GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No.2016/Proj./LMRC/30/9

New Delhi, date 29.06.2016

Managing Director,
Lucknow Metro Rail Corporation Ltd.,
Administrative Building, Vipin Khand,
Gomti Nagar, Lucknow-226010

Sub: Approval of Documents of Track Structure as per Annexure C-1 (May, 2016) for Lucknow Metro Rail Corporation.

Ref: LMRC's letter No. LMRC/D (W&I) Railways/2015 dated 23.06.2016

Lucknow Metro Rail Corporation's (LMRC) request for approval of Track Structure (Annexure-C1) May, 2016 for use on Standard Gauge of Lucknow Metro's North–South corridor has been examined in consultation with RDSO and approval of Railway Board is hereby conveyed.

Accordingly, approved copy of Annexure-C1 is enclosed.

Encl: as above (42 Pages)

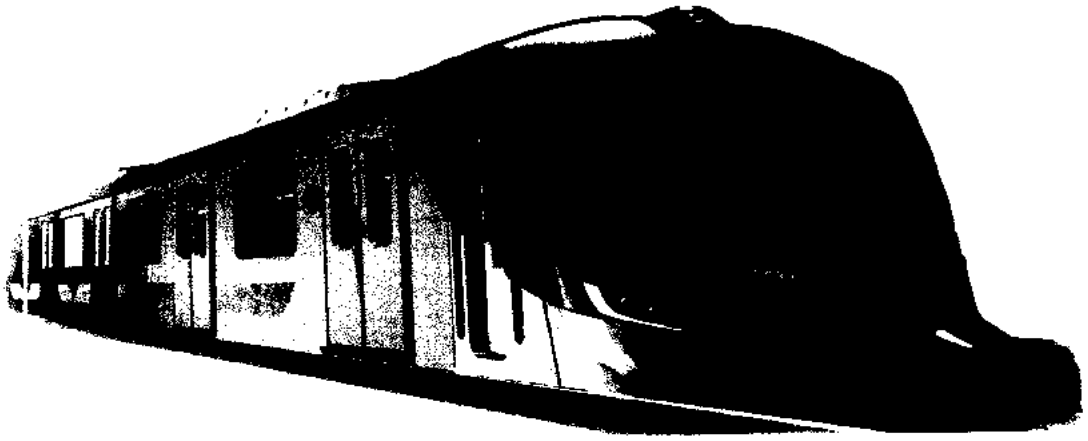
29.06.2016

(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/99/LMRC/Civil dated 23.06.2016 for information please.

Safety Certification and Technical Clearance of Metro Systems

(Annexure – C1)



29/6/2016

MAY, 2016

LUCKNOW METRO RAIL CORPORATION LIMITED

ADMINISTRATIVE BUILDING, VIPIN KHAND,
GOMTINAGAR, LUCKNOW-226010

Annexure C-1

LMRC's COMPLIANCE OF TECHNICAL STANDARDS OF TRACK STRUCTURES FOR STANDARD GAUGE OF NORTH – SOUTH CORRIDOR OF LUCKNOW METRO

Standard Stipulated	LMRC's Compliance / Comment
1. Scope: To stipulate the desirable technical standards /specifications for track structure for Metro Railways/ MRTS Systems in the country.	Noted.
2. Operating Environment: Track Structure should fulfill generally the following conditions:	
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.)	Design speed- 95 kmph (Max.) Operating speed- 85 kmph (Max.)
2.4 Static axle load –20 T (max.)	16T (Max.)
2.5 Design rail temperature range – (-)10 degree Celsius to (+) 70 degree Celsius	Comply (-10°C to +70°C)
2.6 Maximum Curvature and ruling gradient - As specified in SOD	Yes, as specified in SOD.
3. Track Structure: **3.1 General:** The track structure should fulfil the following requirements:	

3.1.1 The track structure should conform to/ satisfy Schedule of Dimension requirement and other maintenance instructions of Metro systems.	Yes, conforming to/satisfying Schedule of Dimensions requirement and other maintenance instructions of Metro systems.
3.1.2 Ride comfort and running safety of track vehicle dynamics should be satisfied.	Yes, complying.
3.1.3 The track structure should be designed with Long welded / Continuously welded rail on main line track in case of ballasted as well as ballastless track.	Yes, complying. The track length on main line is with continuously welded Rails and 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.	Yes, complying. The horizontal alignment consists of a series of straights joined to circular curves with transition curves. Curvature and cant have been provided corresponding to train speed. Adequate transition length on curves is being provided. Compound and reverse curves wherever provided shall be connected by adequate transition curves.
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.	Yes, complying. The vertical alignments are being designed to achieve a smooth profile line with gradual changes connected by vertical curves. The vertical curves have not been located at stations within the length of platform. No vertical curve has been provided within the length of transition. Minimum radius of vertical curve adopted is 1500 meters.

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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	Commented in relevant paras.
4.1 Rails: 4.1.1 For Main line Track: 4.1.1.1 The rail used on main line on curves and approaches of Stations shall be 60E1 (UIC 60), 1080 grade Head Hardened. 4.1.1.2 At other locations on straight line of main line, the use of 60E1 (UIC 60), 1080 grade HH / 60E1 (UIC 60), 880 grade rail shall be decided by Metro Railway depending upon speed, axle load and other factors pertaining to safety and life of rail. However on curves with small straight track in between, the 60E1 (UIC 60), 1080 grade Head hardened rail should be continued on straight patches also. 4.1.1.3 It is essential to have preventive rail grinding arrangements in case 60E1 (UIC 60), 1080 HH rails are used.	29/6/2016 The rails on whole of the main lines is UIC-60/60E1, 1080 Grade, Head Hardened. The maximum operating speed is 85 kmph. The Rail Grinding Machine shall be used for preventive rail grinding of track periodically as and when required.

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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.	Non- HH, 880 grade UIC 60 rails is being used in depot line.
4.1.3 Specification: 4.1.3.1 The rail shall be class 'A' rails as per IRS-T-12-2009 specification with latest amendments. However, any suitable length of rail more than 13 m considered appropriate by metro on consideration of transportation and handling can be adopted, provided the rails are ultimately welded into long welded rails.	Class 'A', UIC 60/60E1 Rails conforming to IRS-T-12-2009 with latest amendments have been used. Length of rails procured is 18 Meters and all rails are welded into CWR.
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.	The rails are manufactured and tested in accordance with IRST-12-2009 (with latest amendments). Rails are being manufactured by Nippon Steel & Sumitomo Metal Corporation (NSSMC), Japan and evaluated by LMRC in Inspection & Test Plan as enclosed in Annexure-'A'.
4.2 Welding of rail: 4.2.1 The welding of rails should conform to Indian Railway specifications and technical instructions issued from time to time. 4.2.2 The present instructions are contained in following documents: 4.2.2.1 Alumino Thermit Welding: (i) Indian Railway Standard specifications for Alumino Thermit Welding of Rails (IRS/T-19 with latest amendments) (ii) Manual for Fusion Welding of Rails by The Alumino-Thermic Process: Revised-2012 with latest amendments	Comply 29/6/16 A.T. Welding is complying to IRS/T-19 with latest amendments and Manual for Fusion Welding of Rails by The Alumino-Thermic Process: Revised-2012 with latest amendments.

4.2.2.2 Flash Butt Welding: Manual for Flash Butt Welding of Rails, January 2012 with latest amendments. 4.2.2.3 Special attention is required by metros for provisions of these instructions regarding procurement, execution of works and areas requiring prior approval/ standardisation by RDSO.	Flash Butt welding is complying to Manual for Flash Butt Welding of Rails, January 2012 with latest amendments. Instructions regarding standardization of Flash Butt welding parameters and execution of FB welding of rails as per approved QAP by RDSO shall be followed.
4.3 Ultrasonic Testing of Rail and Welds: The rails and welds shall be ultrasonically tested in field as per requirement of concerned specification/ manual/ instructions. The testing shall be ensured as per provisions of "Manual for Ultrasonic Testing of Rail and Welds- Revised 2012" with latest amendments. The provisions of "IRS specification for Ultrasonic testing of Rails/Welds (Provisional), Revised-2012" shall also be followed.	All the rails and welds are being ultrasonically tested as per provisions of "Manual for Ultrasonic Testing of Rail and Welds- Revised 2012" with latest amendments and provisions of "IRS specification for Ultrasonic testing of Rails/Welds (Provisional), Revised-2012" are also followed.
5. Sleeper and fastening for Ballasted track **5.1 Sleepers:** 5.1.1 Broad Gauge The PSC sleepers shall be used in accordance with RDSO drawing no. T-2496 and specification IRS-T-39 (revised from time to time). 5.1.2 Standard Gauge PSC sleeper for standard gauge will be designed by Metro Railways following in principal guidelines of Indian Railway and the same shall be approved by Metro.	Not applicable. 21/6/2016 No PSC sleepers are used on Main lines. PSC sleepers being used in depot are of same design as used in DMRC (Drg. No.DMRC/SG dated 23.10.2008), which have been designed following in principle guidelines of Indian Railways and approved by LMRC.

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.	Elastic fastening system prevalent on Indian Railways is being used duly ensuring the Inspection protocol for fastening components laid down for IR for ballasted track in depot.
6. Track slab for Ballastless track	
6.1 Track shall be laid on cast in situ/precast reinforced plinth or slab, herein referred to as the 'track slab'. The track slab shall be designed as plinth beam or slab type ballastless track structure with derailment guards. It shall accommodate the base plates of the fastening system.	Yes, complying. The ballastless track is being laid on RCC plinth along with derailment guards on elevated sections and on RCC slab in underground sections. The base plate of fastening system is conveniently accommodated.
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:	The track slab on which the rails and fastenings are fitted performs the following functions satisfactorily.
i) Resist the track forces. (Static and dynamic)	i) Resist static and dynamic track forces.
ii) Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure.	ii) Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure.
iii) Provide a level base for uniform transmission of track/rail forces.	iii) Provide a level base for uniform transmission of track/rail forces.
iv) Have geometrical accuracy and enable installation of track to the tolerances laid down.	iv) Yes, provide highly accurate track geometry.

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v) Ensure drainage.	v) Comply. It ensures drainage.
vi) Resist weathering.	vi) Comply. It resists weathering.
vii) Be construction friendly, maintainable and quickly repairable in the event of a derailment. The 'Repair and Maintenance methods' shall be detailed in a Manual to be prepared and made available.	vii) Yes, complying. It is construction friendly. Manual incorporating 'repair and maintenance methods' will be prepared and made available.
viii) Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design.	viii) Comply. All the plinths/slabs are connected by electrical conductor strips.
ix) Plinth beam or slab of ballastless track should be suitable for embankment or viaduct or tunnel/Underground structure.	ix) Yes, complying.
x) Proper design of expansion joints suitable for joints of viaduct structure.	x) Yes, complying. 29/6/2016
xi) Design should be suitable for curves as per SOD of Metro system.	xi) The design is suitable for curves as per SOD of LMRC.
xii) Design of subgrade/embankment for slab should be furnished to ensure durability and functional stability in service.	xii) The whole of the mainline is either on viaduct or in tunnel. The ballasted track in depot is on compact embankment.
xiii) Design should be suitable and incorporate provision of utilities e.g. cable, wires, ducts, water channels, etc.	xiii) The design is capable of provision of utilities i.e. cable, wire, ducts, water channel etc.
The detailed design calculations of track slab along with detailed structural drawings as approved by metro authorities shall be furnished for record.	The plinth slab being adopted is similar to that adopted in Standard Gauge sections of DMRC using 'fastening system 336'. The structural drawings of

	plinth slab are enclosed as Annexure-B.
7. Check Rail / Restraining Rail: 7.1 Check rails/ Restraining Rails should be provided on curves on main line where radius is 218m or less on Broad gauge and radius is 190m or less on Standard gauge. The clearance of check rail/ restraining rails shall be suitably decided after requisite studies. The detailed design calculations/ studies in this regard shall be furnished for record. 7.2 Check rails/ Restraining Rails shall not be mandatory for curves in depots, yards and non-passenger lines where speed is not more than 25 kmph. However decision in this regard may be taken by Metro themselves based on layout and maintenance requirement.	Complying. Check rails are being provided on curves having radius 190 Meters or sharper than 190m on mainline. The check rail clearance has been kept to fulfill the functional requirement. Check rails as per similar drawings of DMRC adopted in Jaipur Metro (Drawing No. DMRC/Track/ Jaipur/DWG- CR-001 & 004), are being provided. Drawings are enclosed as Annexure-C. Noted please. 21/6/2016
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.	Derailment guards are being provided on elevated viaducts. The derailment guards in underground tunnels as stipulated vide Railway Board's letter No. 2011/Proj./MOU/31/1 Vol.I dated 26.11.2015 shall be provided in underground tunnels.

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.	29/6/2016
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.	Complying, the lateral clearance between running rail and derailment guard has been kept within 210 ± 30 mm. It will not be lower than 25mm below the top of running rail and will be clear of rail fastenings.
8.3 Derailment guard shall be designed such that in case of derailment: (i) The wheels of a derailed vehicle under crush load, moving at maximum speed are retained on the viaduct or tunnel. (ii) Damage to track and supporting structures is minimum.	Yes, complying. The wheels of a derailed vehicle under crush load, moving at maximum speed shall be retained on the viaduct or tunnel. Yes, complying. The damage to track and supporting structures shall be minimum in case of derailment.

The detailed design calculations of derailment guards along with detailed structural drawings shall be furnished for record.	The Derailment Guard is designed for a load of 3 Ton per Meter. Structural drawings of derailment guard are provided in Annexure-B with track plinth/slab drawings for record of RDSO.
9. Glued Insulated Rail joint 9.1 Normally glued joint should be avoided. 9.2 Wherever inescapable, G3 (L) type of glued insulated rail joint shall be used as per RDSO drawing no.T-5843. The glued joints shall be manufactured and tested in accordance with RDSO's 'Manual for Glued Insulated Rail Joints-1998' with all amendments.	Noted. Provision of glued joints is not required in mainline as confirmed by Signalling contractor as track proving is through axle counters. Yes, complying. G3(L) type of glued insulated rail joint as per RDSO Drg. No. T-5843 will be used and these will be manufactured and tested in accordance with RDSO's 'Manual for Glued Insulated Rail Joints, 1998 with all amendments.
10. Turnouts, Scissors Crossover **10.1 Standards of Turnout:** **10.1.1 Main lines:** On main lines, the turnouts and diamond crossing shall be of the following standards: **(i) Standard Gauge** a) 1 in 9 type or flatter turnout (desirable) b) 1 in 7 type turnout (minimum) c) Scissors cross-over of 1 in 9 / 1 in 7 type consisting of 4 turnouts and 1 diamond crossing	21/6/2016 Complying. Turnouts being used are: a) 1 in 9 type b) Scissor crossover of 1 in 9 type consisting of 4 turnouts and 1 diamond crossing.

