GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

2019/Proj./MEGA/C-1/30/01 New Delhi, dated 07.01.2019

Managing Director,
Metro Link Express for Gandhinagar and Ahmadabad
(MEGA) Company Limited,
05th Floor, Nirman Bhawan,
Opp. Sachivalaya Gate No.4,
Sector-10-A, Gandhi Nagar
Gujarat -382010

Sub: Approval of Annexure C-1 (Track Structure) for Ahmedabad Metro Rail Project Phase-I.
Ref: MEGA's letter No. MEGA/CMRS/2018/01/003 dated 13.12.2018

The request of Metro Link Express for Gandhinagar and Ahmedabad (MEGA) Company Limited for approval of Annexure C-1 (Track Structure) for Ahmedabad Metro Rail Project Phase-I has been examined in consultation with RDSO and approval of Railway Board is hereby conveyed.

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

Encl: As above

07-01-2019
(Ruth Changsan)
Director/MTP
Railway Board
☎ 011-23097061

Copy to : (i) **Executive Director/UTHS**, RDSO, Manak Nagar, Lucknow w.r.t their letter No. UTHS/81/MEGA/Civil dated 17.12.2018.

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

ANNEXURE – C1

PART A: Compliance Matrix for "Technical Standards of Track Structure for Ahmedabad Metro Rail Project (MEGA Co. Ltd), Phase-I"

1. **SCOPE:**
   To stipulate the desirable technical standards /specifications for Track Structure for Ahmedabad Metro Rail Project (MEGA Co. Ltd), Phase – I.

2. **OPERATING ENVIRONMENT:**

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
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.)	Maximum 90 kmph.
2.4	Static axle load –20 T (max.)	Maximum 16 T
2.5	Design rail temperature range – (-)10 degree Celsius to (+) 70 degree Celsius	3.5^{0}C to 66.5^{0}C, as depicted in the map of Rail Temperature Zones of India in the LWR Manual of Indian Railways for Ahmedabad- (Zone III)
2.6	Maximum Curvature and ruling gradient - As specified in SOD	**Minimum Radius of curve (Horizontal)** **1)On Main lines:** a) Underground Sections: 200m b) Elevated and At grade Sections (without Check rail) : 190m c) With Check Rail: 120m **2) Depot & Non-passenger lines:** 100m **Maximum Permissible Gradient on Mid-Section:** 4% (Compensated).

3. **TRACK STRUCTURE:**
   3.1 The track structure should fulfil the following requirements:

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
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.	MEGA confirms to comply.
3.1.3	The track structure should be designed with Long welded / Continuously welded rail on main line	**Complied.**

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	track in case of ballasted as well as ballastless track.	
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.**
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 viii. Gradients	**Complied** as shown in relevant Paras.

4. RAIL AND RAIL WELDING:

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
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.	**Complied.**
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.	**Complied.**

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4.1.1.3	It is essential to have preventive rail grinding arrangements in case 60E1 (UIC 60), 1080 HH rails are used.	Preventive Rail Grinding will be done before starting Revenue Operation.
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.	**Complied**.
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.	**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-12-2009. Metro railways will ensure that the inspection and test plan approved by them strictly conforms to the requirement of IRS specifications.	**Complied.**
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.	**Complied.**
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)	**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, January 2012 with latest amendments.	**Complied.**
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.	Flash Butt Welding of 1080 & 880 grade rails have been done using Flash Butt Welding Machine No. CW 664, 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	MEGA confirms to comply.

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	of Rail and Welds- Revised 2012" with latest amendments. The provisions of "IRS specification for Ultrasonic testing of Rails/Welds (Provisional), Revised-2012" shall also be followed.	

5. SLEEPER AND FASTENING FOR BALLASTED TRACK:

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
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.** 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 MoR, as amended from time to time shall be used.

