 | Standard Gauge PSC sleeper for standard gauge will be designed by Metro Railways following in principal guidelines of Indian Railway and the same shall be approved by Metro. | Complied |
| 5.2 | Fastening system The elastic fastening system prevalent on Indian Railways shall be used duly ensuring the Inspection protocol for fastening components laid down for IR. In case of use of elastic fastening other than in use on IR, prior approval shall be obtained from Railways. | Complied Approval to use of Pandrol Double resilient Baseplate Assembly Drg No:21166 (2 Hole) fastening system approved by MoR vide letter No. 2023/Proj./MPMRCL/Bhopal-Indore/C-2/30/33, Dated 10-05-2023 is attached as Annexure 1 |

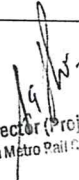
6. TRACK SLAB FOR BALLSTLESS TRACK

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|---|--|
| 6.1 | Track shall be laid on cast in situ/precast reinforced plinth or slab, herein referred to as the 'track slab'. The track slab shall be designed as plinth beam or slab type ballastless track structure with derailment guards. It shall accommodate the base plates of the fastening system. | Complied |
| 6.2 | In general, track slab (including sleeper, if any) on which the fastening and rail are to be fitted shall perform the following functions: | |
| i | Resist the track forces. (Static and dynamic) | Complied. |

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| ii | Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure. | Complied. |
| iii | Provide a level base for uniform transmission of track/rail forces. | Complied. |
| iv | Have geometrical accuracy and enable installation of track to the tolerances laid down. | Complied. |
| v | Ensure drainage. | Complied. |
| vi | Resist weathering. | Complied. |
| vii | Be construction friendly, maintainable and quickly repairable in the event of a derailment. The 'Repair and Maintenance methods' shall be detailed in a Manual to be prepared and made available. | Complied. |
| viii | Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design. | Complied. |
| ix | Plinth beam or slab of ballastless track should be suitable for embankment or viaduct or tunnel/Underground structure. | Complied. |
| x | Proper design of expansion joints suitable for joints of viaduct structure. | Complied. |
| xi | Design should be suitable for curves as per SOD of Metro system. | Complied. |
| xii | Design of subgrade/embankment for slab should be furnished to ensure durability and functional stability in service. | Mainline is on Viaduct/Tunnel. Viaduct designed as per approved DBR of MoR/RDSO. Hence not applicable. |
| xiii | Design should be suitable and incorporate provision of utilities e.g. cable, wires, ducts, water channels, etc. | Complied. |
| xiv | The detailed design calculations of track slab along with detailed structural drawings as approved by metro authorities shall be furnished for record. | Complied. The detailed design calculations of track slab are enclosed as Annexure-2 . Structural drawings are enclosed as Annexure-3 . |

7. CHECK RAIL/ Restraining Rail:

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
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| 7.1 | Check rails/ Restraining Rails should be provided on curves on main line where radius is 218m or less | Complied. |

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| | on Broad gauge and radius is 190m or less on Standard gauge. The clearance of check rail/restraining rails shall be suitably decided after requisite studies. The detailed design calculations/studies in this regard shall be furnished for record. | Calculation report enclosed as Annexure-4 |
| 7.2 | Check rails/ Restraining Rails shall not be mandatory for curves in depots, yards and non-passenger lines where speed is not more than 25 kmph. However, decision in this regard may be taken by Metro itself based on layout and maintenance requirement. | Complied. Check rail / Restraining rail shall not be mandatory for curves in depots, yards and non-passenger lines where speed is less than 25 Kmph. |

8. DERAILMENT GAURDS

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|--|---|
| 8.1 | The derailment guard should be provided inside/outside of running rail on viaduct as well as in tunnel having multiple tracks and at grade section locations specified by the Metro railway. For single track tunnel, location for providing derailment guard is given in note. In tunnels, the derailment guard should preferably be provided inside the track, so that it permits less sway of coach towards tunnel wall in case of derailment. | Derailment guard at viaduct is being provided outside of running Rail. In Tunnels, the derailment guard is provided inside the track/running rail. A minimum 610 mm wide pathway for evacuation is being ensured in between running rail. |
| | <p>Note: Location for providing Derailment Guard in single track tunnel:</p> <p>1.Entry of tunnel:200 m from tunnel portal outside the tunnel to 50 m inside the tunnel</p> <p>2.Exit of tunnel :50m from inside of tunnel portal to 200 m outside the tunnel.</p> <p>3.In Curved Track having radius 500 m or less including transition portion but excluding location where check rail is provided.</p> <p>4.Covering locations of all important installations e.g. Location of any Sub-Station or hazardous structures inside the tunnel, etc. damage to which in the assessment of metro rail administration can result into serious loss of life or and infrastructure as a result of derailment in tunnel.</p> <p>The above is subject to the condition that metro railway shall carry out the risk assessment analysis</p> | <p>Complied.</p> <p>Complied.</p> <p>Complied.</p> <p>Complied.</p>  |