(ii) Broad Gauge a) 1 in 12 type turnout b) 1 in 8.5 type turnout c) Scissors cross-over of 1 in 12 type consisting of 4 turnouts and 1 diamond crossing	Not applicable.
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 b) Scissors crossover of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing c) 1 in 7 derailing switches/1 in 7 type symmetrical split turnout	Turnouts being used are: a) 1 in 7 type b) Scissor crossover of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing. c) 1 in 7 type derailing switches
(ii) Broad Gauge a) 1 in 8.5 type turnout b) Scissors cross-over of 1 in 8.5 type consisting of 4 turnouts and 1 diamond crossing c) 1 in 8.5 derailing switches /1 in 8.5 type symmetrical split turnout	Not applicable
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 please. 21/6/2016

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.	a) Complying. Turnouts on Main line have been designed for installation on concrete slab for ballastless track. Turnouts in depots have been designed for installation on PSC sleepers on ballasted track.
(b) Turnouts shall be manufactured to allow for installation of continuously welded track.	b) Complying. Turnouts have been designed and manufactured for installation of continuously welded track.
(c) Turnout shall be compatible with proposed rolling stock and its operational characteristics.	c) Complying. Turnouts are compatible with the rolling stock and its operational characteristics.
(d) The assembly must ensure continuous electrical contact with the train and all the points shall be operated by electric motors.	d) Complying. The assembly ensures continuous electrical contact with the train and all the points will be operated by electric motors.
(e) The CMS crossing to be used on mainline shall be subjected to explosive hardening.	e) Complying. The CMS crossing used on mainline are explosively hardened.
(f) All turnouts shall be laid with cant with a rail slope as that of main line towards centre of track.	f) Complying. The turnouts are being laid with a rail slope of 1 in 20 towards centre of track.
(g) All turnouts and their components shall be designed to minimize electrical leakage from running rails to the ground.	g) Complying. The turnouts and their components have been designed to minimize electrical leakage from running rails to the ground.

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(h) Scissor crossover should be designed for Track centres not infringing SOD.	h) The Scissor crossover has been designed to ensure that track centers do not infringe SOD.
10.2 Type and geometry of turnout Detailed design of all turnouts, scissors, and crossover should comply the following geometrical parameters. (a) **Standard Gauge** (i) **<u>1 in 9 turnout:</u>** The design shall be tangential with a switch angle not exceeding 0°20'00". It is desirable that the radius of lead rail of turnout is not less than 300m. Lead curve of 190 m radius may be laid as an exception. All clearances shall be in accordance with relevant provisions of SOD. (ii) **<u>1 in 7 turnout</u>**: The design shall be tangential with a switch angle not exceeding 0°20'00". It is desirable that the radius of lead rail of turnout is not less than 190m. Lead curve of 140 m radius may be laid as an exception. All clearances shall be in accordance with relevant provisions of SOD. **(iii) Scissors Crossover** The basic geometry of the turnouts of scissors crossover shall be same as that of corresponding ordinary turnouts as mentioned in clause 10.2 (i) (ii) above.	Complying. The detailed design of all turnouts, scissors, crossovers comply the following geometrical parameters: Complying. (i) Switch Angle=0°-8'-12" (ii) Radius of Lead rail=300M (iii). All clearances in accordance with SOD are being complied. Complying. (i) Switch Angle=0°-8'-50" (ii) Radius of Lead rail of turnout =190M (iii) All clearances as per SOD are being complied. Complying as mentioned in clause 10.2 (i) & (ii) above.

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(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. **(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. **(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.	Not Applicable
10.3 Operating requirement of turnout, scissor crossover: Track layout design shall permit trains to operate at maximum capability wherever possible. Turnouts and crossover shall be selected such that they do not form a restriction to the operating speed on main line. Switches and crossings shall not be located on transition curves or vertical curves.	Complying. The switches and crossings are not being located on transition curves or vertical curves.
10.3.1 Speed: The turnout shall be designed for the speed on mainline side equal to the speed as on mainline track. The minimum speed potential of the various turnouts and scissors crossover on the Turnout side should be as follows: **10.3.1.1 Standard Gauge** (i) 1 in 9 type turnout with 300 m radius (speed potential of 45Kmph)	Complying. Details given below: i) 1 in 9 (R=300m) = 45 kmph

(ii) 1 in 7 / 1 in 9 type turnout with 190 m radius (speed potential of 35Kmph)	ii) 1 in 7 (R=190M) =35 kmph
(iii) 1 in 7 type turnout with 140 m radius (speed potential of 25 Kmph)	iii) Not applicable.
iv) Scissors crossover 1 in 9 type with 300 m radius (speed potential of 45 Kmph)	iv) Scissor crossover 1 in 9 (R=300M)=45 kmph
(v) Scissors crossover 1 in 9/1 in 7 type with 190 m radius(speed potential of 35Kmph)	v) Scissor crossover 1in 7 (R=190M) =35 kmph.
(vi) Scissors crossover 1 in 7 type with 140 m radius(speed potential of 25 Kmph)	vi) Not applicable.
(vii) 1 in 7 type symmetrical split turnout (speed potential of 45Kmph)	vii) Not applicable.
10.3.1.2 Broad Gauge (i) 1 in 12 type turnout (speed potential of 50Kmph) (ii) 1 in 8.5 type turnout (speed potential of 30Kmph) (iii) Scissors crossover 1 in 12 type (speed potential of 50Kmph) (iv) Scissors crossover 1 in 8.5 type (speed potential of 30Kmph) (v) 1 in 8.5 type symmetrical split turnout (speed potential of 40Kmph)	Not Applicable
10.4 Technical Specification **10.4.1 General** (a) All the points shall be capable of being operated by electric motors in accordance with the signalling specification.	a) Yes, complying. All the points are being operated by electric motors in interface with signaling specification.
(b) The top surfaces of PSC sleeper/RCC slab supporting rail seat of	b) Yes, complying. Top surfaces of PSC sleeper/RCC

turnouts and scissors crossover shall be flat without any cant/slope. (c) The track form of the turnout shall have uniform resilience as that of the adjoining track form. (d) The fixation of turnouts, scissor cross-over on track slab shall be through base plates/bearing plates.	plinths are flat. c) Yes, complying. The track form has uniform resilience as that of adjoining track form. d) Yes, complying. The turnouts/ scissor crossovers on track are fixed through base plates/bearing plates.
10.4.2 Rails 1. The rails used in turnouts shall be 1080 grade Head Hardened. However, rails used in turnouts on depot and other non-running lines may be of 880 grade. 2. The rails used for manufacturing of turnouts shall satisfy the following conditions: a. The rails shall be manufactured and tested in accordance with IRS/T-12-2009 with latest amendment. b. The section of rails shall be 60E1 (UIC60) for stock, lead and 60E1A1 (ZU1-60) /60E1A4 for switch rail. c. The rails shall qualify as Class 'A' rails as per IRS/T-12-2009. d. The rails shall be with ends un-drilled.	UIC 60/60E 1 rails of 1080 grade Head Hardened are being used in turnouts. (a) Complying. The rails used in manufacturing of turnouts are manufactured and tested in accordance with IRS/T-12-2009 with latest amendment. b) Complying. The section of rails being used is UIC 60/60E-1 for stock, lead and 60E1A1 (ZU1-60) for switches. c) Complying. The class 'A' rails as per IRS/T-12-2009 with latest amendments are being used. d) The rails are with undrilled ends.

e. The rails shall be of grade 1080HH and be suitable for being welded by alumino- thermic or flash butt welding technique.	e) The rails are of grade 1080HH and suitable for welding by A.T. welding process or Flash Butt welding technique.
10.4.3 Switches 1. Each switch device shall consist of two stock rails, one left hand and one right hand and two switch rails, one left hand and one right hand.	Complying.
2. The switch rail shall be one piece with no weld or joint within the switch rail length.	Complying. The switch rail is one piece without any weld/ joint within the switch length.
3. The end of the asymmetrical switch rail shall be forged to 60E1 (UIC60) rail profile with minimum length of 500 mm. The forged switch rail end shall be suitable for welding or installation of insulated rail joint.	Complying. The end of switch rail is forged to UIC 60/60E1 rail profile with minimum length of 500 mm. The forged switch rail end is suitable for welding or installation of insulated rail joint.
4. 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. Slide chairs in switch portion are coated with a special coating to reduce point operating force and to eliminate the requirement of sliding surfaces during service.
5. Switches shall provide suitable flange way clearance between the stock rail and the switch rail with the switch rail in open position (minimum 60mm). The 1 in 12 and 1 in 9 (with radius of 300 mts) and flatter turnouts shall be provided with second drive or other suitable arrangement to ensure minimum gap of 60mm at JOH as well as proper housing of switch rail with stock rail up to JoH. 1 in 8.5, 1 in 9 turnout (with radius of 190m) and 1 in 7 and sharper turnouts may not be provided with second drive arrangement, however minimum gap of 60mm	1 in 9 turnouts (with 300m radius) are provided with second drive arrangement. The clearance of 60mm at JOH for 1 in 9 as well as 1 in 7 turnouts for proper housing of switch rail with stock rail upto JOH is ensured. The normal opening of switch at toe of switch is kept 160 mm.

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at JOH as well as proper housing of switch rail with stock rail up to JoH should be ensured. The normal opening of switch at toe of switch shall be kept as 160mm.	
6. The switch manufacturer shall include provision for all holes required to main drive machines, stretcher bars and detection equipment to suit the requirements of the signalling and switch operating system duly chamfered to avoid stress concentration at the edge of the holes.	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. The switches with anti-creep device at the heel of switche are being provided.
8. The switches and all slide chairs shall be same for ballasted and ballastless turnouts.	Complying. The switches and all slide chairs are same for ballasted and ballastless turnouts.
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.	Complying. All CMS crossings have extended weldable leg of 1.2 Meter rail for welding with UIC 60/60E1 rails.
2. The CMS crossings shall be manufactured from Austenitic Manganese steel as per UIC 866.	Complying. The CMS crossings are 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.	Complying. The CMS crossings are provided with welded leg extensions of UIC60/60E-1 rail for welding of buffer transition rail pieces.
4. All CMS crossings on main line shall have a minimum initial hardness of 340 BHN.	Complying. The CMS crossings on main line have 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.	Complying. The CMS crossings and their welded leg extension for scissor crossovers are suitably designed and there is no necessity of providing small cut pieces for interconnections. The rail cant is being provided on top surface of CMS crossing and bottom surface of CMS crossing are flat.
10.4.5 Check Rails 1. The check rail section shall be 33C1 (UIC 33) or similar without any direct connection with running 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. 3. Each check rail end shall be flared by machining to have minimum clearance of 62mm at end. 4. The check rail connections in turnouts shall be through specially designed bearing plates / brackets. 5. All the check rails shall be higher by 25mm above running rails. The	The check rail section of 33C1 (UIC 33) without any direct connection with running rails are being used. Complying. The Check rails having facility for the adjustment of check rail clearances upto 10mm over and above the initially designed clearance are being used. Complying. The check rail ends are flared by machining and have minimum clearance of 62mm at the end. Complying. The check rail connections in turnouts are through specially designed bearing plates/ brackets. Complying. All the check rails higher by 25mm above

lengths and positions of the check rail in diamond crossings shall provide safety and be compatible with the overall track layout.	running rails are being used. The lengths and positions of the check rail in diamond crossings provides safety and are compatible with the overall track layout.
10.4.6 Sleeper for Turnouts, Scissor crossover (Ballasted Track) 10.4.6.1 Sleeper shall be of pre-stressed concrete, mono-block, suitable for installation in track both with and without signaling circuits and with and without electrification.	PSC sleepers have been used in maintenance depots only. Mono-block pre-stressed concrete sleepers suitable with or without electrification are being used.
10.4.6.2 Sleepers shall be designed to provide a minimum service life of fifty years under nominal axle load as that of main line for the Metro system. Rail seat pads and rail clip etc shall be designed to provide a minimum service life of 15 years.	Sleepers are designed to provide minimum service life of fifty years under nominal axle load of 16 tons and a maximum speed of 95 kmph. Rail seat pads and liners are designed to provide a minimum service life of 15 years.
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.	Complying. The base surface of sleepers is rough cast while the top and side surfaces are smooth.
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.	The PSC sleepers are used in maintenance depot only. However, the sleepers are suitable for installation by track laying machines and sleeper insertion equipment.
10.4.6.5 The sleeper must be able to transfer all the relevant track forces generated by train operations and the forces of rail expansion and contraction to the ballast.	Complying. The sleepers are able to transfer all the relevant track forces generated by train operations and the forces of rail expansion and contraction to the ballast.

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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	Complying. Elastic resilient type sleeper fastening are being used.
(ii) Spacing of sleepers – 600mm (max) for main line and 650 mm (max) for Depots and other non-running lines, except at few locations such as near point machine locations where it may be varied to meet the design requirements.	The maximum Spacing of sleepers is 650 mm in Depots except at point machine locations.
(iii) Ballast cushion – 300 mm for mainline and 250mm for Depots and sidings	The ballast cushion of 250 mm in depot lines is being provided.
(iv) Ballast profile suitable for LWR/CWR.	Complying.
Specifications and Drawings (With latest amendment) (i) Special Cement – IRS T 40 1985 (ii) HTS wire plain and strand – BIS – 1785 (Pt-1) 1983 and BIS 6006 (iii) Polyethylene dowels – Provisional 1997 Drg. No. RDSO 3002 Alt-3 (iv) IRS Specification for Turnout Sleeper T- 45 1996 (v) IRS Bridge code 1982 (vi) Code of Practice for Pre-stressed Concrete IS-1343	Complying. The S.G. Sleepers are being manufactured by the manufacturer of Railways B.G. sleepers based on specifications of Indian Railways.
(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	The connections of the slide chairs and bearing plates/ special bearing plates/ brackets are designed for easy installation and maintenance. All the fittings

to ensure interchangeability of slide chairs between ballasted and ballastless turnouts.	are suitably designed for full compatibility and interchangeability of slide chairs between ballasted and ballastless turnouts.
(ii) For attaining suitable cant of the rail, as provided on mainline, (excluding crossing and switch portion), suitably designed pads of appropriate material shall be provided between rail pad & PSC sleeper. Also fastening system should be designed to get the desired Toe Load.	Complying. For 1 in 20 cant of the rail (excluding crossing portion), the pads of appropriate material are being provided between rail & PSC sleeper. The fastening system is also designed for the desired Toe Load.
(iv) The detailed design of Monoblock PSC sleepers for the turnouts along with structural drawings shall be checked and approved by metro railways.	The same turnout Monoblock PSC sleepers for S.G. as used by DMRC in Phase II based on Indian Railway design for B.G. turnout PSC sleepers are being used. The design of S.G. PSC sleepers is in accordance with the design parameters of Broad Gauge sleepers.
11. Switch Expansion Joint- 1. The SEJ for ballasted track shall be laid on PSC sleepers whereas the SEJs for ballastless track, if required, shall be laid on reinforced concrete slab. 2. The rail section for all SEJs shall be UIC 60, 1080 HH grade as per IRS-T-12-2009. 3. The SEJ for ballasted track shall be designed for a maximum gap of 80 mm. 4. The SEJ for ballastless track should be designed for the maximum gap required as per design. 5. The ballasted SEJ shall be as per RDSO drawing T-6902 &T-6922. 20 6. The ballasted SEJ for BG shall be laid with PSC sleepers as per RDSO	29/6/2016 SEJs are not planned to be installed. However, if need arises, the SEJ for ballasted track shall be laid on PSC sleepers whereas SEJs for ballastless track shall be laid on RCC slab with the specifications/parameters as mentioned in 11.2 to 11.8.

