GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

2018/Proj./NOIDA/C-1/30/7

New Delhi, dated 12.02.2018

Managing Director,
Noida Metro Rail Corporation Limited,
Ganga Shopping Complex, Sector-29
Noida 301201 (Uttar Pradesh)

Sub: Approval of Track Structure - Compliance to (Annexure C1) of 'Procedure for Safety Certification and Technical Clearance of Metro Systems (December, 2015)' for Standard Gauge (1435mm) section for Noida-Greater Noida Corridor.

Ref: NMRCL's letter No. NMRC/ED/2018/1517 dated 11.01.2018

The Track Structure documents as per Annexure C-1 of 'Procedure for Safety Certification and Technical Clearance of Metro Systems (December, 2015)' for Standard Gauge (1435mm) as submitted by Noida - Greater Noida Metro Rail Corporation Limited (NMRCL) has been examined in consultation with RDSO and approval of Railway Board is hereby conveyed for the same.

Accordingly, approved copy of Annexure C-1 is enclosed.

Encl: As above

12.02.2018

(Ruth Changsan)
Director/MTP
Railway Board
☎ 011-23097061

Copy to : **Executive Director/UTHS**, RDSO, Manak Nagar, Lucknow w.r.t their letter No. UTHS/110/Noida Metro/Civil dated 25.01.2018

Annexure C-1

COMPLIANCE FOR STANDARDS FOR TRACK STRUCTURE AND SALIENT FEATURES OF TRACK STRUCTURE ADOPTED BY NOIDA METRO RAIL COORPORATION

Standard Stipulated as per Annexure C-1 of Procedure of Safety Certification and Technical Clearance of Metro Systems	**NMRC's Comments**
1. Scope: To stipulate the desirable technical standards /specifications for track structure for Metro Railways/ MRTS Systems in the country.	
2. Operating Environment: Track Structure should fulfill generally the following conditions:	
2.1 Gauge – Broad gauge- 1676/1673mm (nominal) and standard gauge – 1435mm.	**2.1** Standard Gauge-1435 mm
2.2 Rail Seat inclination (slope): 1 in 20	**2.2** 1 in 20
2.3 Speed potential – 110 kmph (max.)	**2.3** Track structure is fit for maximum permissible speed of 90 kmph and is fit for maximum operational speed of 80 kmph.
2.4 Static axle load –20 T (max.)	**2.4** 17 MT (Max.)
2.5 Design rail temperature range – (-)10 degree Celsius to (+) 70 degree Celsius	**2.5** Compliant (-10°c to 70°c)
2.6 Maximum Curvature and ruling gradient - As specified in SOD	**2.6** Yes, specified in NMRC SOD.
3. Track Structure: **3.1 General:** The track structure should fulfill the following requirements:	
3.1.1 The track structure should conform to/ satisfy Schedule of Dimension requirement and other maintenance instructions of Metro systems.	**3.1.1** Yes, conforming to/satisfying Schedule of Dimensions requirement and other maintenance instructions of Metro systems.

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3.1.2 Ride comfort and running safety of track vehicle dynamics should be satisfied.	**3.1.2** Yes, complying.
3.1.3 The track structure should be designed with Long welded / Continuously welded rail on main line track in case of ballasted as well as ballast-less track.	**3.1.3** Yes, complying.
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.	**3.1.4** The maximum cant is 110mm, cant deficiency=85mm and cant gradient **1 in 440** or Flatter. Adequate transition lengths are provided.
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.	**3.1.5** Yes, complying. The Vertical alignment is designed to achieve a smooth profile with gradual changes. The changes in the profile are connected by vertical curves of adequate length available in the location. Vertical curves are not located at station within the length of platform. Vertical curves of radius 1500 meter or flatter as per SOD are being provided and provide satisfactory riding comfort.
3.2 The technical standards for Track structure deals with the following components- (i) Rail and Welding (ii) Sleeper and fastening for ballasted track (iii) Track slab for ballastless track (iv) Fastening system for ballastless track (v) Insulated Glued joint (vi) Turnout, scissors crossover (vii) Switch Expansion Joints	Commented in relevant paras.