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8

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| | for derailment in tunnels and ensure that the maintenance practices in the maintenance manual are as per the risk assessment mitigation plan. | |
| 8.2 | <p>The lateral clearance between the running rail and the derailment guard shall be 210 ± 30 mm. It shall not be lower than 25 mm below the top of the running rail and should be clear of the rail fastenings to permit installation, replacement and maintenance. Metro Administration should ensure that KE is not infringing the Structure Gauge, in case of derailment in single track tunnel, so long the wheels of any derailed vehicle are within the main rail and derailment guard,"</p> <p>Note: " In case of Double resilient Base plate assembly Fastening System as approved by MoR, the lateral clearance between running rail and the derailment guard shall be 250 ± 20 mm. This fastening system ,if used in tunnels having multiple tracks, Metro Administration should ensure that KE for adjacent track is not infringed so long as the wheels of any derailed vehicle are within the main rail and derailment guard.</p> | <p>Complied. Lateral clearance between the running rail and the derailment guard provided is 210mm (± 30 mm).</p> <p>Noted</p> |
| 8.3 | Derailment guard shall be designed such that in case of derailment: | |
| (i) | The wheels of a derailed vehicle under crush load, moving at maximum speed are retained on the viaduct or tunnel. | Complied. |
| (ii) | Damage to track and supporting structures is minimized. | Complied. |
| (iii) | The detailed design calculations of derailment guards along with detailed structural drawings shall be furnished for record. | Enclosed as Annexure-2 & 3. |

9. GLUED INSULATED RAIL JOINT

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|---|--|
| 9.1 | Normally glued joint should be avoided. | Noted. |
| 9.2 | Wherever inescapable, G3 (L) type of glued insulated rail joint shall be used as per RDSO drawing no.T-2572. The glued joints shall be manufactured and tested in accordance with | Complied. |

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| | RDSO's 'Manual for Glued Insulated Rail Joints-1998' with all amendments. | |
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10. Turnouts, Scissors Crossove

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|--|--|
| 10.1 | Standards of Turnouts | |
| 10.1.1 | Main lines On main lines, the turnouts and diamond crossing shall be of the following standards: | |
| (i) | Standard Gauge | |
| (a) | 1 in 9 type or flatter turnout (desirable) | Complied. |
| (b) | 1 in 7 type turnout (minimum) | Complied. |
| (c) | Scissors cross-over of 1in9 / 1 in 7 type consisting of 4 turnouts and 1 diamond crossing | Complied. |
| (ii) | Broad Gauge | NA |
| (a) | 1 in 12 type turnout | NA |
| (b) | 1 in 8.5 type turnout | NA |
| (c) | Scissors cross-over of 1in 12 type consisting of 4 turnouts and 1 diamond crossing | NA |
| 10.1.2 | Depots and Non – running lines On depots and other non – running lines, the turnouts and diamond crossing shall be of the following standards: | |
| (i) | Standard Gauge | |
| (a) | 1 in 7 type or flatter turnout | Complied. |
| (b) | Scissors cross-over of 1in 7 type consisting of 4 turnouts and 1 diamond crossing | Complied. |
| (c) | 1 in 7 derailing switch / 1 in 7 type symmetrical split turnout | Complied. |
| (ii) | Broad Gauge | |
| (a) | 1 in 8.5 type turnout | NA |
| (b) | Scissors cross-over of 1in8.5 type consisting of 4 turnouts and 1 diamond crossing. | NA |
| (c) | 1 in 8.5 derailing switch / 1 in 8.5 type symmetrical split turnout | NA |
| 10.1.3 | If any Metro railway decides to use sharper angle layout, they should establish the adequacy of the speed potential of the turnout for the purpose for which it is used and the negotiability of the turn out by the rolling stock with a safety margin. | Noted. |
| 10.1.4 | The requirement for turnouts as specified in the following clauses shall include switch devices, crossings and associated check and lead rails as appropriate. | |