<table>
<tr><td>drawing T-4149. For Standard Gauge, PSC sleeper shall be designed such that SEJ to RDSO drawing along with its bearing plates/chairs may be accommodated for installation of SEJ.
7. Sleepers used for SEJs shall be flat and cant will be provided through CI chair.
8. The SEJ shall be suitable for two way directional traffic.</td><td></td></tr>
<tr><td>12. Fastening system for ballastless track:
Provisions contained separately in "PERFORMANCE CRITERIA OF FASTENING SYSTEM FOR BALLASTLESS TRACK ON METRO RAILWAYS/MRTS SYSTEM" (Annexure C-2) be referred to.</td><td>The 'fastening system 336' complying MOR's Performance criteria and approved vide letter No. 98/Proj./DLI/30/1(Vol.III) dated 24.01.2013 are being used.</td></tr>
<tr><td>13. Noise and Vibration
Metro system shall be designed to ensure that noise emitted is well within the prescribed limits for the particular area. Each Metro system shall specify the prescribed limits of permissible Noise and vibration parameters as per legal and statutory requirement of India.
25/6/2016</td><td>Complying, Metro system has been designed to ensure that the noise emitted is well within the prescribed limit of the area. Statutory requirement for noise as per Noise Pollution (Regulation and Control) Rules, 2000 are as under:
Ambient Air Quality Standards in respect of Noise
<table>
<tr><td rowspan="2">Area Code</td><td rowspan="2">Category of Area/Zone</td><td colspan="2">Units in dB (A) Leg.</td></tr>
<tr><td>Day time</td><td>Night time</td></tr>
<tr><td>A</td><td>Industrial Area</td><td>75</td><td>70</td></tr>
<tr><td>B</td><td>Commercial Area</td><td>65</td><td>55</td></tr>
<tr><td>C</td><td>Residential Area</td><td>55</td><td>45</td></tr>
<tr><td>D</td><td>Silence Zone</td><td>50</td><td>40</td></tr>
</table>
<u>Notes:</u>
1. Day time shall mean from 6.00AM to 10.00PM.</td></tr>
</table>

	2. The North-South corridor in Lucknow Metro is traversing predominantly in zone B & C. 3. During oscillation trials if it is found that noise levels are exceeding the above limits, necessary corrective measures shall be taken to contain the same within stipulated limits.
14. GRADIENTS 14.1 The maximum grade (compensated) shall be 4%. Note: (i) There will be no change of gradient in transition portion of curves. (ii) The gradient will be compensated for curvature at the rate of 0.04% per degree of curve.	Yes comply. The maximum grade (compensated) has been kept as 4%. (i) There is no change of gradient in transition portion of curves. (ii) The gradient is compensated for curvature at the rate of 0.04% per degree of curve.
14.2 Maximum permissible gradient on turnouts (i) On Ballasted Track 0.25% (ii) On Ballastless Track 2.5%	Yes, comply.
Note : (i) There shall be no change of grade on and within 15m of any turnout on ballastless track. Similarly, there shall be no change of grade on and within 30 meters of any turnout on ballasted track. (ii) In case of turnouts on gradient, there shall be no horizontal curve on and within 15 meters of any turnout on ballastless track and 30 meters of any turnout on ballasted track.	(i) It is ensured that there is no change of grade on and within 15M of any turnout on ballastless track and there is no change of gradient on and within 30 meters of any turnout on ballasted track. (ii) In case of turnouts on gradients, there is no horizontal curve on and within 15 meters of any turnout on ballastless track and 30 meters of any turnout on ballasted track.

14.3 TRACK GRADIENT IN PLATFORM (a) Maximum- 1 in 400 (b) Desirable- Level Note: There shall be no change of gradient in platform track.	Yes, comply.

Part-B: Salient features of Track Structure as adopted by Metro

i) Track

S.No.	Components / Items	Provision/Reference
1.	Gauge	Standard Gauge-1435 mm
2.	Axle Load	16 tons
3.	Design Speed	Maximum=95 kmph, Operating=85 kmph.
4.	Rail Section and Grade	UIC 60/60E-1, Grade 1080, Head Hardened.
5.	Rail Specifications	IRST-12-2009 with upto date amendments.
6.	Ballasted or Ballastless	Main line: Ballastless, Depot: ballastless/ballasted
7.	Rail inclination (Canting of Track)	1 in 20
8.	Check Rails provision	On curves sharper than 190m on mainline check rails are being provided.
9.	Provision of Derailment upstand/Gaurd	Derailment guards are being provided on elevated sections and will be provided in tunnels also as

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		stipulated in Railway Board letter No. 2011/Proj./MOU/31/1 Vol.I dated 26.11.2015.
10.	Horizontal Clearance of Derailment upstand	210 ± 30 mm
11.	Vertical location of Derailment upstand w.r.t. Rail plane	At rail level.
12.	Glued insulated Rail Joint provided? If Yes, type of GIRL	Not envisaged on mainline. If required, Type G 3(L) as per RDSO drg. No.T-5843 will be provided.
13	Welding Of Rail (LWR /CWR)	CWR
14	Whether SEJ provided? If Yes Type of SEJ.	No
15	Type of welding	Main line by Flash Butt; and Turnouts & scattered joints by AT

ii) Turnouts and switches:

S.N.	Components / Items	1	2	3	4
1	Type of turnout, scissors crossovers (crossing angle)	1 in 9	1 in 7		
2	Canted or uncanted	Canted			
3	Radius (M)	300	190		
4	Length of switch (mm)	13990	12648		
5	Type of Switch (Thick web or otherwise)	Thick web			
6	Switch entry angle	0°-8'-12"	0°-8'-50"		
7	Speed potential (kmph)	45	35		
8	Location of Use (Main line or Depot)	Main line	Depot Siding		

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9	Rail Section used for switch	UIC60/60E-1			
10	Second drive provided	Yes	No		

iii) Crossing:

S.No.	Components / Items	Provisions / Reference
1	Crossing: Curved or Straight	Curved
2	Crossing: Canted or uncanted	Canted on top
3	Length of Weldable length extension	1.2 M
4	Check Rail section	UIC 33 (33 C.1)
5	Height of Check rail above the rail plane	25 mm
6	Check Rail clearance at the middle	41 mm
7	Check Rail clearance at the end	62 mm

Part-C: Check List of submissions while submitting compliance:	
1 Compliance of Part-A	Yes, submitted.
2 Design of subgrade/embankment for slab (Para 6.xii)	Not applicable in Main line
3 Design calculations of track slab /plinth beam along with detailed structural drawings as approved by metro authorities. (Para 6)	Drawings enclosed as Annexure-B.
4 Design calculations/ studies with regard to clearance of Check rails/ Restraining Rails. (Para 7.1)	Drawings of check rails enclosed as Annexure-C.
5 Design calculations of derailment guards along with detailed structural drawings shall be furnished for record. (Para 8)	Drawing of Derailment Guard are part of plinth drawings as enclosed in Annexure-B.

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LMRC's Inspection & Testing Plan of HH Rails (60E1 IRS-T-12-2009, 1080 Grade) for NSSMC (LKT-1)

	Stage	Process/Quality control parameter	Equipment/ Instrument	Frequency of testing	Reference Document for testing method	Remarks	Witness /Review	Test Result/ Compliance
1	Qualifying Criteria	**Qualifying criteria-**						
		Residual Tensile stress	strain Gauge	Test shall be done for each rail section, grade and class after any change in the process of manufacture which may affect the results or annually for first three years after adoption of revised specifications. If results of these three years found consequently satisfactory, the frequency may be relaxed to three years by purchaser.	Clause 22 of IRS-T-12-2009	Residual tensile stress shall not exceed 190 Mpa anywhere in Rail section.	Review	Comply (< 190 Mpal
		Fracture Toughness	Universal Testing Machine		Appendix XI IRS-T-12-2009 & ASTM E399	Min Mean Kic 32 MPa m½ & Min single Kic 30 MPa m½	Review	Comply
		Fatigue test	Fatigue Testing Machine		Clause 22.3 of IRS-T-12-2010 & ASTM E606.	Each sample should endure 10 million cycles at strain of 0.00166	Review	No Failure
2	Templates & Gauge	Theoretical Rail profile & stipulated maximum tolerances	02 sets of plus & minus limit gauges made of steel in accordance with stipulated max & min tolerances to be submitted for approval by purchaser.		Clause 3 of IRS-T-12-2009			Submitted
3	Steel Making/ Manufacture	Basic Oxygen & continuous casting		Throughout the manufacturing process	Clause 5 of IRS-T-12-2009			Comply
4	Vacuum Degassing of liquid steel	Vacuum Degassing	REDA	Throughout Manufacturing process-Every Heat	IRS-T-12-2009 with uptodate amendments			Comply
5	Hydrogen content in liquid steel	Pin Sample method	Pin Sample method	Throughout Manufacturing process-Every Heat		level of hydrogen in liquid steel - 1.6 ppm (Max).	Witness	Comply
6	Chemical analysis of liquid steel	C 0.6-0.8 % Mn 0.8- 1.3 % Si 0.10- 0.50 % S 0.030* P 0.030* Al 0.015 Cr 0.30(Max) V 0.01	Ladle Sample analysis/ Quantometer	a complete ladle sample of each cast	IRS-T-12-2009 with uptodate amendments	Ladle sample analysis as per method specified in IS: 228. Alternatively equivalent procedure as per ASTM will be also acceptable. Copy of results shall be submitted to inspecting agency in the proforma at Appendix VII of IRS-T-12-2009	Review	Comply
	Bloom	Bloom Size -300x400 mm(approx.) as indicated by Rail Manufacturing Plant NSSMC (Area of C/s of 60 KG rail is 76.70 cm.cm)		Throughout Manufacturing process	IRS-T-12-2009 with uptodate amendments	The cross sectional area of bloom shall not be less than ten times that of the rail section.	Review	Comply

7		Bloom tracking	CPU	All blooms		Bloom to carry Heat No ,Strand No & Bloom No	Review	Comply
8	Rolling & Marking	Brand Marks	Hot Branding on Finish Roll	Each Rails	IRS-T-12-2009 with uptodate amendments	Brand marks of suitable size clearly legible shall be rolled in relief on one side of web at Max 5m interval as per circumference of roll.	Witness for 03 pieces of samples	Comply
						The brand mark shall include a) rail section b) grade of steel c) identification mark of manufacturer d) Month(using Roman) & last two digits of year & e) process of steel making ('O' or 'E') **(For NSSMC as per Fig 2)**		Comply
		(Hot stamping)	Hot Stamp Machine	Each Rails	IRS-T-12-2009 with uptodate amendments	Each rail distictly hot stamped atleast once every 5.0m on the web in figures & letters of suitable size having information i) the number of cast from which the rails has been rolled with letter "C" ii) Number of the strand iii) for rails from change over bloom. cast number should be the preceding cast number with prefix "B". **(NSSMC Hot stamping as per Figure 2)**		Comply
		(Cold Punching)		Inspected Rails	Clause 8 .3 of IRS-T-12-2009 with upto date amendments	water proof sticker affixed at one end having Purchaser ID, shift no of product inspected & date of producer inspection. **(NSSMC adopt sealed stamp in accordance with Fig 3)**		Comply
		Drilled / Undrilled Rail End	Undrilled	Each Rails		Undrilled		Comply
9	Straightening	Straightness	Straightening Machine	Each Rails (Throughout Manufacturing process)	Clause 9 of IRS-T-12-2009	Max permissible deviation on 1.5m straight edge shall be 0.7 mm		Comply
10	Heat Treatment	Inline established deep head hardening methods		Each Rails (Throughout Manufacturing process) Hardness test on 10% of the rolled length rails	IRS-T-12-2009 with uptodate amendments	Hardness of Rail head surface shall be between 340- 390 BHN.	Review	Comply

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11	Rail testing	Ultrasonic testing		Online ultrasonic testing machine (Standard test piece to be reported to the purchaser)	Each Rails	IRS-T-12-2009 with uptodate amendments	Permissible defects as per IRS-T-12-2009 with updated amendments	Review	Comply
		(Eddy current testing)		online eddy current tester	Each Rails			Review	Comply
12	Chemical analysis of Finished product	C	0.6-0.8 %	Quantometer/ Spectrometer	one test per cast for ≤ 150t & two per cast for casts > 150 tons.	IRS-T-12-2009 with uptodate amendments	The percentage of each specified element shall confirm to the limits specified in table-1 of clause 7 of IRS-T-12-2009.	Witness (01 test per shipment) others reviewed	Comply
		Mn	0.8- 1.3 %						
		Si	0.10- 0.50 %						
		S	0.030* (* 0.035 for finished Rail)						
		P	0.030* (* 0.035 for finished Rail)						
		Al	0.015						
		Cr	0.30						
		V	0.01						
13	Finished Rail Inspection (Tensile Test & other Mechanical properties)	Yield Strength		Tensile Testing Machine with Test piece specimen having dia 6 mm with gauge length 3.54D or 21mm	one test per 1000 m rail from one heat	IRS-T-12-2009 with uptodate amendments	460 Mpa (Min)	Witness (01 test per shipment) others reviewed	827 Mpa
		Ultimate Tensile Strength					1080 Mpa (Min)		1240 Mpa
		Elongation %					10 % (Min)		13%
		Brinell Hardness test		Hardness testing machine	one test per 1000 m heat treated rail	IRS-T-12-2009 with uptodate amendments	340-390 HBN		359 BHN
		Hardness distribution		Transversely Cut Rail sections (Fig-8/IRS-T-12)	10% of the rolled length rails		No sharp drop in hardness. The hardness 10mm below rail head at centre- Min 340 BHN & 15 mm below- Min 315 BHN		Comply
		Falling weight test (After Heat treatment)		Falling Weight test machine	one test per cast	IRS-T-12-2009 with uptodate amendments	Weight of TUP used is 1270 Kg & Height of Drop 7.4 m .		Not Broken
		Sulphur Print test (Macrographic Examinationto)		Acid Bath & Photographic paper	one Print per cast for ≤ 150t & two per cast for casts > 150 tons	IRS-T-12-2009 with uptodate amendments	limit prints in the album of macrographic prints in Appendix VIII of IRS-T-12-2009		Comply
		Inclusion rating level		Microscope	once every day	IRS-T-12-2009 with uptodate amendments	Record of test results communicated to purchaser.		Comply
		Macro-structure Test		macrographic prints	one test per 1000 Meter Rail				Comply
		Microstructure		viewed under microscope X100 & X500 magnification	one test per 1000 m rail from one heat				Comply