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(viii) Gradients	
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 (UIC 60), 1080 grade Head Hardened. **4.1.1.2** At other locations on straight line of main line, the use of 60E1 (UIC 60), 1080 grade HH / 60E1 (UIC 60), 880 grade 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 (UIC 60), 1080 grade Head hardened rail should be continued on straight patches also.	The rails on whole of the main lines are UIC-60/60E1, 1080 Grade, Head Hardened. The maximum operating speed is 80 kmph.
4.1.1.3 It is essential to have preventive rail grinding arrangements in case 60E1 (UIC 60), 1080 HH rails are used.	**4.1.1.3** NMRC/DMRC has own Rail Grinding Machine and grinding as preventive measures is being/ and will be done at regular interval.
4.1.2 For Depot lines: The rail used on depot lines can be non- head hardened and shall be 60E1 (UIC 60), 880 grade.	**4.1.2** Non HH, 880 grade UIC 60 rails is being used in depot line.
4.1.3 Specification: **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.	**4.1.3.1** NMRC confirms to comply
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	**4.1.3.2** Complied. Manufacturer has submitted their inspection and test plan for approval by NMRC as per IRS-T-12-2009 with latest

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required to submit their inspection and test plan for approval by Metro railway as per IRS-T-12-2009. Metro railways will ensure that the inspection and test plan approved by them strictly conforms to the requirement of IRS specifications.	amendment and same has been approved by NMRC (NMRC's approval copy enclosed herewith as Annexure: 1 for UIC 60 1080 HH rails.)
4.2 Welding of rail: **4.2.1** The welding of rails should conform to Indian Railway specifications and technical instructions issued from time to time. **4.2.2** The present instructions are contained in following documents: **4.2.2.1** Alumino Thermit Welding: (i) Indian Railway Standard specifications for Alumino Thermit Welding of Rails (IRS/T-19 with latest amendments) (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, January 2012 with latest amendments. **4.2.2.3** Special attention is required by metros for provisions of these instructions regarding procurement, execution of works and areas requiring prior approval/ standardization by RDSO.	**4.2** NMRC confirms to comply Item 4.2.1 to 4.2.2.3 **4.2.2.3** Complied. Approved QAP for Mobile flash butt welding plant is used for FB welding of UIC 60EI, 1080 grade HH rails. (QAP approved copy enclosed for ready reference at Annexure: 2.)
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 of "IRS specification	**4.3.** NMRC confirms to comply

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for Ultrasonic testing of Rails/Welds (Provisional), Revised-2012" shall also be followed.	
5. Sleeper and fastening for Ballasted track **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). **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.	**5.1.1** Not applicable. **5.1.2.** NMRC confirms to comply
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.	**5.2** NMRC Confirms to Comply. The fastening system 336 approved by MOR vide letter No.98/Proj./DLI/30/1 (Vol.III) dated 24.1.2013 have been used. In future also, the fastening system conforming to Performance Criteria issued by Railway Board, as amended from time to time shall be used.
6. Track slab for Ballastless track **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. **6.2** In general, track slab (including sleeper, if	**6.1** NMRC confirms to comply **6.2** NMRC confirms to comply Item (i) to (xiii)

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any) on which the fastening and rail are to be fitted shall perform the following functions: i) Resist the track forces. (Static and dynamic) ii) Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure. iii) Provide a level base for uniform transmission of track/rail forces. iv) Have geometrical accuracy and enable installation of track to the tolerances laid down. v) Ensure drainage. vi) Resist weathering. 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. viii) Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design. ix) Plinth beam or slab of ballastless track should be suitable for embankment or viaduct or tunnel/Underground structure. x) Proper design of expansion joints suitable for joints of viaduct structure. xi) Design should be suitable for curves as per SOD of Metro system.	

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xii) Design of subgrade/embankment for slab should be furnished to ensure durability and functional stability in service. xiii) Design should be suitable and incorporate provision of utilities e.g. cable, wires, ducts, water channels, etc. The detailed design calculations of track slab along with detailed structural drawings as approved by metro authorities shall be furnished for record.	The detailed design calculations of track slab & structural drawings are placed as Annexure: 3
7. Check Rail / Restraining Rail: **7.1** Check rails/ Restraining Rails should be provided on curves on main line where radius is 218m or less 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. **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 regards may be taken by Metro themselves based on layout and maintenance requirement.	**7.1** NMRC confirms to comply. Check Rails have been provided on curves sharper than 190 m radius. Detailed design calculation / studies in this regard as furnished for record. **7.2** NMRC confirms to comply.
8. Derailment Guards **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.	**8.1** Derailment guards have been provided inside/outside of running rail on viaducts having multiple tracks and at grade section locations specified by the Metro Railway.