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| (a) | Turnouts (switches, lead, crossings and associated closure & check rails) shall be suitable for installation on PSC sleepers for ballasted track or concrete slab for ballastless track. | Complied. |
| (b) | Turnouts shall be manufactured to allow for installation of continuously welded track. | Complied. |
| (c) | Turnout shall be compatible with proposed rolling stock and its operational characteristics. | Complied. |
| (d) | The assembly must ensure continuous electrical contact with the train and all the points shall be operated by electric motors. | Complied. |
| (e) | The CMS crossing to be used on mainline shall be subjected to explosive hardening. | Complied. |
| (f) | All turnouts shall be laid with cant with a rail slope as that of main line towards centre of track. | Complied. |
| (g) | All turnouts and their components shall be designed to minimize electrical leakage from running rails to the ground. | Complied. |
| (h) | Scissor crossover should be designed for Track centres not infringing SOD. | Complied. |
| 10.2 | TYPE AND GEOMETRY OF TURNOUT | |
| | Detailed design of all turnouts, scissors crossover should comply with the following geometrical parameters. | |
| (a) | Standard Gauge | |
| (i) | 1 in 9 Turnout The design shall be tangential with a switch angle not exceeding 0°20'00". It is desirable that the radius of lead rail of turnout is not less than 300m. Lead curve of 190 m radius may be laid as an exception. All clearances shall be in accordance with relevant provisions of SOD. | Complied. |
| (ii) | 1 in 7 Turnout The design shall be tangential with a switch angle not exceeding 0°20'00". It is desirable that the radius of lead rail of turnout is not less than 190m. Lead curve of 140 m radius may be laid as an exception. All clearances shall be in accordance with relevant provisions of SOD. | Complied. |
| (iii) | Scissor Crossover The basic geometry of the turnouts of scissors crossover shall be same as that of corresponding ordinary turnouts as mentioned in clause 10.2 (a)(i) & (ii) above. | Complied |
| (b) | Broad Gauge | |
| (i) | 1 in 12 Turnout The design shall be tangential with a switch entry angle not exceeding 00 20'00". The radius of lead rail of turnout shall not be less than 410m. All | NA |



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| | clearances shall be in accordance with relevant provisions of SOD. | |
| (ii) | 1 in 8.5 Turnout The design shall be tangential with a switch entry angle not exceeding 00 20'00". The radius of lead rail of turnout shall not be less than 218m. All clearances shall be in accordance with relevant provisions of SOD. | NA |
| (iii) | Scissor Crossover The basic geometry of the turnouts of scissors crossover shall be same as that of corresponding ordinary turnouts as mentioned in clause 10.2 (b)(i) & (ii) above. | NA |
| 10.3 | OPERATING REQUIREMENT OF TURNOUT, SCISSOR CROSSOVER: Track layout design shall permit trains to operate at maximum capability wherever possible. Turnouts and crossover shall be selected such that they do not form a restriction to the operating speed on main line. Switches and crossings shall not be located on transition curves or vertical curves. | Noted and complied |
| 10.3.1 | Speed: The turnout shall be designed for the speed on mainline side equal to the speed as on mainline track. The minimum speed potential of the various turnouts and scissors crossover on the Turnout side should be as follows: | Complied. |
| 10.3.1.1 | STANDARD GAUGE | |
| (i) | 1 in 9 type turnout with 300 m radius (speed potential of 45Kmph) | Complied |
| (ii) | 1 in 7 / 1 in 9 type turnout with 190 m radius (speed potential of 35Kmph) | Complied |
| (iii) | 1 in 7 type turnout with 140 m radius (speed potential of 25 Kmph) | complied |
| (iv) | Scissors crossover 1 in 9 type with 300 m radius (speed potential of 45 Kmph) | Complied. |
| (v) | Scissors crossover 1 in 9/1 in 7 type with 190 m radius(speed potential of 35Kmph) | Complied. |
| (vi) | Scissors crossover 1 in 7 type with 140 m radius(speed potential of 25 Kmph) | Complied. |
| (vii) | 1 in 7 type symmetrical split turnout (speed potential of 45Kmph) | NA |
| 10.3.1.2 | BROAD GAUGE | |
| (i) | 1 in 12 type turnout (speed potential of 50Kmph) | NA |
| (ii) | 1 in 8.5 type turnout (speed potential of 30Kmph) | NA |

