S.No 52

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No.2010/Proj./Genl.3/3 New Delhi, dated 16.05.2013

Managing Director,
Rapid Metrorail Gurgaon Ltd.,
2nd Floor, Ambience Corporate Towers,
Ambience Island, NH-18,
Gurgaon-122001

Sub: Technical Approval of Systems for Gurgaon Metro Project (C-1).

Ref: (i) RMGL/RDSOSITE/2012/1567 dated 28.1.2013.
(ii)RMGL letter RMGL/RDSO/SITE/2013/1634 dated 1.3.2013.
(iii)RMGL e-mail dated 23.4.2013.

Rapid Metrorail, Gurgaon Limited's request contained in the letter cited under reference for Technical approval of their system has been examined in consultation with RDSO, Lucknow.

Approval of Annexure-C-1 for Rapid Metrorail Gurgaon is hereby conveyed. Necessary action may be taken accordingly.

S/C

16/5/13

(Mohit Lila)
Joint Director/Works (Plg.)
Railway Board

Copy to: Executive Director/UT&HS, RDSO, Manak Nagar, Lucknow.

17/5/13

17/05

S.No. 61

Government of India (Bharat Sarkar)
Ministry of Railways (Rail Mantralaya)
Railway Board

No. 2010/Prog/Genl/3/3

Date: 18.09.2013

Managing Director,
Rapid Metrorail Gurgaon Ltd.
Ambience Tower, NH-8
Gurgaon (Haryana)

Sub: Technical approvals for the system (track structure annexure C1)

Ref: 1. RMGL letter no.s RMGL/MOR/SITE/2013/1823, 1825, 1823 and 1823 dated 30.08.2013, 02.09.2013, 10.09.2013 and 11.09.2013 respectively.
2. Railway Board letter no. 2010/Proj/Genl/3/3 dated 16.05.2013

Subsequent to approval of annexure C1 for RMGL by this office vide letter at reference No. 2, issue of non- compliance in connection with FB weld was noticed. Revised approval of Ministry of Railways is hereby conveyed for Track structure (annexure C1 of certification manual for metro railways) subject to following:

(i) All Flash Butt Welds shall be ultrasonically tested as per Chapter 9 of Manual for Ultrasonic testing of Rails and Welds – 2012 before opening of section by competent agency duly certified/approved by RDSO.

(ii) All welds which are found defective in USFD testing and welds on outer rails of curves sharper than 350 m radius shall be protected with Joggled fish plates before opening of the section.

(iii) Balance welds shall be provided with joggled fish plates within a reasonable time (say 6 months). Till all welds are protected with joggled fish plates, the sectional speed shall be reduced to 80% of sanctioned speed to prevent damage and joints shall be inspected during daily patrolling.

(iv) Testing for welds every year for next three years shall be arranged.

(v) The welded joints not meeting the dimensional tolerances shall be rectified/ replaced before opening of section.

Original Received, Copy in Track 19/9/13

रेल मंत्रालय
Ministry of Railways
रेलवे बोर्ड/Railway Board
अनुलग्नक सहित जारी
Issue with Enclosure
हस्ताक्षर/Signature 19/09
जारी की तिथि/Date of Issue .....

18/9/13

(Mohit Lila)
Director/ Works (Plg.)
Ph. 011-23097061

Copy to ED/UTHS/RDSO for information and necessary action. You are requested to ensure that the documents submitted by RMGL have been issued by competent authority of RMGL as per rules and regulations.

TECHNICAL STANDARDS OF TRACK STRUCTURE FOR METRO RAILWAYS

1.0 PURPOSE:

S.No.	Railway Board Track Requirements	RMGL Technical Details/Compliance
	To develop technical standard/specification for track structure for Metro Railways including details of curvature, gradients, turnouts, switch expansion joints, etc. for use on metro system in the country.	Noted.

2.0 OPERATING ENVIRONMENT

Track Structure should fulfil generally the following conditions:

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
2.1	Gauge – Broad gauge – 1676/1673mm (nominal) and standard gauge – 1435mm	Standard gauge -1435mm
2.2	Speed potential – 110 kmph (max)	90kmph(max)
2.3	Static Axle Load – 20T (max)	15T
2.4	Design rail temp. Range – (-) 10 degree Celsius to 70 degree Celsius	-10 degree to 70 degree Celsius
2.5	Curvature and Gradient will be specified in SOD	Specified in SOD

3.0 NOISE AND VIBRATION

<table>
<tr><th>S.No.</th><th>Railway Board Track Requirements</th><th>RMGL Technical Details/Compliance</th></tr>
<tr><td></td><td>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>Compliance 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 in dB(A) Leq.</th></tr>
<tr><th>Day</th><th>Night</th></tr>
<tr><td>A</td><td>Industrial</td><td>75</td><td>70</td></tr>
</table></td></tr>
</table>

	.area		
B	Commercial area	65	55
C	Residential	55	45
D	Silence zone	50	40

Surrounding areas of RMGL corridor are commercial and residential zones. Noise level would be checked by approved methods during trials runs , suitable sound reduction measures shall be taken in case noise level observed is more that permissible as specified in pollution control act and noise control rules2000.