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14	Finished Rail Inspection (Sections & Dimensions)	Overall height of Rails	Template & Gauge	Each Rails	IRS-T-12-2009 with uptodate amendments	(+ 0.8) mm & (-0.4) mm	Witness for 03 pieces of samples	Comply
		Width of Head				± 0.5 mm		
		Width of Flange				(+1.2)mm & (-1.0 mm)		
		Thickness of Web				(+ 1.0) mm & (-0.5) mm		
		Verticality/Asymmetry				± 1.2 mm		
		Flange		Each Rails		The base of the rail shall be true & flat, a slight Concavity not exceeding 0.4 mm shall be permissible.		
		Fishing surface		Each Rails		Fishing surface not to stand away from web contour by more than 1.2 mm & clearance at fishing surface not to exceed 0.2 mm at any point		
		End Squareness		Each Rails		Deviation from square in horizontal & vertical directions shall not exceed 0.60 mm on a length of 200 m		
		Length of Rail (18 M)	Measuring roller/Cold Saw	Each Rails		(+20mm) & (-10mm) Standard Rail length is 18m . Short lengths in pairs of 15m & 17m rails not to exceed 10% of supply.		
		Weight of Rails		one test per cast		the actual weight of Rail shall fall within 0.5 percent below and 1.5 percent above the calculated weight shown **(as per Fig 1 for NSSMC)**		
		Straightness	Straight Edge 1.5m /Naked Eye	Each Rails		Max permissible deviation on 1.5m straight edge shall be 0.7 mm		
		End Straightness (Horizontal)	Gauge	Each Rails		Max Deviation of 0.5 mm measured on 2 m standard straight edge		
		End Straightness (Vertical)		Each Rails		Upsweap deviation on 2 m standard straight edge -0.4 mm & Dnsweap deviation-Nil.		

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15	Finished Rail Inspection (Surface Quality)	Hot Marks	Visual inspection or online Eddy current tester	Each Rails	IRS-T-12-2009 with uptodate amendments	Depth of rolling guide Marks anywhere on the rail should not exceed 0.5 mm & width not to exceed 4.0mm. There should not be more than two guide marks per rail	Witness for 03 pieces of samples	Comply
		Cold Marks				Depth of longitudinal or transverse cold formed scratches anywhere on the rail not to exceed 0.5 mm		
		Seams				greater than 0.2 mm in depth are not acceptable		
		dressing				On running surface max 0.3 mm & on other locations 0.5 mm		
		Protrusions on web				Greater than 1.5 mm high & 20 mm square		
		Protrusions other than web				No Protrusions in head or foot of Rails.		
		Shrinkage cavity, inclusion & segregation				Visible to naked eye not acceptable		
16	Color Code	Rails shall be painted to distinguish Grade, Class, length & other special requirements	Color Painting	Each Rails	IRS-T-12-2009 with uptodate amendments	As Per Color code for Rails in Appendix IV. **(as per Fig 4 for NSSMC)**	Witness for piled rails at warehouse.	Comply
17	Inspection	Stamping (Inspection Agency's Stamp)	After inspection, every accepted rail shall be clearly stamped with the Inspecting Agency's stamp at one end in presence of Inspection Agency & painted as per color code specified in clause 8.4.		IRS-T-12-2009 with uptodate amendments			Comply
18	Rail Loading	Method of Loading	Visual	Each Rails	IRS-T-12-2009 with uptodate amendments	As per Fig 5 & 6 for NSSMC	Witness for piled rails at warehouse.	Comply
19	Lifting	Method of Lifting	Visual	Each Rails	IRS-T-12-2009 with uptodate amendments	NSSMC's method to be indicated		Comply
18	Warranty	USFD Testing	The manufacturer warrants that the rails would be free from manufacturing defects for a period of 25% of service life of rails i.e. 200 GMT traffic.					Comply

Note:- 1. Supplier shall ensure compliance of all clauses of IRS-T-12-2009 including addendum & correction slips & ITP as above.

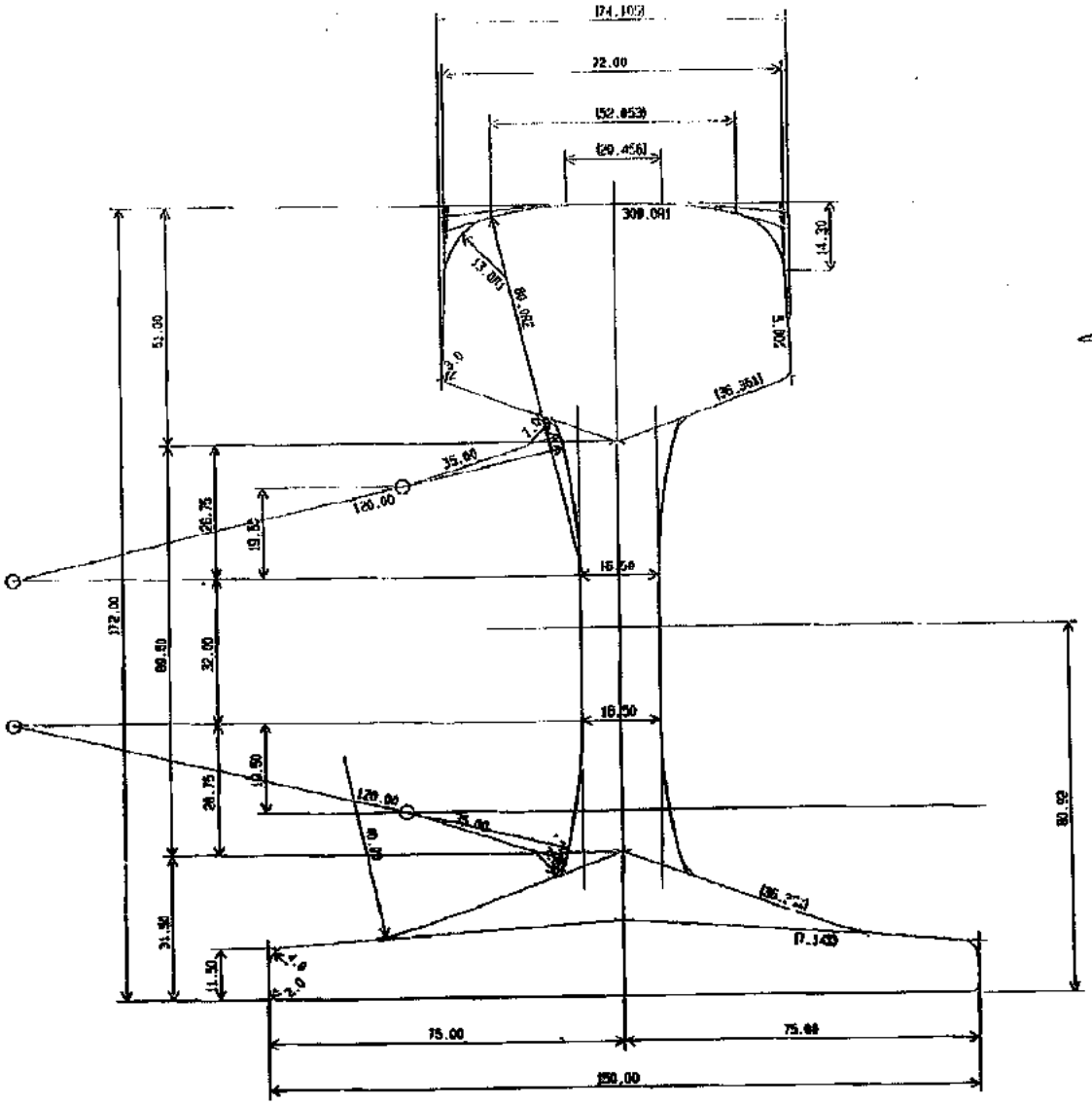


Figure 1 Profile of 60E1 (Calculated weight 60.21kg per meter)

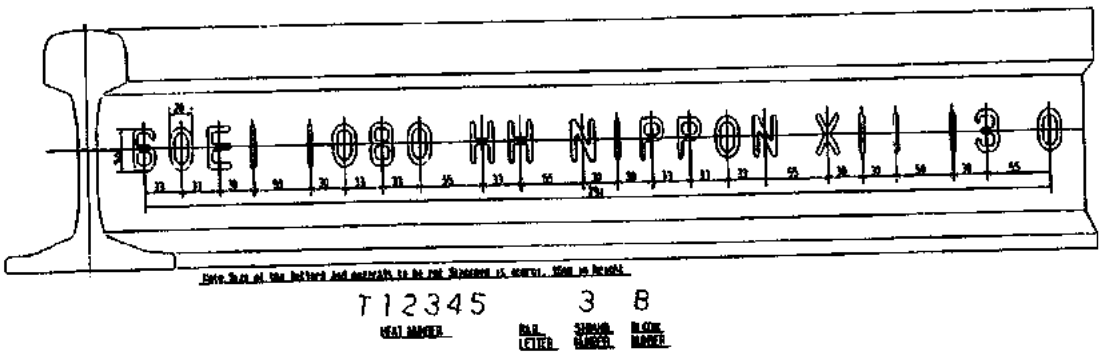


Figure 2 Hot stamping and Hot branding

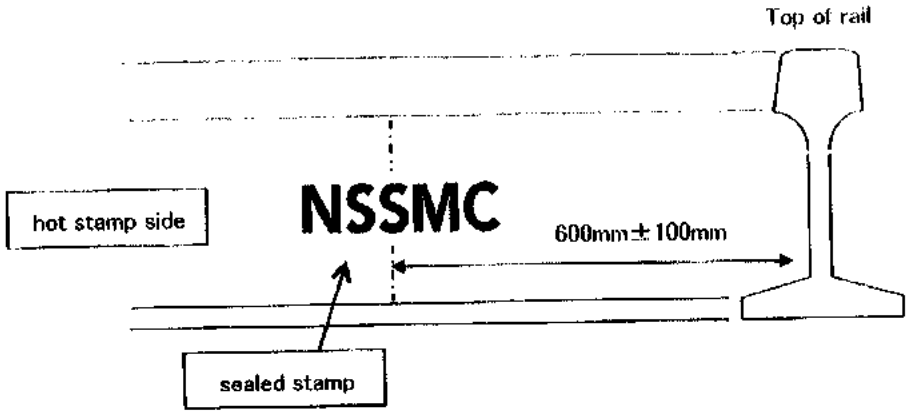
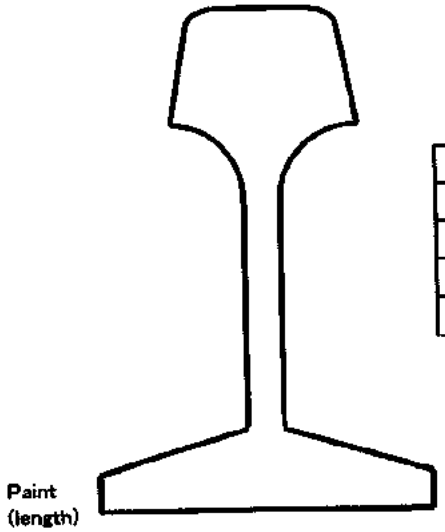


Figure 3 Manufacturer's stamp



Length	Paint (length)
18	pink
17	blue
15	yellow
13	green

Figure 4 Colour code

NSSMC's standard is as follows:

- Dunnages are to be placed as follows:
- The sectional size of the dunnage is 80mm in width and 60mm in height and is placed in two-fold.
- The rails are to be stacked 12-fold maximum.

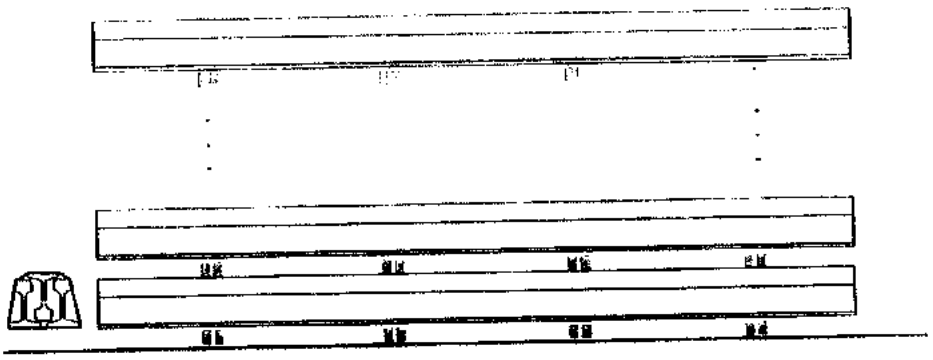
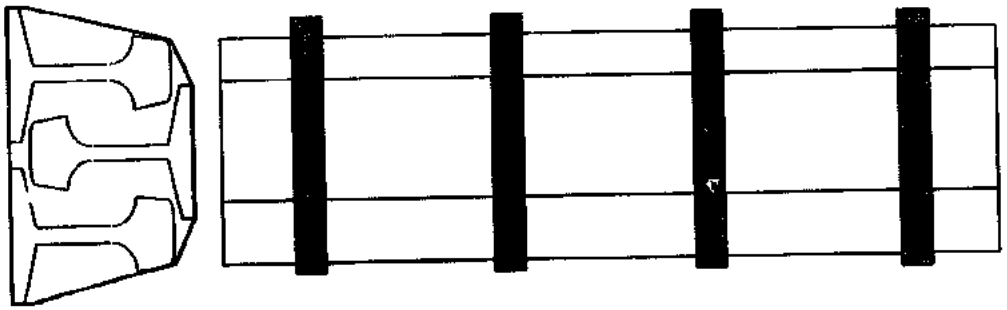


Figure 5 Stacking



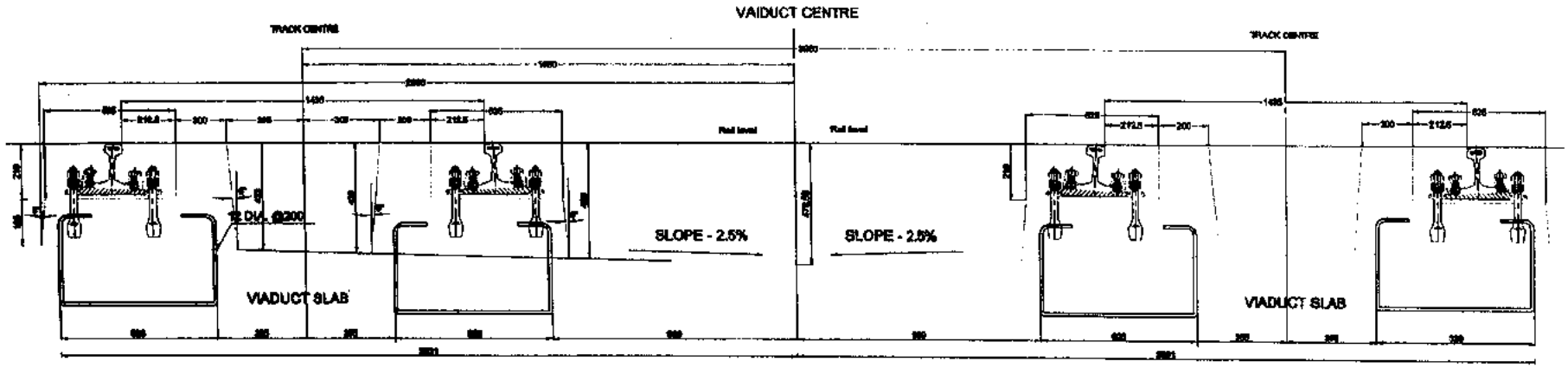
On at least one side of package/bundles the following address shall be written in English with permanent paint

CONTRACT LKT-1
LUCKNOW METRO RAIL CORPORATION
INSTALLLMENT NO. ...
(Total Gross Weight of Installment) ...MT
NIPPON STEEL & SUMITOMO METAL CORP.

