GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No.2016/Proj./Kochi/30/8 New Delhi, date 27.05.2016

Managing Director,
Kochi Metro Rail Ltd.,
8th Floor, Revenue Tower,
Park Avenue, Kochi-682011

Sub: Technical Clearance of Track System: Annexure C-2 (Rev-01) for Kochi Metro.

Ref: (i) Board's letter No. 98/Proj./DLI/30/1 (Voll.III) dated 24.01.2013
(ii) KMRL's letter No. KMRL/Proj./Track/2016/1571 dated 22.04.2016

Kochi Metro Rail Limited's (KMRL) request for approval of Fastening System 336 as approved vide letter under reference (i) for use in Kochi Metro has been examined in consultation with RDSO and approval of Railway Board hereby conveyed. The approved copy of Annexure C-2 is enclosed herewith.

KMRL shall ensure compliance of all the conditions stipulated in Board's letter under reference and clause 4.3 of "Performance criteria of fastening system for ballastless track on Metro Railways /MRTS System (December, 2015)".

Encl: as above (11 Pages)

27.05.2016
(Ruth Changsan)
Director/Works Planning
Railway Board
☎011-23097061

Copy to: Executive Director/UTHS, RDSO, Manak Nagar, Lucknow w.r.t their letter No. UTHS/12/KOMET/Civil dated 12.05.2016 for information please.

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ANNEXURE C2 (Rev-01)

PERFORMANCE CRITERIA OF FASTENING SYSTEM FOR BALLASTLESS TRACK ON KOCHI METRO RAILWAY

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Annexure C2 (Rev-01)

KMRL's COMPLIANCE OF PERFORMANCE CRITERIA OF FASTENING SYSTEM FOR BALLASTLESS TRACK ON KOCHI METRO

Ref	Standard Stipulated	KMRL's Proposal / Comment
1.	**Purpose and Selection:**	
1.1	The performance criteria define the performance standard of fastening system for ballastless track of Metro Railway System. Apart from other things, the fastening system is required to moderate vibration and noise transmitted through the rail and to reduce the track stiffness and the impact on the track structure, to obtain the parameters as detailed in the ensuing paragraphs.	KMRL is using Fastening System 336 as approved by Railway Board to DMRC projects vide their letter no: 98/Proj/DLI/30/1(Vol III) dated 24-01-2013. The fastening system is able to moderate vibration and noise transmitted through the rail and the track stiffness and the impact of the track structure, so as to obtain the parameters as detailed in the ensuing paragraphs.
1.2	A new fastening system, which is fully compliant to performance criteria and not approved by MoR can also be used by Metro Railways/MRTS system as they are free to choose fastening systems for ballastless track complying with this performance criterion. The detail of such fastening system used shall be submitted to MoR and the same shall be kept in observation by MoR for a period of 2 years under service conditions in association of Metro Railways/MRTS system. The Performa for the monitoring performance shall be advised by MoR to concerned Metros Railways/MRTS system.	KMRL is using Fastening System 336 as approved by Railway Board to DMRC projects vide their letter no: 98/Proj/DLI/30/1(Vol III) dated 24-01-2013.
	After successful performance for 2 years, Metro Railways/MRTS system shall process for approval of MOR for further use of fastening system.	

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1.3	The fastening system already approved by MOR as per previous performance criteria for ballastless track dated 21.5.2010 will not require fresh clearance as per this revised criteria and any of these systems can be used by Metro/ MRTS systems.	Noted Please. Fastenings system 336 was approved by MOR for DMRC vide therir letter no: 98/Proj/DLI/30/1(Vol III) dated 24-01-2013. The same type of fastening system 336 is being followed in KMRL.
1.4	In case Metros Railways/MRTS system opts for a new fastening system for ballastless track which is not fully compliant to these performance criteria, they will approach MoR for approval before finalizing the use of fastening system.	Noted Please.
2.	**Operating Environment:**	
	Fastening system is expected to perform generally in the following conditions:	
2.1	Gauge -Broad Gauge, 1676/1673mm (nominal) and standard gauge - 1435mm	Standard Gauge-1435mm
2.2	Speed potential - 110 kmph (max.)	90 kmph (max)
2.3	Rail section - 60kg(UIC)/60E1, 90 UTS/110 UTS	60kg(UIC)/60E1,Grade 1080 Head Hardened
2.4	Static axle load - BG & SG - 20t(Max)	Standard Gauge - Axle load is 16T
2.5	Design rail temperature range - 10 degree Celsius to +70 degree Celsius	Yes complied. The rail temperature in Kochi city Metro area is between 13.5°c and 56.5°c, with mean rail temperature of 36°c.
2.6	Curvature and gradient will be specified in SOD.	As specified in SOD is being used.