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NOTE: **Location for providing Derailment Guard in single track tunnel** 1. Entry of tunnel: 200 m from tunnel portal outside the tunnel to 50 m inside the tunnel. 2. Exit of tunnel: 50 m from inside of tunnel portal to 200 m outside the tunnel. 3. In curved track having radius 500 m or less including transition portion but excluding locations where check rail is provided. 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. The above is subject to the condition that metro railway shall carry out the risk assessment analysis for derailment in tunnels and ensure that the maintenance practices in the maintenance manual are as per the risk assessment mitigation plan.	Noted
8.2 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.	**8.2** Complying, the lateral clearance between running rail and derailment guard has been kept 212.5 mm by NMRC and not lower than25mm below the top of running rail and clear of rail fastenings.
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.	**8.3** Yes, Complying. The derailment guards have been designed such that in case of derailment: (i) The wheels of a derailment vehicle under crush load, moving at maximum speed are retained on the viaduct or tunnel.

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(ii) Damage to track and supporting structures is minimum. The detailed design calculations of derailment guards along with detailed structural drawings shall be furnished for record.	(ii) Damage of track and supporting structure is minimum. The detailed design calculation of derailment guard along with detailed structural drawings shall be furnished to RDSO for record.
9. Glued Insulated Rail joint **9.1** Normally glued joint should be avoided. **9.2** Wherever inescapable, G3 (L) type of glued insulated rail joint shall be used as per RDSO drawing no.T-5843. The glued joints shall be manufactured and tested in accordance with RDSO's 'Manual for Glued Insulated Rail Joints-1998' with all amendments.	 **9.1** Noted., Glued joints are not provided in confirming of signaling request **9.2** Not applicable
10. Turnouts, Scissors Crossover **10.1 Standards of Turnout:** **10.1.1 Main lines:** On main lines, the turnouts and diamond crossing shall be of the following standards: **Standard Gauge** a) 1 in 9 type or flatter turnout (desirable) b) 1 in 7 type turnout (minimum) c) Scissors cross-over of 1 in 9 / 1 in 7 type consisting of 4 turnouts and 1 diamond crossing **10.1.2 Depots and Non running lines:** On depot and other non-running lines, the turnouts	 **10.1.1** Complying. a) Turnout being used are 1 in 9 type b) Scissor crossover of 1 in 9 type consisting of 4 turnouts and 1 diamond crossing. **10.1.2** Turnouts being used are:

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and diamond crossing shall be of the following standards: **Standard Gauge** a) 1 in 7 type or flatter turnout	a) 1 in 7 type
b) Scissors crossover of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing	b) Scissor crossover of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing.
c) 1 in 7 derailing switches/1 in 7 type symmetrical split turnout	c) 1 in 7 derailing switches
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.	**10.1.3** Not applicable
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.	**10.1.4** Noted for compliance
(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.	a) Complying. Turnouts on Main line have been designed and installed on concrete slab for ballastless track. Turnouts in depots have been designed and installed on PSC sleeper on ballasted track.
(b) Turnouts shall be manufactured to allow for installation of continuously welded track.	b) Complying. Turnouts have been designed and manufactured for installation of continuously welded track.
(c) Turnout shall be compatible with proposed	c) Complying. Turnouts are/ shall be

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rolling stock and its operational characteristics.	compatible with the rolling stock and its operational characteristics.
(d) The assembly must ensure continuous electrical contact with the train and all the points shall be operated by electric motors.	d) Complying. The assembly ensures continuous electrical contact with the train and all the points are operated by electric motors.
(e) The CMS crossing to be used on mainline shall be subjected to explosive hardening.	e) Complying. The CMS crossing used on mainline are/ shall be explosively hardened.
(f) All turnouts shall be laid with cant with a rail slope as that of main line towards centre of track.	f) Complying. The turnouts have been laid with a rail slope of 1 in 20 towards centre of track.
(g) All turnouts and their components shall be designed to minimize electrical leakage from running rails to the ground.	g) Complying. The turnouts and their components have been designed to minimize electrical leakage from running rails to the ground.
(h) Scissor crossover should be designed for Track centres not infringing SOD.	h) The Scissor crossover have been designed and installed for Track centers not infringing SOD.
10.2 Type and geometry of turnout Detailed design of all turnouts, scissors, and crossover should comply the following geometrical parameters. **Standard Gauge** (i) **<u>1 in 9 turnout:</u>** 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.	**10.2** Complying. The detailed design of all turnouts, scissors, crossovers comply the following geometrical parameters: **(i)**Complying (i) Switch Angle is less than 0°8'12". (ii) Radius of Lead rail is 300M. (iii) All clearances in accordance with SOD are being complied.