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| (iii) | Scissors crossover 1 in 12 type (speed potential of 50Kmph) | NA |
| (iv) | Scissors crossover 1 in 8.5 type (speed potential of 30Kmph) | NA |
| (v) | 1 in 8.5 type symmetrical split turnout (speed potential of 40Kmph) | NA |
| 10.4 | TECHNICAL SPECIFICATION | |
| 10.4.1 | General: | |
| (a) | All the points shall be capable of being operated by electric motors in accordance with the signaling specification. | Complied. |
| (b) | The top surfaces of PSC sleeper/RCC slab supporting rail seat of turnouts and scissors crossover shall be flat without any cant/slope. | Complied. |
| (c) | The track form of the turnout shall have uniform resilience as that of the adjoining track form. | Complied. |
| (d) | The fixation of turnouts, scissor cross-over on track slab shall be through base plates/bearing plates. | Complied. |
| 10.4.2 | Rails: | |
| 1 | The rails used in turnouts shall be 1080 grade Head Hardened. However, rails used in turnouts on depot and other non-running lines may be of 880 grade. | Complied. |
| 2 | The rails used for manufacturing of turnouts shall satisfy the following conditions: | |
| (a) | The rails shall be manufactured and tested in accordance with IRS/T-12-2009 with latest amendment. | Complied. |
| (b) | The section of rails shall be 60E1 for stock, lead and 60E1A1 /60E1A4 for switch rail. | Complied. |
| (c) | The rails shall qualify as Class 'A' rails as per IRS/T-12-2009. | Complied. |
| (d) | The rails shall be with ends un-drilled. | Complied. |
| (e) | The rails shall be of grade 1080HH and be suitable for being welded by alumino- thermic or flash butt welding technique. | Complied. |
| 10.4.3 | Switches: | |
| 1 | Each switch device shall consist of two stock rails, one left hand and one right hand and two switch rails, one left hand and one right hand. | Complied. |
| 2 | The switch rail shall be one piece with no weld or joint within the switch rail length. | Complied. |
| 3 | The end of the asymmetrical switch rail shall be forged to 60E1 rail profile with minimum length of 500 mm. The forged switch rail end shall be suitable for welding or installation of insulated rail joint. | Complied. |

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| 4 | Slide chairs in the switch portion shall be coated with an appropriate special coating, so as to reduce the point operating force and to eliminate the requirement of lubrication of sliding surfaces during service. | Complied. |
| 5 | Switches shall provide suitable flange way clearance between the stock rail and the switch rail with the switch rail in open position (minimum 60mm). The 1 in 12 and 1 in 9 (with radius of 300 m) and flatter turnouts shall be provided with second drive or other suitable arrangement to ensure minimum gap of 60 mm at JOH as well as proper housing of switch rail with stock rail up to JOH. | Complied. |
| | 1 in 8.5, 1 in 9 turnouts (with radius of 190m) and 1 in 7 and sharper turnouts may not be provided with second drive arrangement, however minimum gap of 60mm at JOH as well as proper housing of switch rail with stock rail up to JOH should be ensured. | Complied. |
| | The normal opening of switch at toe of switch shall be kept as 160mm. | Complied. |
| 6 | The switch manufacturer shall include provision for all holes required to main drive machines, stretcher bars and detection equipment to suit the requirements of the signaling and switch operating system duly chamfered to avoid stress concentration at the edge of the holes. | Complied. |
| 7 | The switches shall be designed with an anti-creep device at the heel of switch to withstand thermal forces of the CWR track. | Complied. |
| 8 | The switches and all slide chairs shall be same for ballasted and ballastless turnouts. | Complied. |
| 10.4.4. | Crossing: | |
| 1 | All crossings shall be cast manganese steel (CMS) crossings with weldable rails of minimum 1.2m length undrilled for welding into the overall turnout. | Complied. |
| 2 | The CMS crossings shall be manufactured from Austenitic Manganese steel as per UIC 866. | Complied. |
| 3 | All CMS crossings shall have welded leg extensions of 60E1 rails. This shall be achieved by flash butt welding of buffer transition rail piece | Complied. |