Figure 6 Packing

Annexure-4, B
(Vol-I)

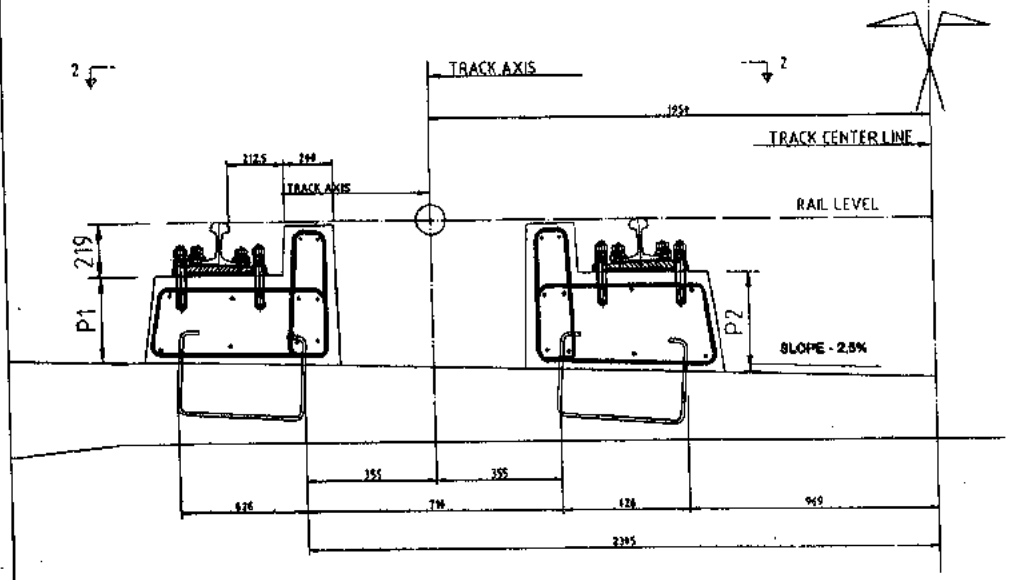
TYPICAL CROSS SECTION OF TRACK STRUCTURE ON VIADUCT SLOPING INWARD W.R.T. STANDARD GAUGE



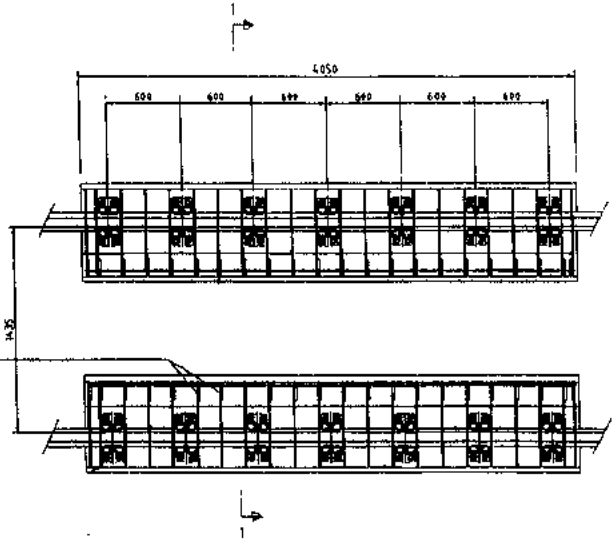
LUCKNOW METRO RAIL CORPORATION LTD.	TRACK
BALLASTLESS TRACK PLINTH	
LKT-S-VIADUCT001	

Annexure-B
(2/12)

TYPICAL SECTION IN STRAIGHT ALIGNMENT ON VIADUCT STRUCTURES



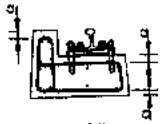
SECTION 1 - 1



PLAN VIEW 2 - 2

NOTES :

1. REFER TO GENERAL NOTES
2. RAIL PLINTHS :
   FOR CONCRETE OUTLINE DRAWINGS ,LKT-6-VIADUCT-001
3. THIS DRAWING MUST BE READ IN CONJUNCTION STARTER BARS REINFORCEMENT DRAWINGS .
4. CONCRETE COVER:



C1 : 25MM MIN.
C2 : 40MM MIN.

5. ALL PLINTHS REINFORCEMETS ARE H12 TYPE
6. OVERLAP OF BOTH RINGS SHALL BE MINIMUM 600MM

NOTES-

PLINTH HEIGHT OUTSIDE STATION AREA.
P1 = MINIMUM VALUE IS 185 mm - CAN VARY UP TO 250 MM TO FULFIL INTERFACE REQUIREMENT
P2 = 240 MM GENERALLY - CAN VARY UPTO 305MM TO FULFIL INTERFACE REQUIREMENT

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL DIMENSIONS ARE TO BE READ AND NOT SCALED.
3. ANY DISCREPANCIES SHALL BE BROUGHT TO THE NOTICE OF THE ENGINEER-IN-CHARGE IMMEDIATELY FOR RESOLUTION BEFORE PROCEEDING WITH THE WORK.
4. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, STRUCTURAL, PLUMBING & FIRE PROTECTION, ELECTRICAL AND BUILT ENVIRONMENT DRAWINGS.

This drawing must not in whole or part or used for any purpose without the prior written permission of LMRC.

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PHASE I A N.S CORRIDOR OF LUCKNOW MRTS

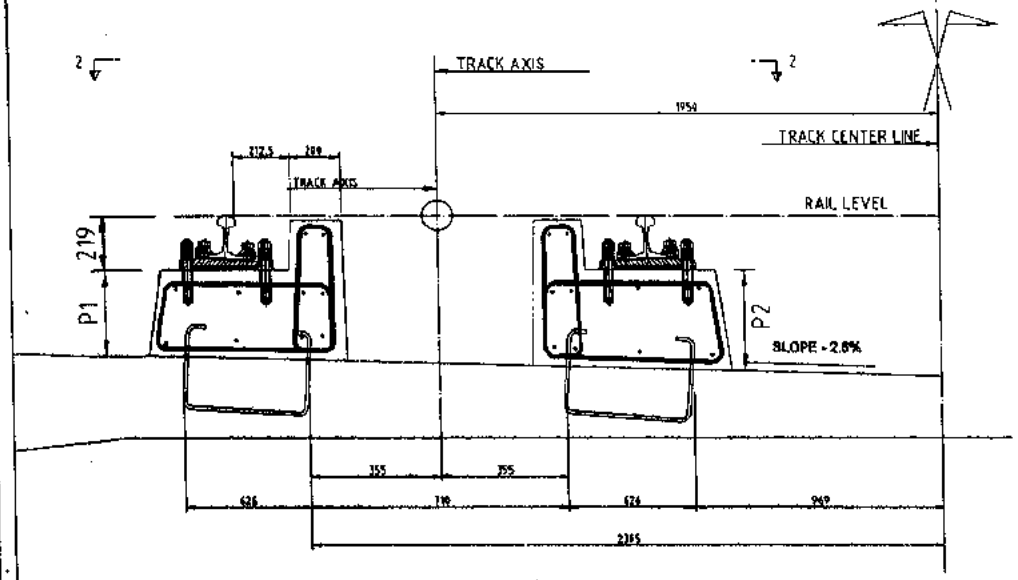
PLINTH.REINFORCEMENT.IN.STRAIGHT

1 | LKT-6-VIADUCT-002 | ISSUE: INDICATIVE

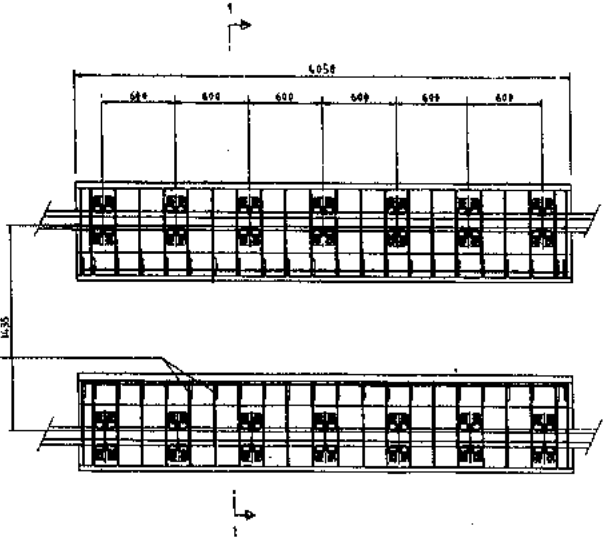
TRACK

Annexure B
(3/12)

TYPICAL SECTION IN STRAIGHT ALIGNMENT ON STATION



SECTION 1 - 1

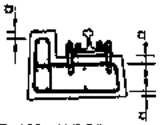


STIRRUPS AND SHEAR CONNECTORS SPACING @200mm

PLAN VIEW 2 - 1

NOTES :

1. REFER TO GENERAL NOTES
2. RAIL PLINTHS :
   FOR CONCRETE OUTLINE DRAWINGS , LKT-6-VIADUCT-002
3. THIS DRAWING MUST BE READ IN CONJUNCTION STARTER BARS REINFORCEMENT DRAWINGS .
4. CONCRETE COVER:



C1 : 25MM MIN.
C2 : 40MM MIN.

5. ALL PLINTHS REINFORCEMENTS ARE H12 TYPE

NOTES:

PLINTH HEIGHT INSIDE STATION AREA:
P1 = VARIES FORM 340 TO 400
P2 = VARIES FORM 390 TO 450

PLAN VIEW 2 - 2

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS ARE TO BE READ AND NOT SCALED.
3. ANY SKEW ANGLE MUST BE CHECKED WITH NOTES IN THE CONCRETE OUTLINE DRAWING BEFORE WORK IS DONE.
4. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, STRUCTURAL, FURNISH & FIRE FIGHTING, ELECTRICAL AND TRAPE MANAGEMENT DRAWINGS.

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LUCKNOW METRO RAIL CORPORATION LTD

PHASE I A N.S CORRIDOR OF LUCKNOW MRTS

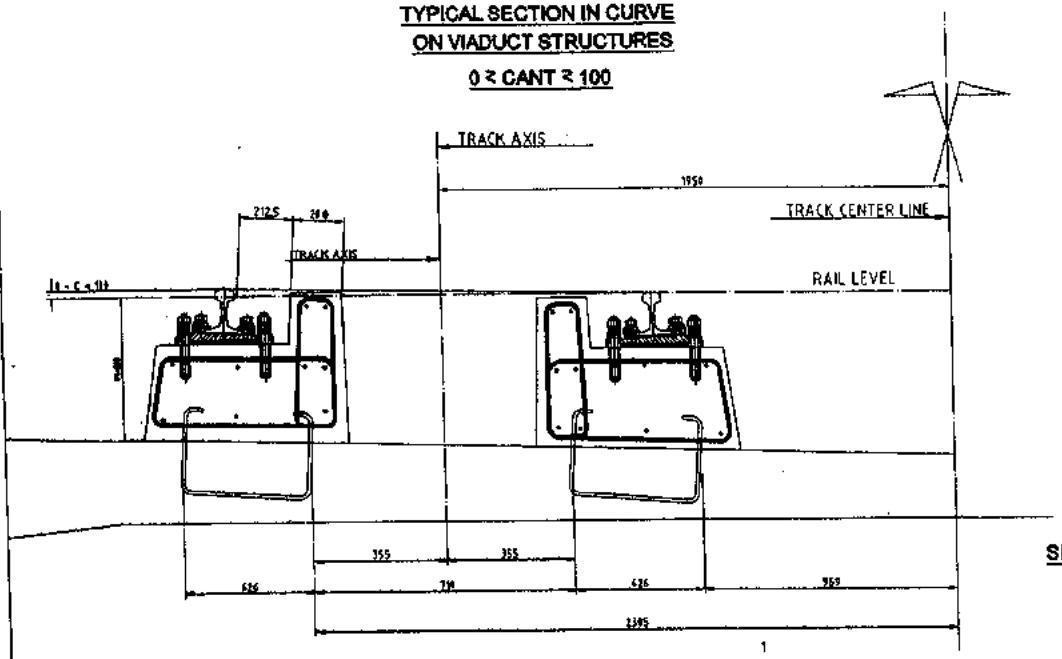
PLINTH.REINFORCEMENT.IN.STRAIGHT

1	LKT-6-VIADUCT-003		INDICATIVE	TRACK

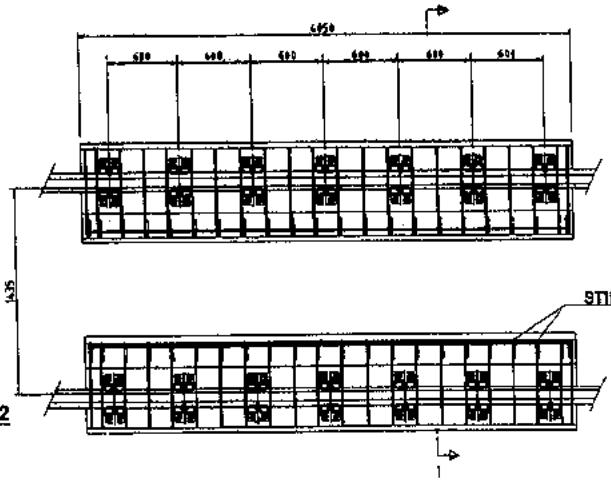
Annexure-B
(4/12)

TYPICAL SECTION IN CURVE ON VIADUCT STRUCTURES

0 ≤ CANT ≤ 100



SECTION 1 - 1



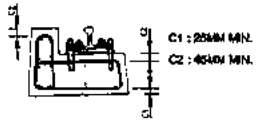
PLAN VIEW 2 - 2

NOTE:

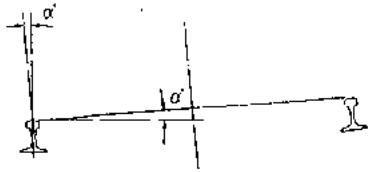
1.-THE SIZE OF REINFORCEMENT WILL BE INCREASED / DECREASED TO SATISHFY FOLLOWING CONDITION FOR CANTED TRACK

a. CONCRETE COVER C1 VARIES FROM 25mm FOR CANT=0 UP TO 65mm FOR CANT=100mm

b. CONCRETE COVER C2 VARIES FROM 45mm FOR CANT=0 UP TO 55mm FOR CANT=100mm



2.-PRINCIPLE OF ROTATION FOR TRACK IN CURVE



3.-P1, MINIMUM VALUE IS 185mm

4.-ALL PLINTHS REINFORCEMETS ARE H12 TYPE

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL DIMENSIONS ARE TO BE READ AND NOT MEASURED.
3. ANY DISCREPANCIES NOTED IN CONNECTION WITH THE WORK OF THE VARIOUS AGENCIES SHALL BE BROUGHT TO NOTICE OF SITE.
4. THE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, STRUCTURAL, PLUMBING & FIRE FIGHTING, ELECTRICAL AND OTHER SERVICE DRAWINGS.