23/7/16

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2.7	Rail seat inclination (slope) - 1 in 20	Rail seat inclination 1 in 20 is followed.
	In addition, the client Railway may specify any other operating condition such as support spacing etc.	Spacing of base plate in ballast less track is 600mm.
3.	**Ballast less Track Structure:**	
	Track shall be laid on cast in situ/pre-cast reinforced plinth or slab, herein after referred to as the 'track slab'. The track slab shall be designed as plinth beam or slab type ballast less track structure with derailment guards. The track slab dimensions and the clearance between rail and derailment guard shall be sufficient to accommodate the base plates of the fastening system and to facilitate easy and convenient replacement of the fastening system. The clearance between rail and derailment guard shall be within the range provided in Annexure-C-1. In general, track slab on which the fastening and rails are to be fitted shall:	Noted. The track slab dimensions and the clearance between rail and derailment guard are sufficient to accommodate the base plates of the fastening system and facilitates easy and convenient replacement of the fastening system. The clearance between rail and derailment guard provided is 210 mm +/- 30 mm as specified in Annexure C-1
(i)	Resist the track forces.	Complied.
(ii)	Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure.	Yes. Complied.
(iii)	Provide a level base for uniform transmission of rail forces.	Yes. Complied.
(iv)	Have geometrical accuracy and enable installation of track to the tolerances laid down.	Yes. Complied.
(v)	Ensure adequate drainage	Yes. Complied.
(vi)	Resist weathering	Yes. Complied.
(vii)	Be construction friendly, maintainable and	Yes, Complied. The repair

27/5/16

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	quickly repairable in the event of a derailment. The 'Repair and Maintenance methods' shall be detailed in the 'Track Maintenance Manual' to be prepared and made available before the line or a portion of a line is opened for traffic.	and maintenance method shall be detailed in Track Manual which is under preparation and will be available before opening of section for traffic.
(viii)	Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design.	Yes. Complied. Design provision ensures electrical continuity between consecutive plinths/slabs. Jumper plates are being provided to join the plinths for electrical continuity.
4.	**Performance Requirement of Fastening System:**	
4.1	**General**	
(i)	The fastening system shall be designed to hold the two rails of the track strongly to the supporting structure in upright position by resisting the vertical, lateral and longitudinal forces (including thermal forces) and vibrations.	Yes comply. The fastening system is able to hold two rails of the track strongly to the supporting structure in upright position by resisting the vertical, lateral and longitudinal forces and vibrations.
(ii)	The fastening shall be with a proven track record. The fastening system should have satisfactory performance record of minimum three years in service in regular revenue operation on ballastless track on any two different established railway systems (except exclusive freight tracks) for a length of at least 5km in each metro having speed potential of at least 80 kmph & design axle load 16T irrespective of wheel profile and rail section. In this regard, supplier should submit certificate of performance from user railways administration including proof of use of the fastening system. The supplier has also to submit a certificate	It is certified that the Fastening System 336 for 60 kg Rail section was adopted in DMRCL projects and is in revenue service for a period of over 10 years over 370 track kilometres and approved by MOR for DMRC vide their letter no: 98/Proj/DLI/30/1(Vol III) dated 24-01-2013. KMRL proposes the same Fastening System336 for the 60 kg Rail section by ensuring all quality testing.

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	that the components of fastening assembly are having same material and specification in case the proven system is having different rail section and wheel profile along with details of test results as per test plan of Table 1.	
	Note: For any metro system having design axle load <16T, the above criteria shall be applicable for the axle load for which the metro system is designed."	
(iii)	The fastening shall provide insulation to take care of return current of traction system.	Yes Complied. Design provision ensures to provide insulation to take care of return current of traction system.
(iv)	Fastening should satisfy the required performance norms as stated in para 4.2, 4.3, 4.4, 4.5,& 4.6.	Yes Complied
4.2	**Following are the technical performance requirements of fastenings:**	
	The Fastening shall	
(i)	Have design service life of 30 years in general. However, its components such as rubber pad, rail clip etc. can be designed for 300 GMT or 15 years whichever is less. Anchor bolts or studs used for fixing base plate to the concrete should not be required to be replaced during service life. Its components must not suffer any degradation during service life to a degree so as to affect the performance and safety of the track. Full service life is to be attained under the following conditions:	Complied
a	Atmospheric ultra violet radiation.	Complied
b	Proximity of track up to 10m from salt water source.	Yes Comply. However, there is no salt water source within 10 meters of Metro line.

27/5/16

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c	Contact with oil, grease or distillate dropped from track vehicles.	Complied
(ii)	Permit quick and easy installation and replacement with special tools.	Complied
(iii)	Be capable of vertical adjustment during service life upto 12mm using shims.	Complied
(iv)	Permit the attainment of the following tolerances when installed, and later during service.	Yes, comply. KMRL is achieving very accurate track parameters during installation and fastening system is maintainable with accurate parameters.