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(ii) **<u>1 in 7 turnout</u>**: 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. (iii) **Scissors 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 (i) (ii) above.	(ii) Complying. (i) Switch Angle less than 0°8'20" (ii) Radius of Lead rail of turnout is 190M (iii) All clearances as per SOD are being. (iii) Complying as mentioned in clause 10.2 (i) & (ii) above.
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. **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: **10.3.1.1** Standard Gauge (i) 1 in 9 type turnout with 300 m radius (speed potential of 45Kmph) (ii) 1 in 7 / 1 in 9 type turnout with 190 m radius (speed potential of 35Kmph)	**10.3** Complying. The switches and crossings are not being located on transition curves or vertical curves. **10.3.1** Complying. **10.3.1.1** i) 1 in 9 (R=300M) = 45 kmph ii) 1 in 7 (R=190M) =35 kmph

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(iii) 1 in 7 type turnout with 140 m radius (speed potential of 25 Kmph) (vi) Scissors crossover 1 in 9 type with 300 m radius (speed potential of 45 Kmph) (v) Scissors crossover 1 in 9/1 in 7 type with 190 m radius(speed potential of 35Kmph) (vi) Scissors crossover 1 in 7 type with 140 m radius(speed potential of 25 Kmph) (vii) 1 in 7 type symmetrical split turnout (speed potential of 45Kmph)	iii) NA iv) Scissor crossover 1 in 9 (R=300M) =45 kmph v) Scissor crossover 1in 7 (R=190M) =35 kmph. vi) NA vii) 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 signalling specification. (b) The top surfaces of PSC sleeper/RCC slab supporting rail seat of turnouts and scissors crossover shall be flat without any cant/slope. (c) The track form of the turnout shall have uniform resilience as that of the adjoining track form. (d) The fixation of turnouts, scissor cross-over on track slab shall be through base plates/bearing plates.	**10.4.1** a) Yes, complying. All the points are being operated by electric motors in interface with signaling specification. b) Yes, complying. Top surfaces of PSC sleeper/RCC plinths in turnouts are flat. c) Yes, complying. The track form have uniform resilience as that of adjoining track form. d) Yes, complying. The turnouts/ scissor crossovers on track have been fixed through base plates/bearing plates.
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.	**10.4.2** **1.** UIC 60/60E 1 rails of 1080 grade Head Hardened are being used in turnouts on main line, however in depots UIC-60kg, 880 grade rails used.

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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. b. The section of rails shall be 60E1 (UIC60) for stock, lead and 60E1A1 (ZU1-60) /60E1A4 for switch rail. c. The rails shall qualify as Class 'A' rails as per IRS/T-12-2009. d. The rails shall be with ends un-drilled. e. The rails shall be of grade 1080HH and be suitable for being welded by alumino- thermic or flash butt welding technique.	**2.** Complying. a) The rails used in turnouts are manufactured and tested in accordance with IRS/T-12-2009 with latest amendment. b) Complying. The section of rails being used is UIC 60/60E-1 for stock, lead and 60E1A1 (ZU1-60) 60E1A4 for switches. c) Complying. The class 'A' rails as per IRST-12/2009 with latest amendments is being used. d) The rails are with undrilled ends. e) The rails are of grade 1080HH and suitable for welding by A.T. welding process or Flash Butt welding technique.
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. **2.** The switch rail shall be one piece with no weld or joint within the switch rail length. **3.** The end of the asymmetrical switch rail shall be forged to 60E1 (UIC60) rail profile with minimum length of 500 mm. The forged switch rail end shall be suitable for welding or installation of insulated rail joint. **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	**10.4.3** **1.** Complying. **2.** Complying. The switch rail is in one piece without any weld/ joint within the switch length. **3.** Complying. The end of switch rail is forged to UIC 60/60E1 rail profile with minimum length of 500 mm. The forged switch rail end is suitable for welding or installation of insulated rail joint. **4.** Complying. Slide chairs in switch portion are coated with a special coating to reduce point operating