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LUCKNOW METRO RAIL CORPORATION LTD.

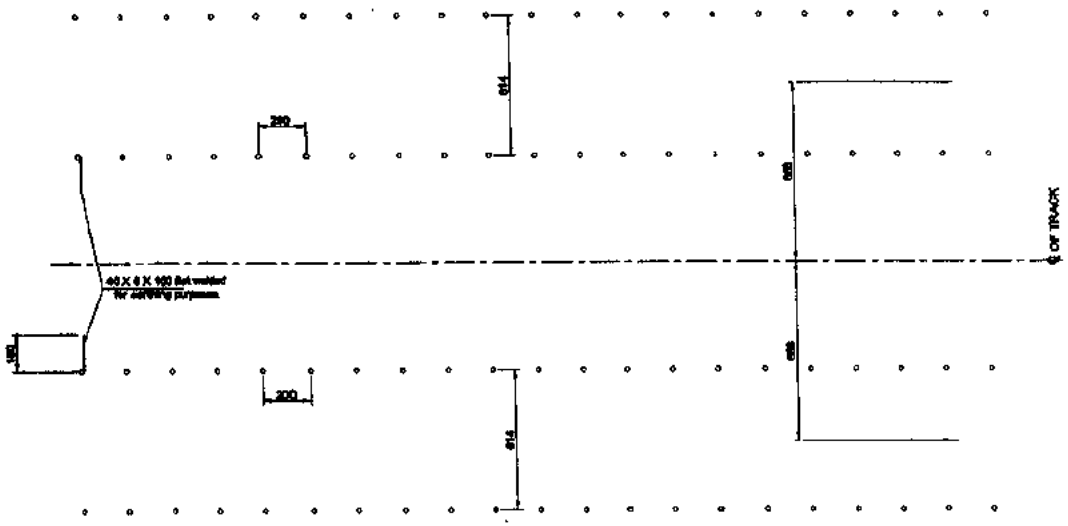
PHASE 1A N-S CORRIDOR OF LUCKNOW MRTS

PLINTH.REINFORCEMENT.IN.CURVE

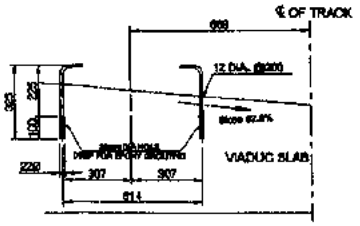
1	LKT-S-VIADUCT-004	SCALE: INDICATIVE	REVISION:	SHEET OF

Annexure-B
(5/12)

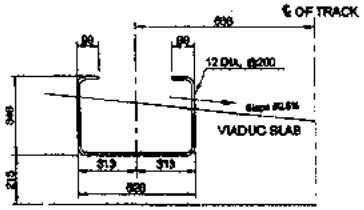
SHEAR CONNECTORS ARRANGEMENT - PLAN VIEW



PLAN VIEW



CROSS SECTION VIEW
WHERE VIADUCT ALREADY CAST



CROSS SECTION VIEW
WHERE VIADUCT STILL TO BE CAST

27/6/2016

Notes :
1. Detail of Plinth with reinforcement in separate drawing.
2. Material of Hook : TOR Se 415 HYSD Bar

GENERAL NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. ALL DRAWINGS ARE TO BE READ AND USED WITH ...
3. ANY ERRORS AND/OR OMISSIONS TO BE REPORTED TO THE ENGINEER BEFORE COMMENCEMENT OF WORK AT SITE.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, STRUCTURAL, PLUMBING & FIRE FIGHTING, ELECTRICAL AND TRAFFIC AND OTHER DRAWINGS.

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LUCKNOW METRO RAIL CORPORATION LTD

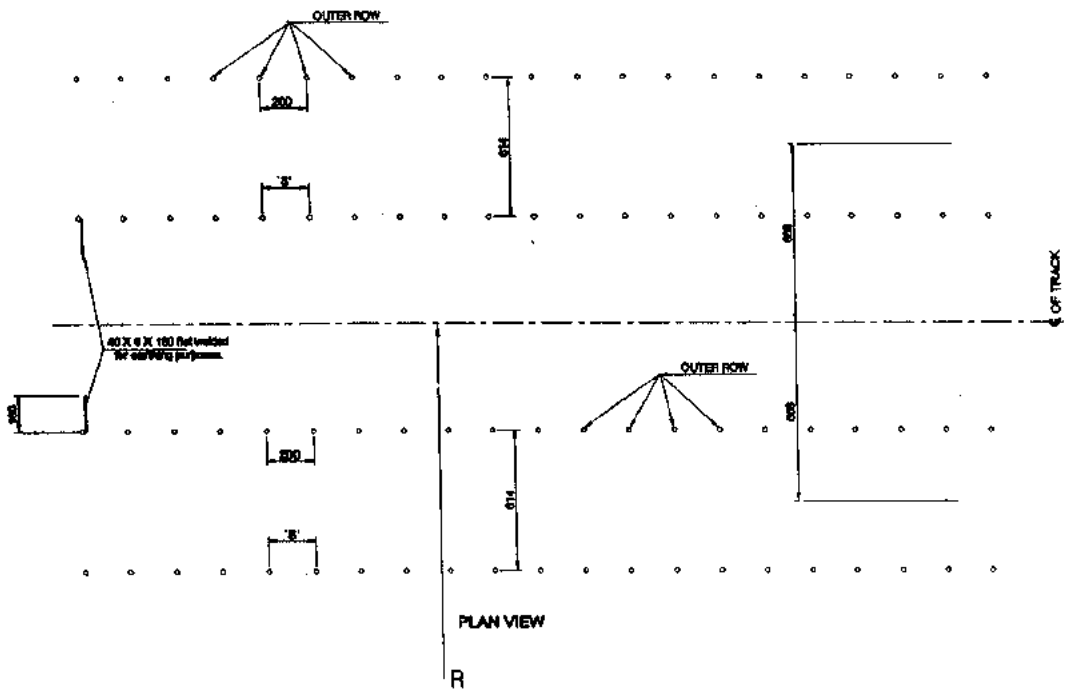
PHASE I A N.S CORRIDOR OF LUCKNOW MRTS

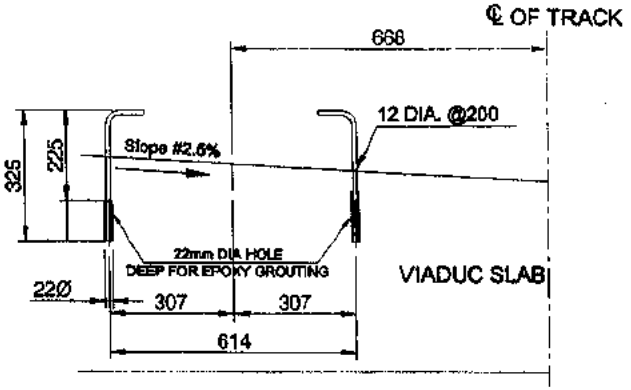
BALLASTLESS TRACK - SHEAR CONNECTORS ON STRAIGHT

LKT-6-VIADUCT-005 | INDICATIVE | TRACK

Annexure - B (6/12)

SHEAR CONNECTORS ARRANGEMENT - PLAN VIEW





CROSS SECTION VIEW
OF VIADUCT

Notes :

1. Spacing 'S' will depend upon radius of the curve.
2. Imaginary line joining corresponding shear connectors of each plinth to be radial.
3. Material of Hook : TOR Se 415 HYSD Bar

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL DIMENSIONS ARE TO BE READ AND NOT SCALED.
3. ANY MINOR DISCREPANCY OF DIMENSIONS TO BE BROUGHT TO THE NOTICE OF THE ENGINEER-IN-CHARGE FOR CORRECTION BEFORE ANY WORK.
4. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, STRUCTURAL, PLUMBING & FIRE FIGHTING, ELECTRICAL AND WORKS MANAGEMENT DRAWINGS.

LUCKNOW METRO RAIL CORPORATION LTD.

PHASE : A N-S CORRIDOR OF LUCKNOW MRTS

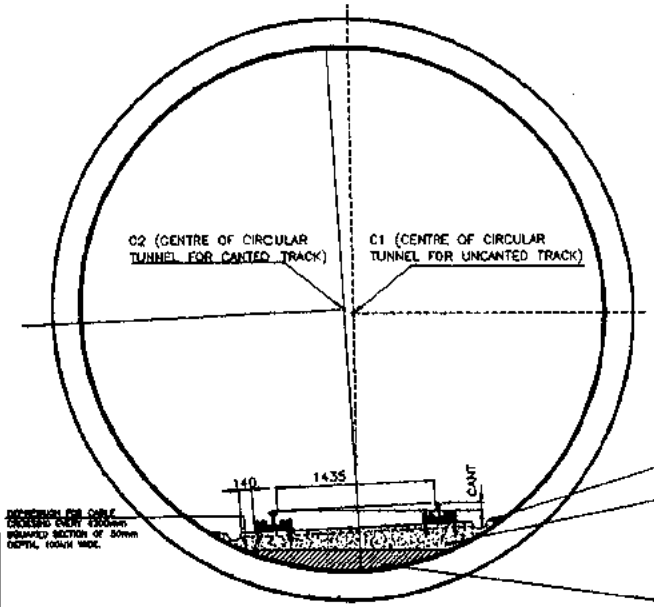
RAIL CORRIDOR BALLASTLESS TRACK - SHEAR CONNECTORS ON CURVE

1 | LKT-6-VIADUCT-008 | INDICATIVE

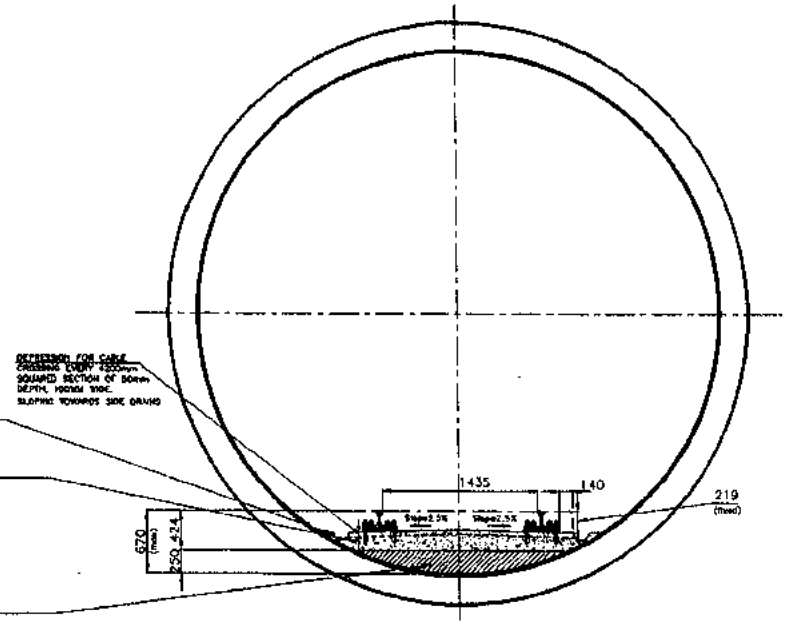
TRACK

Annexure-B
(7/12)

CIRCULAR TUNNEL ON CANTED TRACK



CIRCULAR TUNNEL ON TANGENT TRACK



NOTE:

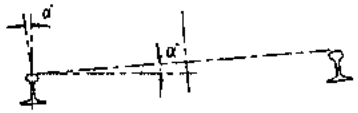
1.-ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE NOTED.

2.-INSTALLATION OF SHEAR CONNECTORS :
SEE DWG BT-07-CIRCULAR TUNNEL-005

3.-SLAB REINFORCEMENT : SEE DWG LKT-5-CIRCULAR TUNNEL-004

4.-SLAB CONCRETE : GRADE M35

5.-PRINCIPLE OF ROTATION FOR TRACK IN CURVE



6.-ON CANTED TRACK THE CENTRE OF THE CIRCULAR TUNNEL WILL BE SHIFTED LATERALY & VERTICALLY WITH RESPECT TO ITS POSITION WITHOUT CANT AND THE VALUES OF THESE SHIFTS SHALL BE OBTAINED BY THE CONTRACTOR FROM CIVIL CONTRACTOR DULY INTERFACING

7.- MINIMUM THICKNESS OF SECOND POUR SLAB BELOW RAIL SEAT IS 175MM.

8.- CROSS SLOPE ON THE SLAB TOP & LONGITUDINAL DRAINS AS SHOWN ABOVE SHALL BE PROVIDED BY CONTRACTOR IN CIRCULAR TUNNEL.

9.- TRACK FORM IN STATION AREAS (CIRCULAR/BOX TUNNEL) SHALL ALSO BE RCC SLAB TYPE. ON THESE LOCATIONS THE WIDTH/DIMENSIONS OF THE SLAB AND ALSO THE LONGITUDINAL & CROSS DRAINAGE WITHIN THE TRACK WORK & ITS CONNECTION TO MAIN DRAINAGE SYSTEM (TO BE PROVIDED BY CIVIL CONTRACTOR) SHALL BE DONE BY THE CONTRACTOR DULY INTERFACING WITH THE CIVIL CONTRACTOR AND AS APPROVED BY THE ENGINEER.