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| | of suitable thickness to CMS crossings and rail leg extension. | |
| 4 | All CMS crossings on main line shall have a minimum initial hardness of 340 BHN. | Complied. |
| 5 | All CMS crossings and their welded leg extensions for all scissor crossovers shall be suitably dimensioned so as to eliminate the necessity of providing small cut rail pieces for the purpose of inter-connection. However, the need for providing insulated glued joints from signaling requirement point of view shall be taken care of in the design, if required. | Complied. |
| 6 | The provision of rail cant shall be taken care of on the top surface of the CMS crossing and the bottom surface of all CMS crossing shall be flat. | Complied. |
| 10.4.5 | Check Rails: | |
| 1 | The check rail section shall be 33C1 (UIC33) or similar without any direct connection with running rails. | Complied. |
| 2 | Check rails shall have the facility for the adjustment of check rail clearances up-to 10mm over and above the initial designed clearance. | Complied. |
| 3 | Each check rail end shall be flared by machining to have minimum clearance of 62mm at end. | Complied. |
| 4 | The check rail connections in turnouts shall be through specially designed bearing plates / brackets. | Complied. |
| 5 | All the check rails shall be higher by 25mm above running rails. The lengths and positions of the check rail in diamond crossings shall provide safety and be compatible with the overall track layout. | Complied. |
| 10.4.6 | Sleeper for Turnouts, Scissor crossover (Ballasted Track): | Ballasted Track in Depot only (Non-Passenger line) |
| 10.4.6.1 | Sleeper shall be of pre-stressed concrete, mono-block, suitable for installation in track both with and without signaling circuits and with and without electrification. | Complied |
| 10.4.6.2 | Sleepers shall be designed to provide a minimum service life of fifty years under nominal axle load as that of main line for the Metro system. Rail seat pads and rail clip etc shall be designed to provide a minimum service life of 15 years. | Complied |
| 10.4.6.3 | The sleeper base surface shall be rough cast while the top and side surface shall be smooth to prevent retention of moisture and foreign materials. | Complied |



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15

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| 10.4.6.4 | Sleepers must be suitable for installation by track laying machines and sleeper insertion equipment of a type used for isolated sleeper laying. | Complied |
| 10.4.6.5 | The sleeper must be able to transfer all the relevant track forces generated by train operations and the forces of rail expansion and contraction to the ballast. | Complied |
| 10.4.6.6 | Design Requirements for PSC Sleepers: | |
| (A) | The sleepers should satisfy the following design requirement: | |
| | Design Parameters | |
| (i) | Rail sleeper fastening – Elastic resilient type | Complied |
| (ii) | Spacing of sleepers – 600mm (max) for main line and 650 mm (max) for Depots and other non-running lines, except at few locations such as near point machine locations where it may be varied to meet the design requirements. | Complied |
| (iii) | Ballast cushion – 300 mm for mainline and 250mm for Depots and sidings | Complied |
| (iv) | Ballast profile suitable for LWR/CWR. | Complied |
| | Specifications and Drawings (With latest amendment) | |
| (i) | Special Cement for PSC sleeper-53-S grade OPC to BIS specification IS-269:2015 | Complied |
| (ii) | HTS wire plain and strand – BIS – 1785 (Pt-1) 1983 and BIS 6006 | Complied |
| (iii) | Polyethylene dowels – Drg. No. RDSO/T 3002 ,IRS Specification for Polyethylene dowles for concrete sleepers -Serial no. T-57:2020 | Complied |
| (iv) | IRS Specification for Turnout Sleeper T- 45 :2021 | Complied |
| (v) | IRS Bridge code 1982. | Complied |
| (vi) | Code of Practice for Pre-stressed Concrete IS-1343 | Complied |

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16

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| (B) | The design should satisfy the following additional requirements- | |
| (i) | The connections of the slide chairs and bearing plates/special bearing plates/brackets shall be designed for easy installation and maintenance. All the fittings shall be suitably designed to ensure full compatibility & also to ensure interchangeability of slide chairs between ballasted and ballastless turnouts. | Complied |
| (ii) | For attaining suitable cant of the rail, as provided on mainline, (excluding crossing and switch portion), suitably designed pads of appropriate material shall be provided between rail pad & PSC sleeper. Also fastening system should be designed to get the desired Toe Load. | Complied |
| (iv) | The detailed design of Monoblock PSC sleepers for the turnouts along with structural drawings shall be checked and approved by metro railways. | Complied |

