

Government of India - Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow -226011 (INDIA)

Global Expression of Interest

Notification No. : CT/EF/GlobalEol-2017/Ballastless Track

Ministry of Railways, Research Designs & Standards Organisation (R.D.S.O.), Lucknow is interested in ascertaining 'Fastening systems for ballastless track for use on Metro Railways/MRTS system' as per details appearing on RDSO website.

Interested firms are requested to see the details in RDSO's website www.rdso.indianrailways.gov.in at **HOME PAGE** under '**EOI**' appearing in **RED**.

भारत सरकार- रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
मानक नगर, लखनऊ -226 011 (भारत)

वैश्विक रुचि की अभिव्यक्ति

सूचना संख्या: सीटी/ईएफ/ग्लोबल/इओआई-2017/बैलास्टरहित ट्रैक

रेल मंत्रालय अनुसंधान अभिकल्प और मानक संगठन (अ० अ० मा० स०), लखनऊ, मेट्रो रेलवे/ एम० आर० टी० एस० सिस्टम हेतु बैलास्टरहित रेलपथ के लिए फास्टेनिंग सिस्टम खोजने का इच्छुक है। जिसका विवरण अ० अ० मा० स० की वेब साइट पर उपलब्ध है।

रुचि लेने वाली फ़र्मों से अनुरोध है कि वे अ० अ० मा० स० की वेब साइट www.rdso.indianrailways.gov.in के होम पेज पर लाल रंग में दिखने वाला शीर्षक "EOI" के अंतर्गत विवरण देखें।

Instructions/ Guidelines for the firms expressing their interest against
Global Expression of Interest (Eoi)
Notification No. CT/EF/GlobalEoi-2017/Ballastless Track

1. DISCLAIMER:

Indian Railways reserves the right not to proceed with the process or at a later stage to change the process as per the requirements of Indian Railways. It also reserves the right to decline to discuss the process further with any party expressing interest. This Eoi shall not be considered in any way a proposal for procurement of Fastening System for Ballastless Track on Metro Railways/MRTS system. The intending participants will furnish offer at their own cost and no claims, whatsoever, in this reference will be entertained by the Railways.

2. PURPOSE OF INVITING Eoi:

The purpose of this Eoi is to explore the Worldwide Technological Advancements and Global availability of fastening systems for ballastless track on Metro Railways/MRTS system in the world for use on Metro Railways/MRTS system in India which comply to the Performance criteria of fastening system for ballastless track on Metro Railways/MRTS system (Annexure C-2 of the Procedure for Safety Certification and Technical Clearance of Metro Systems).

This criteria is given in Procedure for Safety Certification and Technical Clearance of Metro Systems (Dec. 2015) which can be downloaded from RDSO website at link www.rdsi.indianrailways.gov.in → Urban Transport & High Speed Directorate → Technical Clearance and Certification of Metro. A copy of the document is attached as **Appendix-‘2’**.

3. GENERAL INSTRUCTIONS FOR SUBMITTING RESPONSE TO Eoi:

3.1 Eligibility criteria

- i) Firm should be an existing manufacturer / supplier of fastening systems for ballastless track on Metro Railways/MRTS system.
- ii) The fastening systems for ballastless track on Metro Railways/MRTS system offered by the firm should meet the requirements of the Performance criteria of fastening system for ballastless track on Metro Railways/MRTS system (Annexure C-2) (**Appendix – ‘2’**).
- iii) For ascertaining the general credentials, the firm should have supplied the offered fastening system to any Metro Railways/MRTS system in the world in the last three years, meeting the requirements envisaged in **Appendix – ‘2’**.

- 3.2** The firm shall legally indemnify Ministry of Railways against any possible claims/legal /other disputes at present or which may arise in future from any other party in connection with the intellectual property rights of the drawings and design or any other documents submitted by the firm or any other patent rights.