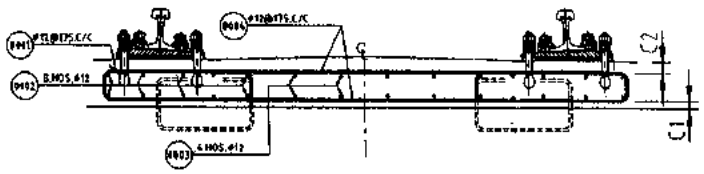
10.- TYPICAL VALUE OF SECOND POUR SLAB DEPTH IS 205mm HOWEVER AT ISOLATED LOCATIONS, THIS DEPTH MAY BE VARRIED UP TO 310mm WITHOUT ANY EXTRA PAYMENT TO FULFILL VARIOUS INTERFACE SYSTEM REQUIRMENTS, TO MAINTANE REQUIRED CLEARANCE/DISTANCES.

25/6/2016

LUCKNOW METRO RAIL CORPORATION LTD.	
UNDERGROUND.TYPICAL.CROSS.SECTIONS_-SLAB.IN.CIRCULAR.TUNNEL	TRACK
LKT-5-CIRCULAR.TUNNEL-001	REV INDICATIVE

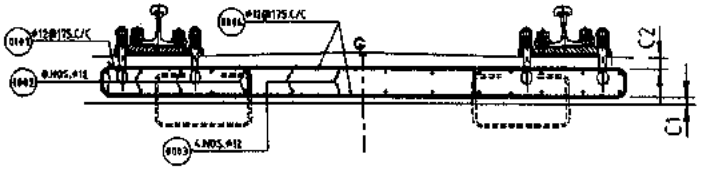
Annexure B
(9/12)

TYPICAL SECTION OF SLAB REINFORCEMENT IN STRAIGHT



SCALE : 1/10

TYPICAL SECTION OF SLAB REINFORCEMENT IN CURVE



SCALE : 1/10

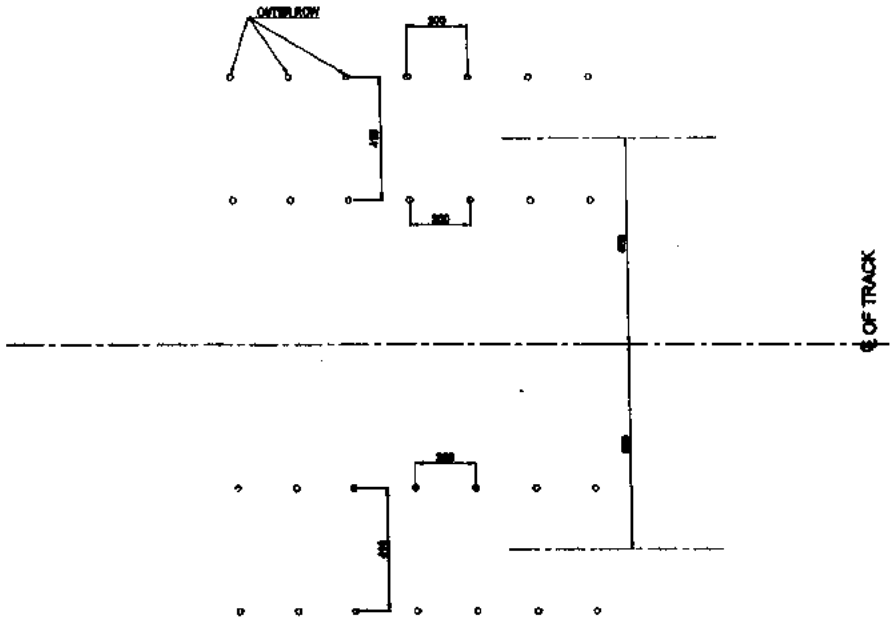
NOTE:

1. ALL DIMENSION ARE IN MM UNLESS OTHERWISE NOTED.
2. CONCRETE COVER:
   C1 : 25MM MIN.
   C2 : 45MM MIN.
3. ALL STEEL REINFORCEMENT IS TOR Fe 415 GRADE.
4. ALL PLINTH REINFORCEMENT IS H-12 TYPE
5. THE SIZE OF REINFORCEMENT WILL BE INCREASED / DECREASED TO SATISHFY FOLLOWING CONDITION FOR CANTED TRACK
   a. CONCRETE COVER C1 VARIES FROM 25mm FOR CANT=0
      UP TO 55mm FOR CANT=100mm
   b. CONCRETE COVER C2 VARIES FROM 45mm FOR CANT=0
      UP TO 55mm FOR CANT=100mm

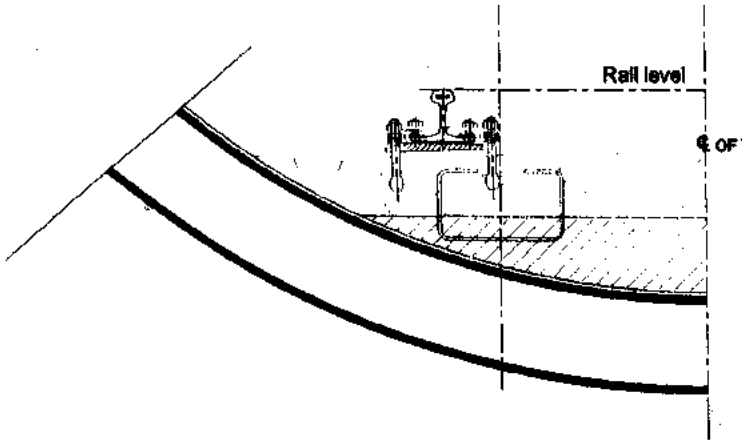
LUCKNOW METRO RAIL CORPORATION LTD.	TRACK
UNDERGROUND CORRIDOR - TYPICAL SLAB REINFORCEMENT IN CIRCULAR TUNNEL & STATION AREA	
LKT-5-CIRCULAR.TUNNEL-004	INDICATIVE

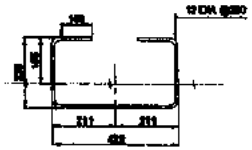
Annexure B
(9/12)

SHEAR CONNECTORS ARRANGEMENT - PLAN VIEW

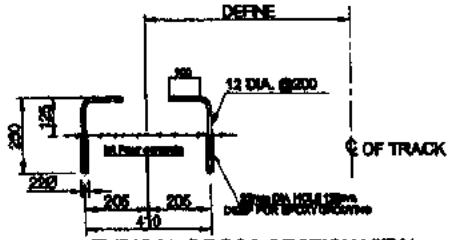


TYPICAL DETAIL





TYPICAL CROSS SECTION VIEW (WHERE SHEAR CONNECTORS HAVE BEEN PROVIDED WITH FIRST POUR CONCRETE)



TYPICAL CROSS SECTION VIEW (WHERE SHEAR CONNECTORS HAVE NOT ALREADY BEEN PROVIDED)

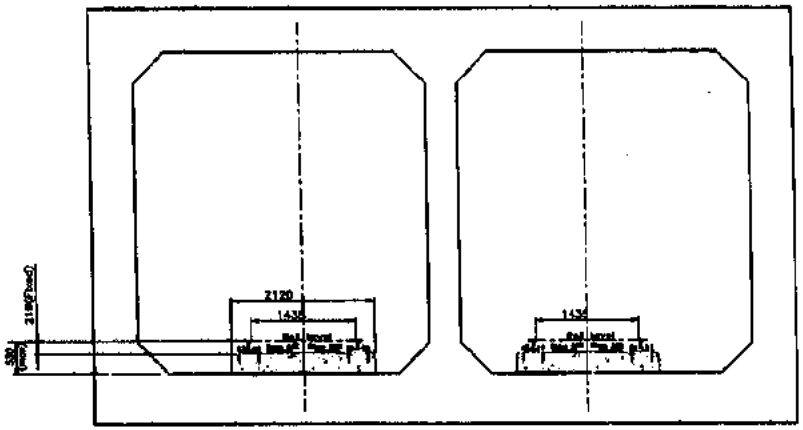
Note :

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE NOTED.
2. MATERIAL OF SHEAR CONNECTOR : TOR Fe 415 GRADE
3. THE ACTUAL DETAILS AND THE DIMENSIONS OF THE SHEAR CONNECTORS, WHERE ALREADY PROVIDED, SHALL BE OBTAINED BY THE CONTRACTOR FROM THE CIVIL CONTRACTOR DULY INTERFACED.
4. THE DISTANCE OF SHEAR CONNECTORS FROM CENTRE OF THE TRACK SHALL BE DEFINED BY THE CONTRACTOR AT THE LOCATIONS WHERE SHEAR CONNECTORS HAVE NOT ALREADY BEEN PROVIDED DULY APPROVED BY ENGINEER.

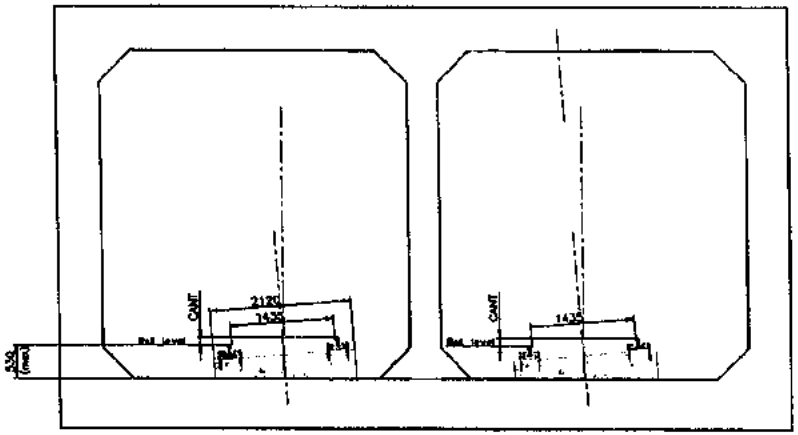
	LUCKNOW METRO RAIL CORPORATION LTD.	TRACK
	UNDERGROUND/CORRIDOR/SHEAR CONNECTOR FOR ALIGN CIRCULAR TUNNEL AND IN STATION AREAS	
	LKT-5-CIRCULAR TUNNEL-005	

Annexure-9
(10/12)

BOX TUNNEL TANGENT TRACK



BOX TUNNEL CURVED TRACK



NOTE: 1.-ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE NOTED

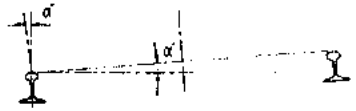
2.-INSTALLATION OF SHEAR CONNECTORS :
SEE DWG LKT-5-BOX.TUNNEL-005

3.-PLINTH REINFORCEMENT : SEE DWG ST-07-BOX.TUNNEL-004

4.-FIRST STAGE/SUPPORT CONCRETE : TO BE DONE BY CIVIL CONTRACTOR.

5.-PLINTH CONCRETE : GRADE M35

6.-PRINCIPLE OF ROTATION FOR TRACK IN CURVE



7.-MINIMUM DEPTH OF PLINTH CONCRETE BELOW RAIL SEAT 185MM.

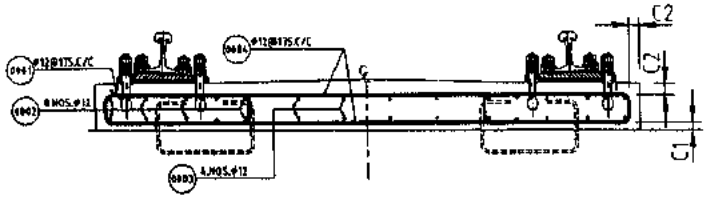
8.- TYPICAL VALUE OF SECOND POUR SLAB DEPTH IS 205mm HOWEVER AT ISOLATED LOCATIONS,THIS DEPTH MAY BE VARRIED UP TO 310mm WITHOUT ANY EXTRA PAYMENT TO FULFILL VAROIUS INTERFACE SYSTEM REQUIRMENTS, TO MAINTAIN REQUIRED CLEARANCE/DISTANCES.

27/6/16

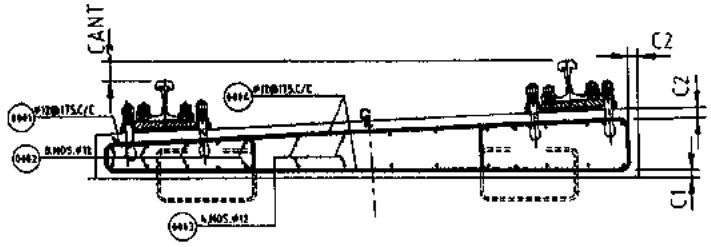
LUCKNOW METRO RAIL CORPORATION LTD.	TRACK
UNDERGROUND.CORRIDOR.TYPICAL.CROSS.SECTION.-.PLINTH.IN.BOX.TUNNEL	
LKT-5-BOX.TUNNEL-001	INDICATIVE

Annexure-B (11/12)

TYPICAL SECTION OF PLINTH REINFORCEMENT IN STRAIGHT



TYPICAL SECTION OF PLINTH REINFORCEMENT IN CURVE



SCALE : 1/10

27/6/2016

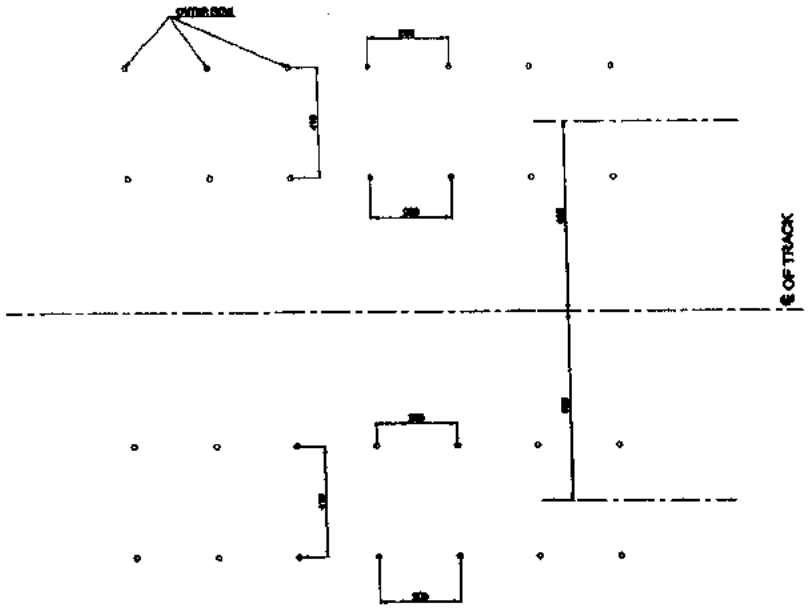
NOTE:

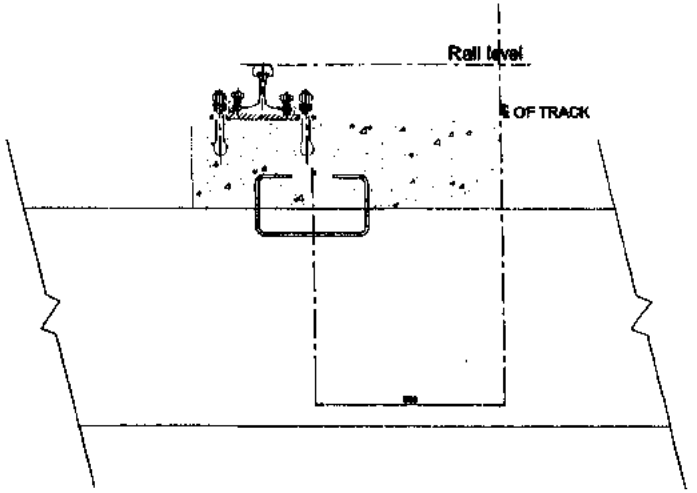
1. ALL DIMENSION ARE IN MM UNLESS OTHERWISE NOTED.
2. CONCRETE COVER:
   C1 : 25MM MIN.
   C2 : 45MM MIN.
3. ALL STEEL REINFORCEMENT IS TOR Fe 415 GRADE.
4. ALL PLINTH REINFORCEMENT IS H-12 TYPE
5. THE SIZE OF REINFORCEMENT WILL BE INCREASED / DECREASED TO SATISHFY FOLLOWING CONDITION FOR CANTED TRACK
   a. CONCRETE COVER C1 VARIES FROM 25mm FOR CANT=0 UP TO 55mm FOR CANT=100mm
   b. CONCRETE COVER C2 VARIES FROM 45mm FOR CANT=0 UP TO 55mm FOR CANT=100mm

LUCKNOW METRO RAIL CORPORATION LTD.	TRACK
UNDERGROUND CORRIDOR - TYPICAL PLINTH REINFORCEMENT BOX TUNNEL	
LKT-5-BOX.TUNNEL-004	INDICATIVE

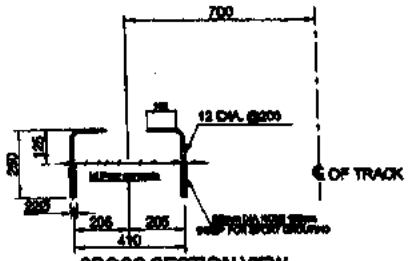
Annexure-A
(13/12)

SHEAR CONNECTORS ARRANGEMENT - PLAN VIEW





CROSS SECTION VIEW
(WHERE SHEAR CONNECTORS HAVE BEEN
PROVIDED WITH FIRST POUR/SUPPORT CONCRETE)



CROSS SECTION VIEW
(WHERE SHEAR CONNECTORS HAVE NOT
ALREADY BEEN PROVIDED)

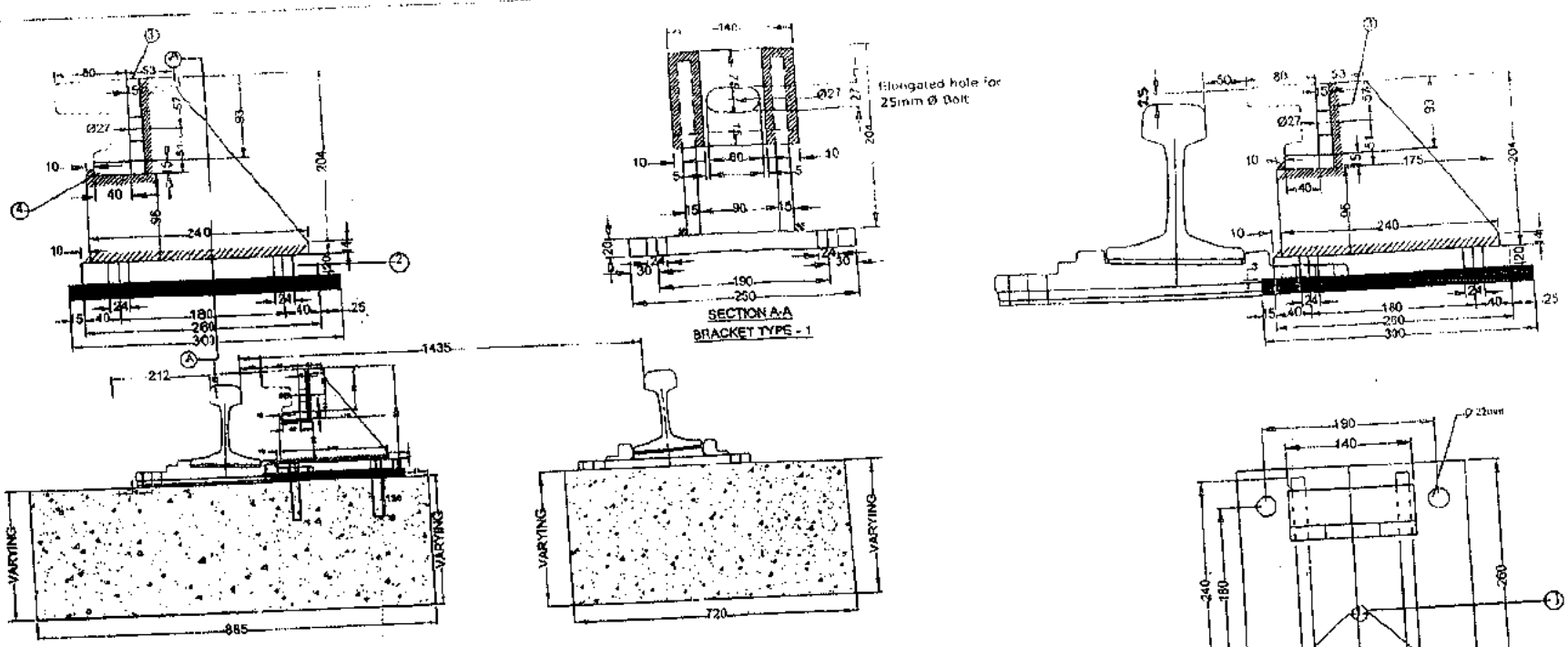
Note :

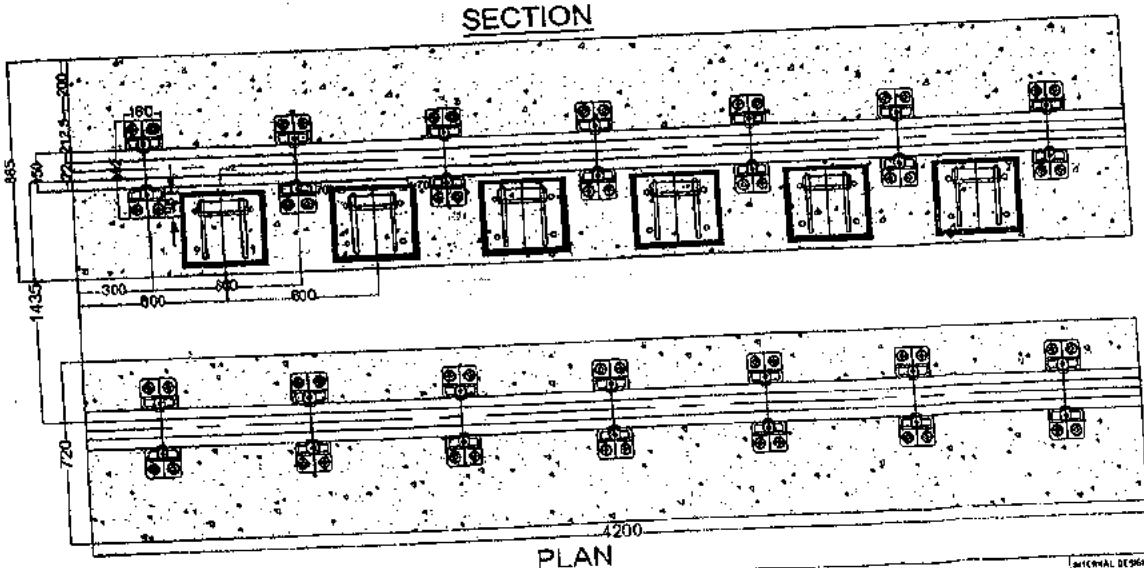
1. All dimensions are in mm unless otherwise noted.
2. Material of Shear Connector : TOR Fe 415 GRADE

29/12/2016

LUCKNOW METRO RAIL CORPORATION LTD.	
UNDERGROUND CORRIDOR SHEAR CONNECTOR DETAILS FOR PLINTH IN BOX TUNNEL	
LKT-6-BOX TUNNEL-005	INDICATIVE

TRACK





Note : 1. Bracket Type 2 at checkrail joints & Bracket Type 1 at rest of locations.
2. Material to be used shall be IS: 2062 Gr. 'B'
3. All Welding Should be 10 mm Fillet welding
4. Grouting below GI plate using Sika 53 (UF) or equivalent.
5. Ht of Grout to be confirmed on site
6. Anchor bolt shall be HTS 8.8 grade with min. strength 65kn length 220 MM and Ø22 MM and L50 MM under the concrete .
7. Bol for Check Rail 25ØMM
8. Check Rail will be UIC 33

CHECK RAIL PLATE DETAIL

SL NO	DESCRIPTION	QTY
1	PL 15mmx240mmx195	2Nos
2	PL 20mmx250mmx260	1No
3	PL 15mmx108mmx140	1No
4	PL 15mmx40mmx140	1No

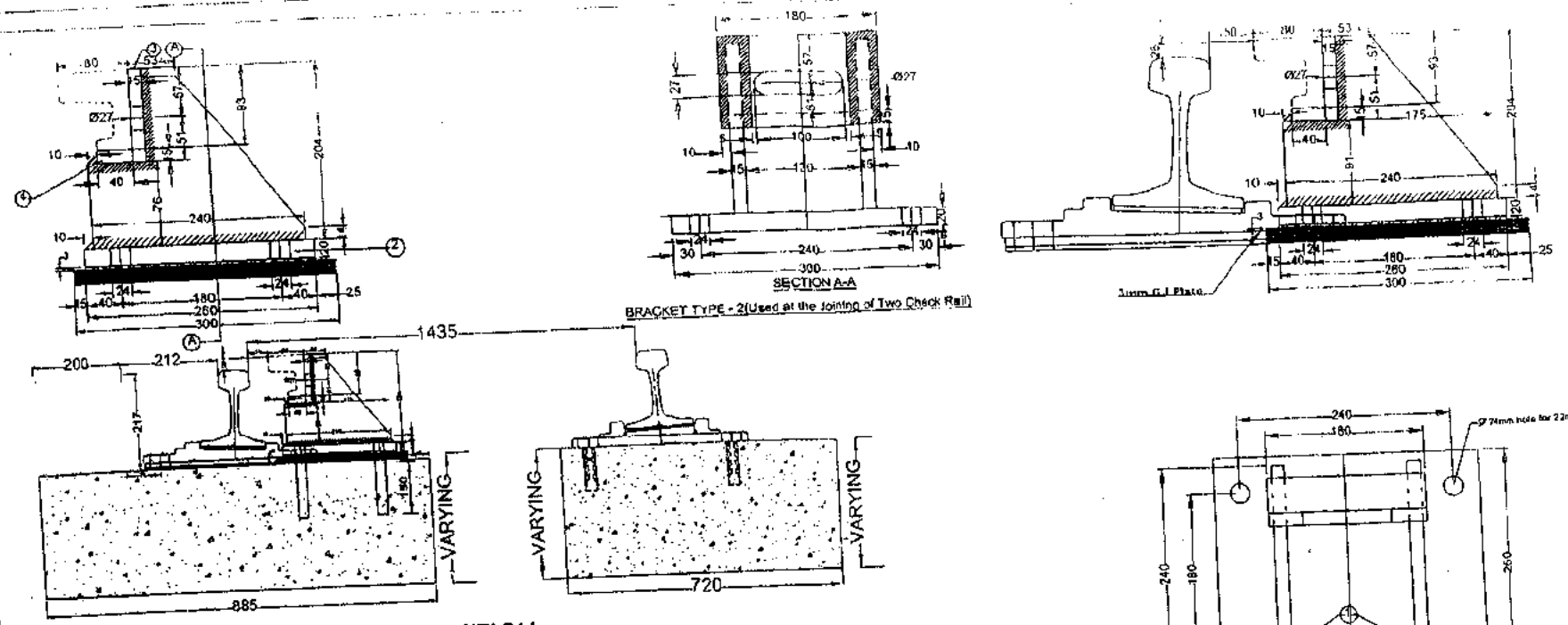
(S.K. AGRAWAL)
A. EN/Track
Delhi Metro Rail Corpn. Ltd.
9, Jantar Mantar, New Delhi

MATERIAL DESIGN NAME	STATUS		
PREPARED BY ANAND SINGH	SCALE:	DATE: 25-04-2012	
CHECKED BY	FORMAT:		

DELHI METRO RAIL CORP LTD

PROJECT:
GALVANIZED M.S. BRACKET TYPE - 1 FOR UIC - 33 CHECK RAIL FLANGE WAY GAP 50 MM

DWG.No.:- DMRC/TRACK/JAIPUR/DWG-CR-001 REV.:-0



Note : 1. Bracket Type 2 at checkrail joints & Bracket Type 1 at rest of locations.
2. Material to be used shall be IS: 2062 Gr. 'B'
3. All Welding Should be 10 mm Fillet welding
4. Grouting below GI plate using Sika 63 (UF) or equivalent.
5.Height of Grout to be confirmed on site
6.Anchor bolt shall be HTS 8.8 Grade min Stength 65KN,Length 220mm,Ø22mm& 150mm under concrete.
7.Bolt for Check RailØ25mm

CHECK RAIL PLATE DETAIL		
SL NO	DESCRIPTION	QTY
1	PL 15mmx240mmx195	2Nos
2	PL 20mmx300mmx260	1No
3	PL 15mmx108mmx180	1No
4	PL 15mmx40mmx100	1No

(S.K. AGRAWAL)
A. EN/Track
Delhi Metro Rail Corpn. Ltd.
8, Jantar Mantar, New Delhi

DELHI METRO RAIL CORP LTD

PREPARED BY ANAND SINGH
CHECKED BY
SCALE:
FORMAT
DATE:
STATUS:

PROJECT: JAIPUR METRO RAIL CORP.
GALVANIZED M.S. BRACKET TYPE - 2 FOR UIC - 60 CHECK RAIL PLANED WAY GAP 50 MM

DWG NO DMRC/TRACK/JAIPUR/DWG-CR-004 REV :-0