11. SWITCH EXPANSION JOINT:

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
|---------|--|---|
| 1 | The SEJ for ballasted track shall be laid on PSC sleepers whereas the SEJs for ballastless track, if required, shall be laid on reinforced concrete slab. | SEJ's are not planned to be installed. However, if need arises, the SEJ shall be installed with the specifications/parameter as mentioned in 11.1 to 11.8 |
| 2 | The rail section for all SEJs shall be 60E1, 1080 HH grade as per IRS-T-12-2009. | |
| 3 | The SEJ for ballasted track shall be designed for a maximum gap of 80 mm. | |
| 4 | The SEJ for ballastless track should be designed for the maximum gap required as per design. | |
| 5 | The ballasted SEJ shall be as per RDSO drawing T-6902 & T-6922. | |
| 6 | The ballasted SEJ for BG shall be laid with PSC sleepers as per RDSO drawing T-4149. For Standard Gauge, PSC sleeper shall be designed such that SEJ to RDSO drawing along with its bearing plates/chairs may be accommodated for installation of SEJ. | |
| 7 | Sleepers used for SEJs shall be flat and cant will be provided through CI chair. | |
| 8 | The SEJ shall be suitable for two way directional traffic. | |



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17

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12. FASTENING SYSTEM FOR BALLASTLESS TRACK

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| Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
| Provisions contained separately in "PERFORMANCE CRITERIA OF FASTENING SYSTEM FOR BALLASTLESS TRACK ON METRO RAILWAYS/MRTS SYSTEM" (Annexure C-2) be referred to. | Compliance submitted in Annexure-C-2. |

13. NOISE AND VIBRATION:

| ST. NOISE AND VIBRATION | Standard Specification adopted by MPMRCL | | | | | | | | | | | | | | | | | | | | | | |
|--|---|-----------|-----------------------|---------------------|--|----------|------------|-----|-----------------|----|----|-----|------------|----|----|-----|-------------|----|----|-----|--------------|----|----|
| Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Complied. Statutory requirement for noise is as per Noise-Pollution (Regulation and Control) Rules,2000. Ambient Air quality standards in respect of Noise | | | | | | | | | | | | | | | | | | | | | | |
| Metro system shall be designed to ensure that noise emitted is well within the prescribed limits for the particular area. Each Metro system shall specify the prescribed limits of permissible Noise and vibration parameters as per legal and statutory requirement of India. | | | | | | | | | | | | | | | | | | | | | | | |
| | <table><tr><th rowspan="2">Area code</th><th rowspan="2">Category of Area/Zone</th><th colspan="2">Limits In dB(A) Leg</th></tr><tr><th>Day Time</th><th>Night Time</th></tr><tr><td>(A)</td><td>Industrial Area</td><td>75</td><td>70</td></tr><tr><td>(B)</td><td>Commercial</td><td>65</td><td>55</td></tr><tr><td>(C)</td><td>Residential</td><td>55</td><td>45</td></tr><tr><td>(D)</td><td>Silence Zone</td><td>50</td><td>40</td></tr></table> | Area code | Category of Area/Zone | Limits In dB(A) Leg | | Day Time | Night Time | (A) | Industrial Area | 75 | 70 | (B) | Commercial | 65 | 55 | (C) | Residential | 55 | 45 | (D) | Silence Zone | 50 | 40 |
| Area code | Category of Area/Zone | | | Limits In dB(A) Leg | | | | | | | | | | | | | | | | | | | |
| | | Day Time | Night Time | | | | | | | | | | | | | | | | | | | | |
| (A) | Industrial Area | 75 | 70 | | | | | | | | | | | | | | | | | | | | |
| (B) | Commercial | 65 | 55 | | | | | | | | | | | | | | | | | | | | |
| (C) | Residential | 55 | 45 | | | | | | | | | | | | | | | | | | | | |
| (D) | Silence Zone | 50 | 40 | | | | | | | | | | | | | | | | | | | | |
| | 1.Day time shall mean 06.00AM to 10.00PM 2.Metro corridor in Bhopal & Indore are predominately is Zone B and Zone C. 3. During oscillation trial if it is found that noise levels are exceeding the applicable limits, necessary corrective measures shall be taken to contain the same within the limits. | | | | | | | | | | | | | | | | | | | | | | |



14. GRADIENTS

| Sl. No. | Standards stipulated as per Annexure-C1 of Procedure for safety Certification and Technical Clearance of Metro Systems | Standard Specification adopted by MPMRCL |
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18