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the requirement of lubrication of sliding surfaces during service. **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 mts) and flatter turnouts shall be provided with second drive or other suitable arrangement to ensure minimum gap of 60mm at JOH as well as proper housing of switch rail with stock rail up to JoH. 1 in 8.5, 1 in 9 turnout (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. The normal opening of switch at toe of switch shall be kept as 160mm. **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 signalling and switch operating system duly chamfered to avoid stress concentration at the edge of the holes. **7.** The switches shall be designed with an anti-creep device at the heel of switch to withstand thermal forces of the CWR track. **8.** The switches and all slide chairs shall be same for ballasted and ballastless turnouts.	force and to eliminate the requirement of lubrication of sliding surfaces during service. **5.** 1 in 9 turnouts (with radius 300 m) is provided with second drive arrangement. The minimum clearance of 60mm is ensured at JOH in open position of switch rail, in both 1 in 9 and 1 in 7 turnouts. The normal opening of switch at toe of switch is kept 160 mm. **6.** NMRC confirms to comply **7.** NMRC confirms to comply **8.** NMRC confirms to comply
10.4.4 Crossings **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.	**10.4.4** **1.** NMRC confirms to Comply

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2. The CMS crossings shall be manufactured from Austenitic Manganese steel as per UIC 866.	**2.** NMRC confirms to comply
3. All CMS crossings shall have welded leg extensions of 60E1 (UIC60) rails. This shall be achieved by flash butt welding of buffer transition rail piece of suitable thickness to CMS crossings and rail leg extension.	**3.** NMRC confirms to Comply
4. All CMS crossings on main line shall have a minimum initial hardness of 340 BHN.	**4.** NMRC confirms to Comply
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 signalling requirement point of view shall be taken care of in the design, if required.	**5.** Complying. The CMS crossings and their welded leg extension for scissor crossovers are suitably designed and there is no necessity of providing small cut pieces for interconnections.
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.	**6.** NMRC confirms to Comply
10.4.5 Check Rails **1.** The check rail section shall be 33C1 (UIC33) or similar without any direct connection with running rails.	**10.4.5** **1.** The check rail section of 33C1 (UIC33) without any direct connection with running rails are used.
2. Check rails shall have the facility for the adjustment of check rail clearances up-to 10mm over and above the initial designed clearance.	**2.** Complying.
3. Each check rail end shall be flared by machining to have minimum clearance of 62mm at end.	**3.** Complying. The check rail ends are flared by machining and have minimum clearance of 62mm at the end.

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4. The check rail connections in turnouts shall be through specially designed bearing plates / brackets.	**4.** Complying. The check rail connection in turnouts is through specially designed bearing plates / brackets.
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.	**5.** Complying. All the check rails higher by 25mm above running rails are being used. The lengths and positions of the check rail in diamond crossings provides safety and are compatible with the overall track layout.
10.4.6 Sleeper for Turnouts, Scissor crossover (Ballasted Track) **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.	**10.4.6** **10.4.6.1** PSC sleepers have been used in maintenance depots only. Mono-block pre-stressed concrete sleepers suitable with or without electrification have been/ shall be used.
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.	**10.4.6.2** NMRC confirms to Comply
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.	**10.4.6.3** Complying.
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.	**10.4.6.4** The PSC sleepers have been used in maintenance depot only. However the sleepers are suitable for installation by track laying machines and sleeper insertion

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	equipment.
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.	**10.4.6.5** Complying.
10.4.6.6 Design Requirements for PSC Sleepers: **(A)** The sleepers should satisfy the following design requirement:	**10.4.6.6** **(A)**
Design Parameters **(i)** Rail sleeper fastening – Elastic resilient type	(i) Complying. Elastic resilient type sleeper fastening are being used.
(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.	(ii) The maximum Spacing of sleepers is 600mm on main line in elevated sections, 650 mm (max) in Depots except at point machine locations.
(iii) Ballast cushion – 300 mm for mainline and 250mm for Depots and sidings	(iii) NMRC Confirms to Comply
(iv) Ballast profile suitable for LWR/CWR.	(iv)The ballast profile is/ shall be suitable for LWR/CWR
Specifications and Drawings (With latest amendment) (i) Special Cement – IRS T 40 1985 (ii) HTS wire plain and strand – BIS – 1785 (Pt-1) 1983 and BIS 6006 (iii) Polyethylene dowels – Provisional 1997 Drg. No. RDSO 3002 Alt-3 (iv) IRS Specification for Turnout Sleeper T- 45 1996 (v) IRS Bridge code 1982 (vi) Code of Practice for Pre-stressed Concrete IS-1343	NMRC confirms to Comply