4 .0TRACK STRUCTURE

The track structure should fulfil following requirements:

S.No.	Railway Board Track Requirements	RMGL Technical Details/Compliance
i	The track structure should conform to/satisfy Schedule of Dimension requirement and other maintenance instructions of Metro Systems.	Complying
ii	Ride comfort and running safety of track vehicle dynamics should be satisfied.	Complying
iii	The track structure should be designed with Long welded/ Continuous welded rail on main line track in case of ballasted as well as ballastless track.	The track structure has been designed with Continuous welded rail on main line on ballast less track.

iv	The horizontal alignment shall consist of a series of straights joined to circular curves generally with transition curve. 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.	RMGL horizontal alignment consists of a series of straights joined to circular curves with transition curve. Curvature and cant has been calculated based on the train speed for train type on the section. There are no Compound and reverse curves on the alignment.
v	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 shall not be located at stations within the length of platform. A vertical curve within the length of transition is also not desirable. Vertical curve radius is constrained by the need to limit the vertical acceleration for passenger ride comfort.	The vertical alignment has been designed to achieve a smooth profile line with gradual changes. Changes in the profile has been connected by vertical curves having generous length as the location allows. Vertical curves are not located at stations within the length of platform. No vertical curve within the length of transition has been provided. Vertical curve radius are constrained for limiting the vertical acceleration for passenger ride comfort. Minimum radius of vertical curve provided is 1500m .
vi	Check Rail should be provided on curves where radius is 218m or less on Broad gauge and radius is 190m or less on Standard gauge.	Complying

5.0 RAILS

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
i	The rail used in Metro shall be 60E1 (UIC 60), 1080 grade Head Hardened on curves and approaches of stations for main line track. The rail used on depot lines shall be 60E1 (UIC 60), 880 grade. The use of 60E1 (UIC 60), 1080 grade HH/60E1 (UIC 60), 880 grade rail on straight line of main line 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. It is essential to have preventive rail grinding arrangements in case 60E1 (UIC 60), 1080 HH rails are used.	60E1 (UIC60) 1080 grade Head Hardened rails are used on main line as well as in depot lines. RMGL being a small metro, single rail section has been adopted. This is also confirmed that preventive grinding arrangements would be arranged and ensured.
ii	The rail shall be class 'A' rails as per IRS-T-12-2009 specification and it shall be manufactured and tested in accordance with IRS-T-12-2009 (with latest amendment). The chosen manufactures shall be required to submit their inspection and test plan for approval by Metro Railway as per IRS-T-12-2009	Complying, Inspection &test plan attached strictly as per IRS-T-12-2009 specifications (with latest amendment) which has jointly been agreed& signed by both, the supplier and the purchaser and has been made part of contract .
iii	Welding of rail should conform to Indian Railway Specifications and technical instructions issued from time to time	Complying

6.0 SLEEPER AND FASTENING FOR BALLASTED TRACK

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
	SLEEPER AND FASTENING FOR BALLASTED TRACK	Not applicable (Ballasted track not used)

7.0 TRACK SLAB FOR BALLASTLESS TRACK

	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. In general, track slab (including sleeper, if any) on which the fastening and rail are to be fitted shall perform the following functions:	Noted and complying

S.No.	Railway Board Track Requirements	RMGL Technical Details/ compliance
i	Resist the track forces (static and dynamic)	Complying ,copy of DBR attached.
ii	Provide a level base for uniform transmission of track/rail forces	complying
iii	Have geometrical accuracy and enable installation of track to the tolerances laid down	complying
iv	Ensure drainage	complying
v	Resist weathering	complying
vi	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	complying
vii	Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design	complying
viii	Plinth beam or slab of ballastless track should be suitable for embankment or viaduct or tunnel/Underground structure	complying
ix	Proper design of expansion joints suitable for joints of viaduct structure	complying
x	Design should be suitable for curves as per SOD of Metro system	complying
xi	Design of sub grade /embankment for slab should be furnished to ensure durability and functional stability in service	complying
xii	Design should be suitable and incorporate provision of utilities e.g. cable, wires, ducts, water channels, etc	complying

	Detailed design calculations of track slab with detailed structural drawings shall be furnished.	Plinth slab design of DMRC has been adopted, which is a proven system and working well for a decade by now. Structural drawings are attached. Detailed calculations are also attached.