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| 14.1 | The maximum grade (compensated) shall be 4%. | Complied. |
| Note: | There will be no change of gradient in transition | Complied. |
| (i) | portion of curves. | |
| (ii) | The gradient will be compensated for curvature at the rate of 0.04% per degree of curve. | Complied. |
| 14.2 | Maximum permissible gradient on turnouts | |
| (i) | On Ballasted Track 0.25% | Complied. |
| (i) | On Ballastless Track 3.0% | Complied. |
| Note: | There shall be no change of gradient (i.e vertical curve) on and within 15m(desirable) /3.0 m (minimum)of any turnout on ballastless track. In case of ballasted track ,there shall be no change of gradient on and within 30 meter of any turnout | Complied. |
| (ii) | There shall be no horizontal curve within 15.0 m (desirable)/3.0m (minimum) of any turnout on Ballastless track and 30 meters of any turnout on Ballasted Track | Complied. |
| (iii) | Turnout shall normally be installed on straight track . In track exceptional situation, turnout may take off from curve provided that the radius of lead curve (mainline as well as diverging line)is not less than 190 mtr. The negotiability of rolling stock on such turnout must be certified by rolling stock supplier and confirmed through oscillation trial and a suitable speed restriction should be imposed on main and / or diverging line based on Track geometry and other consideration, if required. In case of turnout installed on curved track ,the minimum distance of commencement of vertical curve or another horizontal curve shall be 15 mtr for ballastless track .Turnout shall not be laid on Transition curve . | Complied. |
| (iv) | The limit of turnout for above purposes shall be taken from Stock Rail Joint (SRJ) to end (i.e., heel) of crossing for Ballast less track. For Ballasted track, it shall be from SRJ to last common sleeper behind end of crossing. | Complied. |
| (v) | Metro Authority need to ensure that Rolling stock is fit to negotiate the maximum permissible gradient on turnout considering the location with respect to vertical/horizontal curves in Vicinity. | Complied. |



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19


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| (vi) | The above stipulations shall also be applicable for turnout to be laid outside station limit if any, | Complied. |
| 14.3 | Track Gradient in Platform | |
| (a) | Desirable Level: level | Complied. |
| (b) | Maximum Gradient :1 in 1200 | Complied. |
| (c) | Exceptional Gradient :1 in 400 | Complied. |
| Note: | Any gradient steeper than 1 in 1200 and up to Exceptional gradient of 1 in 400 shall be proposed by Civil Engineering Head and approved by Managing Director in consultation with Head of Safety nominated by Metro Rail Authority (ii) There shall be no change of gradient in platform track | Complied. Complied. |

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Signature Not Verified

Digitally Signed: **Project features of Track Structure as adopted by Metro Railways**
Name: MANISH GANGAREKAR
Date: 19-Oct-2023 10:48:34

Documents to be uploaded on Portal as C1.2)

i) Track

| SI No. | Components / Items | Provisions / Reference |
|--------|--|---|
| 1 | Gauge | 1435mm |
| 2 | Axle Load | 16 T |
| 3 | Design Speed | 90kmph |
| 4 | Rail Section and Grade | Main line = UIC 60/60E1, IRS-T-12-2009, 1080 grade HH Depot line = UIC 60/60E1, IRS-T-12-2009, 880 Gr. |
| 5 | Rail Specifications | IRS T-12-2009 |
| 6 | Ballasted or Ballastless | Viaduct mainline = Ballastless (BLT) Depot = Ballasted/Ballastless (Embedded) |
| 7 | Rail inclination (Canting of Track) | 1 in 20 |
| 8 | Check Rails provision | On main line with curves of Radius 190m and sharper. |
| 9 | Provision of Derailment upstand/Guard | Provided on Mainline |
| 10 | Horizontal Clearance of Derailment upstand | 210 ± 30mm (Provision in SOD) |
| 11 | Vertical location of Derailment upstand w.r.t. Rail plane | Not lower than 25mm from top of Rail level (Provision in SOD) |
| 12 | Glued insulated Rail Joint provided? If Yes, type of GIRL | Yes. G3L as per RDSO drawing No. T – 2572 are used for traction isolation. |
| 13 | Welding Of Rail (LWR /CWR) | CWR |
| 14 | Whether SEJ provided? If Yes Type of SEJ | No |
| 15 | Type of welding | FBW and SKV (Alumino Thermic) |