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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. **(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. **(iii)** The detailed design of Monoblock PSC sleepers for the turnouts along with structural drawings shall be checked and approved by metro railways.	**(B)** **(i)** The connections of the slide chairs and bearing plates/special bearing plates/brackets are/ shall be designed/ shall be for easy installation and maintenance. All the fittings are suitably designed for full compatibility and interchangeability of slide chairs between ballasted and ballastless turnouts. **(ii)** NMRC confirms to Comply **(iii)** The turnout Monoblock sleepers have been used by DMRC since 2009 based on Indian Railway design for B.G. turnout PSC sleepers. The design of S.G. PSC sleepers are in accordance with the design parameters of Broad Gauge sleepers. DMRC shall approve the designs. Similar design adopted for NMRC.
11. Switch Expansion Joint- 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. 2. The rail section for all SEJs shall be UIC 60, 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.	**11.** SEJ has not been installed by NMRC. However, if need arises, the SEJ for ballasted track shall be laid on PSC sleepers whereas SEJs for ballastless track shall be laid on RCC slab with the specifications/parameters as mentioned in 11.2 to 11.8.

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<table>
<tr><td>5. The ballasted SEJ shall be as per RDSO drawing T-6902 &T-6922. 20
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.</td><td></td></tr>
<tr><td>12. Fastening system for ballastless track:
Provisions contained separately in "PERFORMANCE CRITERIA OF FASTENING SYSTEM FOR BALLASTLESS TRACK ON METRO RAILWAYS/MRTS SYSTEM" (Annexure C-2) be referred to.</td><td>12. NMRC confirms to Comply</td></tr>
<tr><td>13. Noise and Vibration
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.</td><td>Complied. As per pollution control act and noise control rules 2000. The prescribed limits are as below in schedule.
<table>
<tr><th rowspan="2">Area Code</th><th rowspan="2">Category of area/zone</th><th colspan="2">Limits dB(A) Leg.</th></tr>
<tr><th>Day</th><th>Night</th></tr>
<tr><td>A</td><td>Industrial area</td><td>75</td><td>75</td></tr>
<tr><td>B</td><td>Commercial area</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>
1. Day time shall mean 06.00 AM to 10.00 PM as per metro Rail Transit System Guide lines for Noise and Vibrations issued by RDSO.
2. Metro corridor in NMRC is traversing predominately is Zone-A and Zone-B.
3. During oscillation trial if it is</td></tr>
</table>

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	found that noise levels are exceeding the above limits, corrective actions will be taken. 4. **Vibration : Complied** For vibration Noida Metro will undertake vibration mitigation measures as per the international practice for different categories of buildings.
14. GRADIENTS **14.1** The maximum grade (compensated) shall be 4%. Note: (i) There will be no change of gradient in transition portion of curves. (ii) The gradient will be compensated for curvature at the rate of 0.04% per degree of curve. **14.2** Maximum permissible gradient on turnouts (i) On Ballasted Track 0.25% (ii) On Ballastless Track 3% Note : (i) There shall be no change of grade on and within 15.0m (desirable)/3.0m (minimum) of any turnout on ballastless track. In case of Ballasted track, there shall be no change of grade on and within 30 meters of any turnout on ballasted track. (ii) In case of turnouts on gradient, there shall be no horizontal curve on and within 15.0 m (desirable)/3.0m (minimum) of any turnout on ballastless track and 30 meters of any turnout	**14.1** Yes complying. The maximum grade (compensated) has been kept less than 4%. (i) There is no change of gradient in transition portion of curves. (ii) The gradient is compensated for curvature at the rate of 0.04% per degree of curve. **14.2** NMRC confirms to Comply Note : (i) It is ensured that there is no change of grade on and within 15.0m (desirable)/3.0m (minimum) of turnout on ballastless track and there is no change of gradient on and within 30 meters of any turnout on ballasted track. (ii) NMRC confirms to comply.