7.1 DERAILMENT GUARDS

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
	The derailment guard should be provided inside/ outside of running rail on viaduct as well as tunnel and at grade section locations specified by the Metro Railway. The lateral clearance between the running rail and the derailment guard shall be 250 ±40mm. It shall not be lower than 25mm below the top of the running rail and should be clear of the rail fastenings to permit installation, replacement and maintenance. Derailment guard shall be designed such that in case of derailment :	Derailment guard is provided at 212.5 mm inside running rail. It is laid at the level of running rail top level. Derailment guard has been designed such that in case of derailment (plinth and up stand design calculations already sent to RDSO):
	(i) The wheels of a derailed vehicle under crush load, moving at maximum speed are retained on the viaduct or tunnel.	The wheels of a derailed vehicle under crush load, moving at maximum speed are retained on the viaduct or tunnel.
	(ii) Damage to track and supporting structures is minimum	Damage to track and supporting structures is minimum

8.0 FASTENING SYSTEM FOR BALLASTLESS TRACK

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
1	The performance criterions for fastening system of ballastless track is already specified separately vide Railway Board letter No. 2009/Proj/MAS/9/2 dated 21.02.2010.	Compliance sent separately as annexure C2

9.0 GLUED INSULATED RAIL JOINT

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
1	Normally glued joint should be avoided. Wherever inescapable, G3(L) type of glued insulated rail joint shall be used as per RDSO drawing No. T5843. The glued joints shall be manufactured and tested in accordance with RDSO's Manual for Glued Insulated Rail Joints-1998' with all amendments.	Complying, and G3(L) type of glued insulated rail joint is used as per RDSO drawing No. T-5843. The glued joints are manufactured and tested in accordance with RDSO's Manual for Glued Insulated Rail Joints-1998' with all amendments.

10.0 TURNOUTS, SCISSORS CROSSOVER

10.1 GENERAL

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
i	A. On main lines, the turnouts and diamond crossing shall be of the following types: **Standard Gauge** (a) 1 in 9 type turnout (b) 1 in 7 type turnout (c) Scissors crossover of 1 in 9 type consisting of 4 turnouts and 1 diamond crossing	A. **Standard Gauge** (a) 1 in 9 type turnout. (b) 1 in 7 type turnout. (c) Not used.
	B. On Depot lines, the turnouts and diamond crossing shall be of the following types: **Standard Gauge** (a) 1 in 7type turnout (b) Scissors crossover of 1 in 7 type consisting of 4 turnouts and 1 diamond	B. **Standard Gauge** (a) 1 in 7 type turnout.

	crossing (c) 1in7 derailing switches/1in7 derailing symmetrical split turnout	(b) Not used. (c) Not used
ii	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. (b) Turnouts shall be manufactured to allow for installation of continuously welded track. (c) Turnout shall be compatible with proposed 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. (e) The CMS crossing to be used on main line shall be subjected to explosive hardening. (f) All turnouts shall be laid with cant with a rail slope of 1 in 20 toward centre of track. (g) All turnouts and their components shall be designed to minimize electrical leakage from running rails to the ground. (h) Scissor crossover shall be designed for track centres not infringing SOD.	(a) Complying. (b) Complying (c) Complying (d) Complying (e) Complying (f) Complying (g) Complying (h) Not used.

10.2 TYPES AND GEOMETRY OF TURNOUT

Detailed design of all turnouts, scissors crossover should comply the following geometrical parameters.

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
1	**Standard Gauge** **(i) 1 in 9 Turnout** The design shall be tangential with a switch entry angle not exceeding	**Standard Gauge** **(i)1in9 Turnout** The switch entry angle is 00 08'12''. The radius of lead rail is 300m. All

	00 20'00". The radius of lead rail of turnout shall not be less than 300m. All clearances shall be in accordance with relevant provisions of SOD.	clearances are as per provisions of SOD.
	(ii) 1 in 7 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 190m. All clearances shall be in accordance with relevant provisions of SOD.	**(ii) 1in7 Turnout** The switch entry angle is 00 08' 50''. The radius of lead rail is 190m. All clearances are as per provisions of SOD.
	(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(i)(ii) above.	Scissor crossover not used.

10.3 OPERATING REQUIREMENT OF TURNOUT, SCISSOR CROSSOVER :

S.No	Railway Board Track Requirements	RMGL Technical Details/Compliance
	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 the diverging route. Switches and crossings shall not be located on transition curves or vertical curves.	Conditions stipulated are complied.