Sl	Parameter	Installation (mm)	Maintenance (mm)	Remarks
1	Gauge	+2,-1	+4,-2	Maintainable
2	XL on straight track	±1.5	±5	Maintainable
3	SE on curved track	±1.5	±3	Maintainable
4	Vertical alignment over 20m chord	±3	±6	Maintainable
5	Lateral alignment over 20m chord on straight track	±2	±6	Maintainable
6	On curves-variation over the theoretical versine on 20m chord	±2	±5	Maintainable

27/5/16

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4.3	Anchor bolts/studs used for fixing the bearing plate in concrete shall have splayed ends. Detailed calculations for the number of anchor bolts required on tangent and curved tracks shall be furnished by the supplier and approved by the Metro system	Complied. Calculation for the number of anchor bolts required on tangent and curved tracks of radius greater than 500m and less than 500 m curves are enclosed.
4.4	For all the fastening components as per approved assembly, the supplier shall furnish detail drawings, specifications and inspection& test plan to the Metros. Metros to ensure that components are supplied as per drawings & specifications.	Yes Complied. The detail drawings, specifications and inspection and test plan are as approved by KMRL. Quality assurance plan ensures testing of fastening systems as per approved ITP. Test reports of all fastenings are enclosed.
4.5	The supplier should furnish the 'Installation and Maintenance Manual' which shall be approved by the Metro system.	Noted. Installation Procedure enclosed Approval of Maintenance Manual is in process.
4.6	Any change in component subsequent to the approval of the fastening system by MoR shall be permitted only for specific requirement of the metro. MoR approval of such changes shall be processed by metro with specific recommendations enclosing test report of the component / whole assembly with detailed justification.	Noted please.
4.7	The rail fastening system shall be tested to the following specifications (Table 1) for ~~different technical parameters and should~~ meet the acceptance criteria as mentioned in the following table. Test report of the reputed independent institute / laboratory will have to be submitted. The testing is to be done for Cat B as specified in EN-	The rail fastening systems 336 are tested to the ~~following specifications (Table~~ 1) for different technical parameters and meets the acceptance criteria as mentioned in the table. Test end reports of all

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	13481-Part-I 2012 & EN-13481-5 :2012 with rail section to be used in proposed system if other design particulars are meeting the requirement of Cat -B.	fastening are enclosed.

Table-1

Test Plan for Fastening system (bonded & non bonded) for Ballastless Track

(As per provisions of latest EN 13481-1:2012 & EN 13481-5:2012)

SN	Technical Parameter	Test Method	Acceptance Criteria	Remarks
1	Longitudinal rail restraint	EN-13146-1-2012	7kN (min)	Test result enclosed as checklist 4. (70 sheets, Page No. 101 - 239) *Test result enclosed in Rev-01 (13 sheets, Page (21-46) in addition.*
2	Vertical static stiffness of complete fastening assembly	EN-13146-4-2012	35 kN/mm (max)	Test result enclosed as checklist 4.
3	Dynamic/static stiffness ratio	EN 13481-5-2012	1.4 (max)	Test result enclosed as checklist 4.
4	Clamping force	EN-13146-7-2012	18kN (min) Per rail seat	Test result enclosed as checklist 4.
5	Electrical resistance	EN-13146-5-2012	5kΩ (min)	Test result enclosed as checklist 4.

27/7/16

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6	Effect of severe environmental conditions	EN-13146-6-2012	The fastening assembly shall be capable of being dismantled, without failure of any component & reassembled using manual tools provided for this purpose after exposure to the salt spray test.	Test result enclosed as checklist 4.
7	Effect of repeated loading	EN-13146-4-2012	No wear or deformation	Test result enclosed as checklist 4.
7A	On Vertical static stiffness	EN-13146-4-2012	Variation ≤ 25% of the initial value	Test result enclosed as checklist 4.
7B	On Longitudinal rail restraint	EN-13146-1-2012	Variation ≤ 20% of the initial value	Test result enclosed as checklist 4.
7C	On Clamping force	EN-13146-7-2012	Variation ≤ 20% of the initial value	Test result enclosed as checklist 4.

Part-B: Salient features of Fastening System

S.N.	Components / Items	Provisions in Metro
1	Brief description of fastening system	Fastening System 336 designed , manufactured and supplied by Vossloh Germany are being used
2	Axle load	16 T
3	Speed potential	90 kmph
4	Drawing and their numbers	Enclosed.(12 sheets page No. 53-

27/5/16

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		76) *Drawings enclosed in Rev-01* *(1 Sheet. Page No: 13-14) in addition.* *(Assembly for 2 Anchor bolt drawing No:2549a, Assembly for 4 Anchor bolt drawing No.2424d)*
5	Specifications and their numbers	Enclosed (12 sheets Page No. 77-100)
6	Any variation for straight and curve portion? If yes, give detail	Four numbers of Anchor bolts are used for curve of radius 1000m and sharper. Remaining sections are with two anchor bolts.
7	Vertical stiffness of complete fastening system	Complied
8	Service life of fastening system.	30 years
9	Reference of Railway Board's approval for proposed fastening system.	MOR vide their letter no: 98/Proj/DLI/30/1(Vol III) dated 24-01-2013 has accorded approval for DMRC. KMRL proposes to use the same type of Fastening System 336.

27/5/16

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