- 3.3 The submission by Interested firms shall be made to Director/Track-IV, RDSO, Anusandhan Bhawan, Manak Nagar, Lucknow- 226011 by **03.10.2017** (15:00 Hrs). The respondents must furnish the application form & details **in duplicate** as required in the “**Format for Letter of Response**” at **Appendix – ‘3’** and details stipulated in **Appendix – ‘1’**. All pages of the documents should be signed with stamp. In the EoI, the firms should mention RDSO’s Notification No.CT/EF/GlobalEoI-2017/Ballastless Track
- 3.4 Firm should submit technical information / details of their fastening system in the format which is enclosed as **Appendix - 4** in reference to Performance Criteria of fastening system for ballastless track. Incomplete offer shall be summarily rejected.
- 3.5 The firm should submit technical literature, test reports from any of the world recognized/accredited institute/test house, user certificate, drawings and any other necessary documents in support of details given in proforma as per **Appendix - 4**. The information supplied should be able to demonstrate, compliance of the fastenings to the requirements.
- 3.6 The details forwarded by the firm shall be scrutinized by RDSO. After scrutinizing the details, the firm shall be advised for clarifications required, if any. Firm will have to submit the clarification within one month of intimation.
- 3.7 The firm will arrange for detailed technical presentation at RDSO about all details mentioned in this document for their fastening system, if required.
- 3.8 The firm whose fastening system is found compliant to the performance criteria as per **Appendix - 2** may be the prospective suppliers in India for the Metro Railways/MRTS system in India.
- 3.9 RDSO reserves all the right of this exercise. In case of any doubt/dispute, decision of RDSO shall be final.

Director/Track-IV,
For Director General (Track)
RDSO, Lucknow.

'Procedure for Safety Certification and Technical Clearance of Metro Systems (Dec. 2015)' - Annexure-C2

Part-A: Performance criteria of fastening system for ballastless track on Metro Railways/MRTS system (Compliance to be given)

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, 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. After successful performance for 2 years, Metro Railways/MRTS system shall process for approval of MoR for further use of fastening system.
- 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.
- 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.

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
- 2.2 Speed potential – 110 kmph(max.)
- 2.3 Rail section - 60kg(UIC)/60E1, 90 UTS/110 UTS
- 2.4 Static axle load – BG & SG – 20t(Max)
- 2.5 Design rail temperature range – 10 degree Celsius to +70 degree Celsius
- 2.6 Curvature and gradient will be specified in SOD.
- 2.7 Rail seat inclination (slope) – 1 in 20

In addition, the client Railway may specify any other operating condition such as support spacing etc.

3. **Ballastless 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 ballastless 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:

- i) Resist the track forces.
- 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 rail forces.
- iv) Have geometrical accuracy and enable installation of track to the tolerances laid down.
- v) Ensure adequate 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 the 'Track Maintenance Manual' to be prepared and made available before the line or a portion of a line is opened for traffic .
- viii) Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design.

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.
- 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 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.
- iv) Fastening should satisfy the required performance norms as stated in para 4.2, 4.3, 4.4, 4.5,& 4.6.

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:
 - a) Atmospheric ultra violet radiation.
 - b) Proximity of track up to 10m from salt water source.
 - c) Contact with oil, grease or distillate dropped from track vehicles.
- ii) Permit quick and easy installation and replacement with special tools.
- iii) Be capable of vertical adjustment during service life upto 12mm using shims.
- iv) Permit the attainment of the following tolerances when installed, and later during service.

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

- 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
- 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..
- 4.5 The supplier should furnish the 'Installation and Maintenance Manual' which shall be approved by the Metro system.
- 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.

- 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-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.

Table-1
Test Plan for Fastening system (bonded & non bonded) for Ballastless Track on
Metro Railways/MRTS system

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

S.N.	Technical Parameters	Test Method	Acceptance criteria	Remarks
1	Longitudinal rail restraint	EN-13146-1-2012	7kN (min)	This has to be tested before repeated load test
2	Vertical static stiffness of complete fastening assembly	EN-13146-4-2012	35 kN/mm (max)	No sliding, yield or cracking is allowed for the fastener parts.
3	Dynamic/static stiffness ratio	EN 13481-5-2012	1.4 (max)	Ratio is calculated by dividing the dynamic stiffness to static vertical stiffness.
4	Clamping force	EN-13146-7-2012	18kN (min) Per rail seat	This has to be tested before repeated load test
5	Electrical resistance	EN-13146-5-2012	5kΩ (min)	Higher value may be specified if required by Metros for track circuit
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.	-
7	Effect of repeated loading	EN-13146-4- 2012	No wear or deformation	-
7A	On Vertical static stiffness	EN-13146-4- 2012	Variation \leq 25% of the initial value	No sign of bond failure/ fracture/slippage
7B	On Longitudinal rail restraint	EN-13146-1- 2012	Variation \leq 20% of the initial value	Except the rail and fastener, no sliding, yield or cracking is allowed for fastener