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| Sl. No | Components/Items | Scissors cross over (1 in 7) ballasted | Turnouts (1 in 7) 190 ballasted | Turnout 1 in 9 190 ballasted | Turnout 1 in 9 300 ballasted | Scissors cross over ballasted 1 in 9 300 m | Remarks |
|--------|--|---|---|---|---|---|---------|
| 1 | Type of turnout scissors cross over (crossing angle) | Scissors cross Over for track center of 7.5 m (1 no) crossing angle=8.13° | Turnout (1 in 7). crossing angle=1 in 7 (8.13°) | Turnout (1 in 9). crossing angle=1 in 9 (6.34°) | Turnout (1 in 9). crossing angle=1 in 9 (6.34°) | Scissors cross Over for track center of 5 m (1 no) crossing angle=8.13° | |
| 2 | Canted/un canted | canted (1 in 20) | canted (1 in 20) | canted (1 in 20) | canted (1 in 20) | canted (1 in 20) | |
| 3 | Radius | 140 m | 190 m | 190 m | 300 m | 300 m | |
| 4 | Length of switches | 12.648 m | 12.648 m | 12.648 m | 13.967 m | 13.967 m | |
| 5 | Type of switches(thick web or other wise) | Thick web switches | Thick web switches | Thick web switches | Thick web switches | Thick web switches | |
| 6 | Switch Entry angle | (0° 16' 36.75") | (0° 14' 35.81") | (0° 14' 36.03") | (0° 9' 15.59") | (0° 9' 15.59") | |
| 7 | Speed Potential | 25 Kmph | 35 Kmph | 35 Kmph | 45 Kmph | 45 Kmph | |
| 8 | Location of use Main line/Depot | Depot | Depot | Main line | Main line | Main line | |



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|----|--------------------------------|---|---|---|---|---|
| 9 | Rail section used for switches | 60E 1 HH 1080 grade rails as per IRS T-12/2009 for stock rail and (60 E1 A1 (asymmetrical)-1080 grade for switch/tongue rail) | 60E 1 HH 1080 grade rails as per IRS T-12/2009 for stock rail and (60 E1 A1 (asymmetrical)-1080 grade for switch/tongue rail) | 60E 1 HH 1080 grade rails as per IRS T-12/2009 for stock rail and (60 E1 A1 (asymmetrical)-1080 grade for switch/tongue rail) | 60E 1 HH 1080 grade rails as per IRS T-12/2009 for stock rail and (60 E1 A1 (asymmetrical)-1080 grade for switch/tongue rail) | 60E 1 HH 1080 grade rails as per IRS T-12/2009 for stock rail and (60 E1 A1 (asymmetrical)-1080 grade for switch/tongue rail) |
| 10 | Second Drive provided | NA | NA | NA | Provided | NA |

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iii) Crossings

| Sl No. | Components / Items | Provisions / Reference |
|--------|---|--|
| 1 | Crossing: Curved or Straight | 1 in 9 190, 1 in 9 300 = Straight & Curved 1 in 7, 190 m = Straight |
| 2 | Crossing: Canted or uncanted | Canted |
| 3 | Length of Weldable length extension | 2.18 m & 1.18 m in 1 in 9 R300, 1.8 m & 1.3 m in 1 in 7 R190 |
| 4 | Check Rail section | EN 33C1 (UIC 33) |
| 5 | Height of Check rail above the rail plane | 25 mm |
| 6 | Check Rail clearance at the middle | 36 mm to 42 mm |
| 7 | Check Rail clearance at the end | 62 mm minimum |

Part-C: Check List of submissions while submitting compliance:
(document to be uploaded on Portal as C1.3)

| S.No | Document Number | Document Name | |
|------|-----------------|---|---------------------------------------|
| 1 | C1.3.1 | Compliance of Part-A | Complied |
| 2 | C1.3.2 | Design of subgrade/embankment for slab (Para 6.xii) | NA |
| 3 | C1.3.3 | Design calculations of track slab /plinth beam along with detailed structural drawings as approved by metro authorities. (Para 6) | Complied. Enclosed as Annexure - 2 |
| 4 | C1.3.4 | Design calculations/ studies with regard to clearance of Check rails/ Restraining Rails. (Para 7.1) | Complied. |
| 5 | C1.3.5 | Design calculations of derailment guards along with detailed structural drawings shall be furnished for record. (Para 8) | Complied. Enclosed as Annexure - 2 |

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