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on ballasted track. (iii)Turnout shall normally be installed on straight track. In exceptional situations, turnout may take off from curve provided that the radius of lead curve(mainline as well as diverging line) is not less than 190m. 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 considerations, if required. In case of turnout installed on curved track, the minimum distance for commencement of vertical curve or another horizontal curve shall be 15m for ballastless track. Turnout shall not be laid on transition curve. (iv)The limit of turnout for above purposes shall be taken from SRJ (Stock Rail Joint) to end (i.e.,heel) of crossing for ballastless track. For ballasted track, it shall be from SRJ to last common sleeper behind end of crossing. (v) The maximum permissible gradient on turnout and the location of turnout with respect to vertical/ horizontal curve in vicinity shall be confirmed from rolling stock supplier for the negotiability of rolling stock. (vi)The above stipulations shall be applicable for turnout to be laid outside station limit, if any. **14.3** TRACK GRADIENT IN PLATFORM (a) Maximum 1 in 400 (b) Desirable Level Note: There shall be no change of gradient in platform track.	(iii) NMRC confirms to comply. (iv) NMRC confirms to comply. (v) NMRC confirms to comply. (vi) NMRC confirms to comply. **14.3** NMRC confirms to Comply (a) Complied (b) Complied Complied

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Part-B: Salient features of Track Structure approved for NMRC		
Track		
Sl. No.	Components / Items	Provisions / Reference
1	Gauge	1. Standard Gauge-1435 mm
2	Axle Load	17 tons (maximum)
3	Design Speed	Track structure is fit for maximum permissible speed of 90 kmph and is fit for maximum operational speed of 80 kmph.
4	Rail Section and Grade	UIC 60/60E-1, Grade 1080, Head Hardened.
5	Rail Specifications	Rails as per IRST-12-2009 with up-to date amendments.
6	Ballasted or Ballastless	Main line: Ballastless, Depot: ballastless/ballasted
7	Rail inclination (Canting of Track)	1 in20
8	Check Rails provision	Check rail shall be provided on curves sharper than 190 m radius.
9	Provision of Derailment upstand/Guard	Derailment guards have been provided as per clause No. 8 of Annexure C1
10	Horizontal Clearance of Derailment upstand	Provided as 210 ± 30 mm compliant to para 8.2 of Annexure C1.
11	Vertical location of Derailment upstand w.r.t. Rail plane	At Rail Level.
12	Glued insulated Rail Joint provided? If Yes , type of GIRJ	No
13	Welding Of Rail (LWR /CWR)	CWR
14	Whether SEJ provided? If Yes Type of SEJ	No
15	Type of welding	Main line by Flash Butt and Turnouts & scattered joints by AT

i) Turnouts and switches:

S.N.	Components / Items	1	2	3	4
1	Type of turnout, scissors crossovers (crossing angle)	1 in 9	1 in 7	1 in 9 Scissors	1 in 7 Scissors

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2	Canted or uncanted	Canted			
3	Radius (M)	300	190	300	190
4	Length of switch(mm)	13990	12698	13990	12698
5	Type of Switch (Thick web or otherwise)	Thick web	Thick web	Thick web	Thick web
6	Switch entry angle	0º-8'-12"	0º-8'-50"	0º-8'-12"	0º-8'-50"
7	Speed potential (kmph)	45	35	45	35
8	Location of Use (Main line or Depot)	Main line	Depot	Main line	Depot
9	Rail Section used for switch	60 E1 (ZU-1-60)			
10	Second drive provided	Yes	No	Yes	no

ii) Crossing:

S.No.	Components / Items	Provisions / Reference
1	Crossing: Curved or Straight	Curved
2	Crossing: Canted or uncanted	Canted on top
3	Length of Weldable length extension	1.2 M
4	Check Rail section	UIC33(33 c.1)
5	Height of Check rail above the rail plane	25 mm
6	Check Rail clearance at the middle	41 mm
7	Check Rail clearance at the end	80 mm

Part-C : Checklist submission while submitting compliance:

S.No.	Components/Items	Provision/Reference
1.	Compliance of part- A	Complied
2.	Design of subgrade/ embankment for slab (Para 6.xii)	Complied
3.	Design calculations of track slab/plinth beam along with derailed structural drawings as approved by Metro authorities. (Para 6)	Complied
4.	Design calculations/ studies with regard to clearance of check rails/ restraining rails (Para 7.1)	Complied
5.	Design calculations of derailment along with structural guards along with detailed structural drawings shall be furnished for record (Para 8)	Complied

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