S.N.	Technical Parameters	Test Method	Acceptance criteria	Remarks
				parts. Longitudinal load/ deformation curve shall fall in the envelope of upper and lower limit which is to be submitted along with the report.
7C	On Clamping force	EN-13146-7-2012	Variation \leq 20% of the initial value	-

Part-B: Salient features of Fastening System

S.N.	Components / Items	Provisions in Metro
1.	Brief description of fastening system	
2	Axle load	
3	Speed potential	
4	Drawing and their numbers	
5	Specifications and their numbers	
6	Any variation for straight and curve portion? If yes, give detail	
7	Vertical stiffness of complete fastening system	
8	Service life of fastening system.	
9	Reference of Railway Board's approval for proposed fastening system.	

Part-C: Check List of submission

1	Compliance of Part – A	
2	Sets of drawings (two numbers)	
3	Performance record of fastening system	
4	Test report of fastening system.	

FORMAT FOR LETTER OF RESPONSE

Respondents Ref No.:

Date:

Director/Track-IV
Building: Anusandhan Bhawan,
Research Designs & Standards Organization (RDSO)
Ministry of Railways, Manak Nagar
Lucknow (INDIA), Pin - 226011

Dear Sir,

Subject: RESPONSE TO – GLOBAL EOI FOR PARTICIPATION

1. We, the undersigned, offer the following information in response to the Expression of Interest sought by you vide your Notification No. dated.....
2. We are duly authorized to represent and act on behalf of _____ (hereinafter the “respondent”)
3. We have examined and have no reservations to the Eoi Document including Addenda No(s)_____.
4. We are attaching with this letter, the copies of original documents defining: -
 - 4.1 The Respondent’s legal status;
 - 4.2 Its principal place of business;
 - 4.3 Its place of incorporation (if respondents are corporations); or its place of registration (if respondents are cooperative institutions, partnerships or individually owned firms);
 - 4.4 Self certified financial statements of last three years, clearly indicating the financial turn over and net worth.
 - 4.5 Copies of any market research, business studies, feasibility reports etc sponsored by the respondent, relevant to the project under consideration
5. We shall assist Ministry of Railways (MoR) and/or its authorized representatives to obtain further clarification from us, if needed.
 - 5.1 RDSO and/or its authorized representatives may contact the following nodal persons for further information on any aspects of the Response:

S. No.	Contact Name	Address	Telephone	E Mail

6. This application is made in the full understanding that:
 - 6.1 Information furnished in response to EoI shall be used confidentially by RDSO as required.
 - 6.2 RDSO reserves the right to reject or accept any or all applications, cancel the EoI without any obligation to inform the respondent about the grounds of same.
 - 6.3 We confirm that we are interested in participating in this EoI.
 - 6.4 The EoI is only for the Worldwide Technological Advancements and Global availability of fastening systems for ballastless track in the world for use on Metro Railways/MRTS system of Indian Railways which comply to the Performance criteria of fastening system for ballastless track on Metro Railways/MRTS system (Annexure C-2) and not for its procurement.

7. In response to the EoI, we hereby submit the following details annexed to this application -
 - 7.1 Turn-over of the firm during the last three financial years with the copies of annual report
 - 7.2 Details of various items being manufactured / consultancy undertaken.
 - 7.3 Details of customer(s)/Railways where fastening systems for ballastless track on Metro Railways/MRTS system have been supplied by the firm including quantity during last 3 years.
 - 7.4 Experience and expertise for the fastening systems for ballastless track on Metro Railways/MRTS system proposed in EoI.
 - 7.5 Complete details of the fastening systems for ballastless track on Metro Railways/MRTS system with drawing and specification of each component, calculation & test certificates as per **Appendix-‘2’**.
 - 7.6 Details of Intellectual Property Rights (IPR) held, patent filed/held and MoU/ agreement signed.
 - 7.7 Details of ISO/equivalent certification, if any.
 - 7.8 Documents in proof of Eligibility criteria
 - 7.9 Para-wise compliance of Requirements as per **‘Appendix-4’** and supporting documents.