6. TRACK SLAB FOR BALLASTLESS TRACK:

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
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.**
(ii)	Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure	**Complied.**

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(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.	**Complied.**
(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.**

7. CHECK RAIL / RESTRAINING RAIL:

Clause No.	**Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems**	**Standard/Specifications adopted by MEGA Co. Ltd.**
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.	**Complied.**
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.	**Noted.** Check Rails / Restraining Rail for curves in depots and non-passenger lines where speed is not more than 25 kmph has not been proposed.

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8. DERAILMENT GUARDS:

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
8.1	The derailment guard should be provided inside/outside of running rail on viaduct as well as in tunnel and at grade section locations specified by the Metro railway. 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.	Track Plinths/Turnout slabs are provided with reinforced concrete derailment guard on the outside of running rail. In tunnels, it is proposed to provide derailment guard on the inside of the running rail.
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. *(As per MoR amendment No. 2011/Proj./MoU/31/1 Vol.-I, New Delhi, Dated 10.03.2017).* *"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*	**Complied.** Lateral clearance between the running rail and derailment guard is 210(±30mm).

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	derailed vehicle are with the main rail and derailment guard."	
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 minimum.	**Complied.**
(iii)	The detailed design calculations of derailment guards along with detailed structural drawings shall be furnished for record.	Enclosed as Annexure -2.

9. GLUED JOINT:

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
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-5843. The glued joints shall be manufactured and tested in accordance with RDSO's 'Manual for Glued Insulated Rail Joints-1998' with all amendments.	**Complied.** However, glued joint as per RDSO drawing no. T-5843 is proposed in depot/non passenger lines for traction isolation. The glued joint will be manufactured and tested in accordance with RDSO's Manual for Glued Insulated Rail Joint-1998 with all amendments.

10. TURNOUTS, SCISSORS CROSSOVER:

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
10.1	**Standards of Turnout:**	
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)	
	(c). Scissors cross-over of 1 in 9 / 1 in 7 type consisting of 4 turnouts and 1 diamond crossing	**NA**
(ii)	Broad Gauge	
	(a). 1 in 12 type turnout	**NA**
	(b). 1 in 8.5 type turnout	**NA**
	(c). Scissors cross-over of 1 in 12 type consisting of 4 turnouts and 1 diamond crossing	**NA**

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10.1.2	**Depots and Non running lines:** On depot 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 crossover of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing	**NA**
	(c). 1 in 7 derailing switches/1 in 7 type symmetrical split turnout	**NA**
(ii)	Broad Gauge	
	(a). 1 in 8.5 type turnout	**NA**
	(b). Scissors cross-over of 1 in 8.5 type consisting of 4 turnouts and 1 diamond crossing	**NA**
	(c). 1 in 8.5 derailing switches /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.	
(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 center 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 centers not infringing SOD.	**NA**
10.2	**Type and geometry of turnout**	

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	Detailed design of all turnouts, scissors, and crossover should comply 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)	**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.	**NA**
(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 clearances shall be in accordance with relevant provisions of SOD.	**NA**
(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)	**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 (iv) & (v) 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	**Complied & Noted.**

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	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:	**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)	**NA**
(v)	Scissors crossover 1 in 9/1 in 7 type with 190 m radius(speed potential of 35Kmph)	**NA**
(vi)	Scissors crossover 1 in 7 type with 140 m radius(speed potential of 25 Kmph)	**NA**
(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**
(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**	

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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.	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 (UIC60) for stock, lead and 60E1A1 (ZU1-60) /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 (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.	**Complied.**
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 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	**Complied.** **Complied.** **Complied.**

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	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.	**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	**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.	**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 (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.	**Complied.**
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 signalling requirement point of view shall be taken care of in the design, if required.	**NA**
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.**

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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.** **NA**
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.	**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.**
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.**