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
1	**Speed :** The turnout shall be designed for 110 Kmph on Main Line side with speed restrictions on curves if required. The minimum speed potential of the various turnouts and scissors crossover on the turnout side should be as follows : **Standard Gauge**	Complying. The minimum speed potential of the various turnouts and scissors crossover on the turnout side is as follows : **Standard Gauge**

	(i) 1 in 9 type turnout (speed potential of 45Kmph) (ii) 1 in 7 type turnout (speed potential of 35Kmph) (iii) Scissors crossover 1 in 9 type (speed potential of 45Kmph) (iv) Scissors crossover 1 in 7 type (speed potential of 35Kmph) (v) 1 in 7 type symmetrical split turnout (speed potential of 45Kmph)	(i)1 in 9 type turnout (speed potential of 45Kmph) (ii)1 in 7 type turnout (speed potential of 35 Kmph) (iii) Not used (iv) Not used (V) Not used.

10.4 TECHNICAL SPECIFICATION

S.No.	Railway Board Track Requirements	RMGL Technical Details/compliance
10.4.1	**General** (a) All 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 crossover on track slab shall be through base plates/bearing plates.	(a)Complying (b) Complying (c)Complying. (d)Complying.

10.4.2	**Rails** 1. The rails used in turnouts shall be 1080 grade Head Hardened. The rails used for manufactured of turnouts shall satisfy the following conditions :	1. Complying, Rails used in turnouts are 1080 grade head hardened rails.
	a) The rails shall be manufactured and tested in accordance with IRS/T-12-2009 with latest amendment.	Complying
	b) The section of rails shall be 60E1 (UIC 60) for stock, lead and	Complying, section used is 60 E1(UIC60) for stock

	60E1A1 (ZU1-60) for switch rail.	,lead and 60E1A1(ZU1-60) for switch rail.
	c) The rails shall qualify as Class 'A' rails as per IRS/T-12-2009.	Complying and rails qualify as class 'A' rails as per IRS/T-12-2009.
	d) The rails shall be with ends undrilled.	Complying.
	e) The rails shall be of grade 1080HH and be suitable for being welded by alumina-thermic or flash butt welding technique.	Complying, rails used are 1080 grade HH rails and are suitable for flash butt or AT welding techniques.

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. Switches shall be manufactured to suit to special asymmetrical section switch rail type 60E1A1 (ZU1-60).	Complying and switch rail type is 60E1A1(ZU1-60).
	2. The switch rail shall be one piece with no weld or joint within the switch rail length.	Complying.
	3. The end of the asymmetrical switch rail shall be forged to 60E1 (UIC60) rail profile with minimum length of 60kg profile for 500mm. The forged 60E1A1 (ZU1-60) switch rail end shall be suitable for welding or installation of insulated rail joint.	Complying, the end of the asymmetrical switch rail shall be forged to 60E1 (UIC60) rail profile with minimum length of 60kg profile for 500mm. The forged 60E1A1 (ZU1-60) 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 the requirement of lubrication of sliding surfaces during service.	Complying
	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 turnout shall be provided with second drive or other suitable arrangements 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 and 1 in 7 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 nominal opening of switch at toe of switch shall be kept as 160mm.	Complying and required clearances are ensured.
	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.	Complying.
	7. The switches shall be designed with an anti-creep device at the heel of switch to withstand thermal forces of the CWR track.	Complying, Anti creep device is used.
	8. The switches and all slide chairs shall be same for ballasted and ballast less turnouts.	Noted. Ballasted track is not used.

10.4.4	**Crossings** 1. All crossings shall be cast manganese steel (CMS) crossings with weld able rails of minimum 1.2m length undrilled for welding for welding into the overall turnout. 2. The CMS crossings shall be manufactured from Austenitic Manganese steel as per UIC 866. 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. 4. All CMS crossings shall have a minimum initial hardness of 340 BHN. 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. 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.	**Crossings** 1. Complying. 2. Complying 3. Complying 4. Complying 5. Complying 6. Complying

10.4.5	Check Rails	Check Rails
	1. The check rail section shall be 33C1 (UIC33) or similar without any direct connection with running rails.	1. 33C1(UIC 33)section has been used for check rails.
	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
	4. The check rail connections in turnouts shall be through specially designed bearing plates/brackets.	4. Complying
	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.	Complying, Check rails are higher by 25 mm above running rails.

10.4.6	Sleeper for Turnouts, Scissor Cross over (Ballasted Track).	Not applicable (Ballasted track not used).
10.4.7	**Monitoring System**	
1	Safety and maintenance relevant functions of a turnout shall be monitored by a monitoring system. In case of irregularity in track or lack of maintenance, the monitoring system shall send online messages about problems.	Direct monitoring system not provided. Monitoring to be done through regular maintenance and inspection as per our Permanent Way Manual, which is under approval.
2	The monitoring system shall have a modular system structure for being easily expandable.	
3	It shall automatically generate error messages.	
4	It shall have a continuous data acquisition with facility for storage of data.	

11.Switch Expansion Joint

S. No.	Railway Board Track Requirements	RMGL Technical Details
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.	Not provided in the present project but noted for compliance for future projects.
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 80mm.	
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 and 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.	