8. The undersigned declare that the statements made and the information provided in the duly completed application are complete, true, and correct in every detail.

Yours sincerely,

(Sign)

NAME:

In the Capacity of
duly authorized to sign the
response for and on behalf of

Date:

**Technical information of fastening System for Ballastless track on
Metro Railways/MRTS system**

Name of the firm:

Address of the firm:

Para No.	Item	Provisions of the performance criterion Annexure-C2'	Compliance / remarks with details
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, so as to obtain the parameters as detailed in the ensuing paragraphs.	
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.	
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	
2.2		Speed potential – 110 kmph(max.)	
2.3		Rail section - 60kg(UIC)/60E1, 90 UTS/110 UTS	
2.4		Static axle load – BG & SG – 20t(Max)	
2.5		Design rail temperature range – 10 degree Celsius to +70 degree Celsius	
2.6		Curvature and gradient will be specified in SOD.	
2.7		Rail seat inclination (slope) – 1 in 20	
		In addition, the client Railway may specify any other operating condition such as support spacing etc.	

3.	Ballastless Track Structure:	<p>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 ballastless 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 (relevant extract enclosed as Appendix-5). In general, track slab on which the fastening and rails are to be fitted shall:</p> <ul style="list-style-type: none"> i) Resist the track forces. 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 rail forces. iv) Have geometrical accuracy and enable installation of track to the tolerances laid down. v) Ensure adequate 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 the 'Track Maintenance Manual' to be prepared and made available before the line or a portion of a line is opened for traffic . viii) Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design. 	
4.	Performance Requirement of Fastening System:		
4.1	General	<ul style="list-style-type: none"> 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. 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 	

		<p>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 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.</p> <p>iii) The fastening shall provide insulation to take care of return current of traction system.</p> <p>iv) Fastening should satisfy the required performance norms as stated in para 4.2, 4.3, 4.4, 4.5,& 4.6.</p>	
4.2	<p>Following are the technical performance requirements of fastenings:</p>	<p>The Fastening shall</p> <p>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:</p> <p>a) Atmospheric ultra violet radiation.</p> <p>b) Proximity of track up to 10m from salt water source.</p> <p>c) Contact with oil, grease or distillate dropped from track vehicles.</p> <p>ii) Permit quick and easy installation and replacement with special tools.</p> <p>iii) Be capable of vertical adjustment during service life upto 12mm using shims.</p> <p>iv) Permit the attainment of the following tolerances when installed, and later during</p>	

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7	Effect of repeated loading	EN-13146-4- 2012	No wear or deformation	-
7A	On Vertical static stiffness	EN-13146-4- 2012	Variation ≤ 25% of the initial value	No sign of bond failure/ fracture/slippage
7B	On Longitudinal rail restraint	EN-13146-1- 2012	Variation ≤ 20% of the initial value	Except the rail and fastener, no sliding, yield or cracking is allowed for fastener parts. Longitudinal load/ deformation curve shall fall in the envelope of upper and lower limit which is to be submitted along with the report.
7C	On Clamping force	EN-13146-7-2012	Variation ≤ 20% of the initial value	-

‘Procedure for Safety Certification and Technical Clearance of Metro Systems (Dec. 2015)’ – Extract of Annexure-C1

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.

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.

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.

Note: “In case of Double Resilient Base Plate Assembly Fastening System as approved by MoR, the lateral clearance between running rail and the derailment guard shall be 250 ± 20 mm. This fastening system, if used in tunnels having multiple tracks, Metro Administration should ensure that KE for adjacent track is not infringed so long as the wheels of any derailed vehicle are within the main rail and derailment guard.”

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.
(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.