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(iv)	Ballast profile suitable for LWR/CWR.	**Complied.**
	Specifications and Drawings (With latest amendment)	
(i)	Special Cement – IRS T 40 1985	**Complied.**
(ii)	HTS wire plain and strand – BIS – 1785 (Pt-1) 1983 and BIS 6006	**Complied.**
(iii)	Polyethylene dowels – Provisional 1997 Drg. No. RDSO 3002 Alt-3	**Complied.**
(iv)	IRS Specification for Turnout Sleeper T- 45 1996	**Complied.**
(v)	IRS Bridge code	**Complied.**
(vi)	Code of Practice for Pre-stressed Concrete IS-1343	**Complied.**
(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.**
(iii)	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:

Clause No.	**Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems**	**Standard/Specifications adopted by MEGA Co. Ltd.**
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.	i. For Main Lines, Ballastless track with LWR will be provided, where no SEJ is Required. ii. For Depot Lines Track with LWR will be provided, where also no SEJ is required.
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.	
5.	The ballasted SEJ shall be as per RDSO drawing T-6902 &T-6922.	

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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.	

12. FASTENING SYSTEM FOR BALLASTELESS TRACK:

Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	**Standard/Specifications adopted by MEGA Co. Ltd.**
Provisions contained separately in "PERFORMANCE CRITERIA OF FASTENING SYSTEM FOR BALLASTLESS TRACK ON METRO RAILWAYS/MRTS SYSTEM" (Annexure C-2) be referred to.	**Complied.**

13. NOISE AND VIBRATION:

Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	**Standard/Specifications adopted by MEGA Co. Ltd.**
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.	**Complied.** Statutory requirement for noise is as per Noise Pollution Rules, 2000 Ambient Air Quality standards in respect of Noise

Area Code	Category of Zone	Limit in dB(A)leg	
		Day	Night
A	Industrial Area	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zone	50	40

1. **Day time means 6.00AM to 10.00PM.**
2. **Metro corridor in MEGA is predominantly in Zone B & C.**
3. **During oscillation trail if it is found that noise levels are exceeding the above limit, corrective action will be taken.**
4. **Vibration:**
   MEGA will undertake vibration mitigation measures as per the international practice for different categories of buildings.

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14. GRADIENTS:

Clause No.	Standard stipulated as per Annexure-C1 of Procedure for Safety Certification and Technical Clearance of Metro Systems	Standard/Specifications adopted by MEGA Co. Ltd.
14.1	The maximum grade (compensated) shall be 4%.	**Complied.**
Note: (i)	There will be no change of gradient in transition portion of curves.	**Complied.**
(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.**
(ii)	On Ballastless Track 3%	**Complied.**
Note: (i)	There shall be no change of gradient on and within 15m(desirable)/3.0m(minimum) of any turnout on Ballastless track. In Ballasted track there shall be no change of gradient on and within 30 meters of any turnout.	**Complied.**
(ii)	There shall be no horizontal curve within 15 meters (desirable)/3.0m (minimum) of any turnout on ballastless track and 30 meters of any turnout on ballasted track.	**Complied.**
(iii)	Turnouts shall normally be installed on straight track. In inspectional situations, turnout may take off from curve provided that the radius of lead curve (Main line as well as diverging line) is not less than 190m. The negotiability of rolling stocks on such turnout must be certified by rolling stock supplier and confirmed through oscillation trial and a suitable speed restrictions 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. Turnouts shall not be laid on transition curve.	**Complied**
(iv)	The limit of turnout for above purpose shall be taken from stock rail joint (SRJ) 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.	**Complied**
(v)	The maximum permissible gradient on turnout and the location of turnout with respect to vertical /horizontal curves in vicinity shall be confirmed from rolling stock supplier for the negotiability of rolling stock.	**Complied**

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(vi)	The above stipulations shall also be applicable for turnouts to be laid outside station limit, if any.	**Complied**
14.3	**Track Gradient in Platform**	
(a)	Maximum 1 in 400	**Complied.**
(b)	Desirable Level	
Note:	There shall be no change of gradient in platform track.	**Noted.**

PART – B: SALIENT FEATURE OF TRACK STRUCTURES AS ADOPTED BY AHMEDABAD METRO:

I). TRACK:

Sl. No.	Components / Items	Provisions / Reference
1.	Gauge	1435mm
2.	Axle Load	16T
3.	Design Speed	90 kmph
4.	Rail Section and Grade	Mainline = UIC60/60E1 1080 grade HH Depot Line= UIC60/60E1 880 grade.
5.	Rail Specifications	IRS-T-12-2009
6.	Ballasted or Ballastless	Mainline = Ballastless Depot =Ballasted
7.	Rail inclination (Canting of Track)	1 in 20
8.	Check Rails provision	On mainline with curves sharper than 190m.
9.	Provision of Derailment upstand/Guard	Provided on Mainline.
10.	Horizontal Clearance of Derailment upstand	~~250(±20mm)~~ 210(±30mm)
11.	Vertical location of Derailment upstand w.r.t. Rail plane	Not lower than 25mm from Rail top level.
12.	Glued insulated Rail Joint provided? If Yes , type of GIRL	Yes. G3L as per RDSO drawing no. T-5843 are used for traction isolation at depot line.
13	Welding Of Rail (LWR /CWR)	CWR
14	Whether SEJ provided? If Yes Type of SEJ	No
15	Type of welding	FBW & SKV (Alumino Thermic)

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Director/U.T.H.S.
O.D.S.O. (Ministry of Railways)
Manak Nagar, Lucknow-226011

II) TURNOUTS AND SWITCHES:

Sl. No.	Components / Items	1	2	3
1.	Type of turnout, scissors crossovers (crossing angle)	1in 9	1in 9	1in 7
2.	Canted or uncanted	Canted (1in 20)		
3.	Radius	300	190	140
4.	Length of switch	14.39m	11.47m	11.46m
5.	Type of Switch (Thick web or otherwise)	60E1- 60E1A1 Thick web		
6.	Switch entry angle	0° 9' 15.588"	0° 14' 36.0348"	0° 16' 36.7536"
7.	Speed potential	45	35	25
8.	Location of Use (Main line or Depot)	Mainline	Mainline	Mainline/Depot
9.	Rail Section used for switch	UIC 60 1080 Grade HH Rail as per IRS-T-12-2009 for stock rail & 60E1A1 (ZU-1-60) for switch/tongue rail.		
10.	Second drive provided	Yes	No	No

III) CROSSING:

Sl. No.	Components / Items	Provisions / Reference
1.	Crossing: Curved or Straight	Crossings of Turn Out 1/7, R140m and Turn Out 1/9, R300m are curved. Crossings of Turn Out 1/9, R190m is straight.
2.	Crossing: Canted or uncanted	Canted
3.	Length of Weldable length extension	1200mm minimum
4.	Check Rail section	EN 33C1 (UIC33)
5.	Height of Check rail above the rail plane	25mm
6.	Check Rail clearance at the middle	37mm to 42mm
7.	Check Rail clearance at the end	62mm (minimum)

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PART-C: CHECK LIST OF SUBMISSIONS WHILE SUBMITTING COMPLIANCE:

Sl. No.	Components / Items	Provisions / Reference
1.	Compliance of Part-A	**Complied.** Details are enclosed in Annexure – 1.
2.	Design of subgrade/embankment for slab (Para 6.xii)	**NA**
3.	Design calculations of track slab / plinth beam along with detailed structural drawings as approved by metro authorities. (Para 6)	**Complied.** Details are enclosed in Annexure – 2.
4.	Design calculations/ studies with regard to clearance of Check rails/ Restraining Rails. (Para 7.1)	**Complied.** Details are enclosed in Annexure – 3.
5.	Design calculations of derailment guards along with detailed structural drawings shall be furnished for record. (Para 8)	**Complied.** Details are enclosed in Annexure – 2.

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