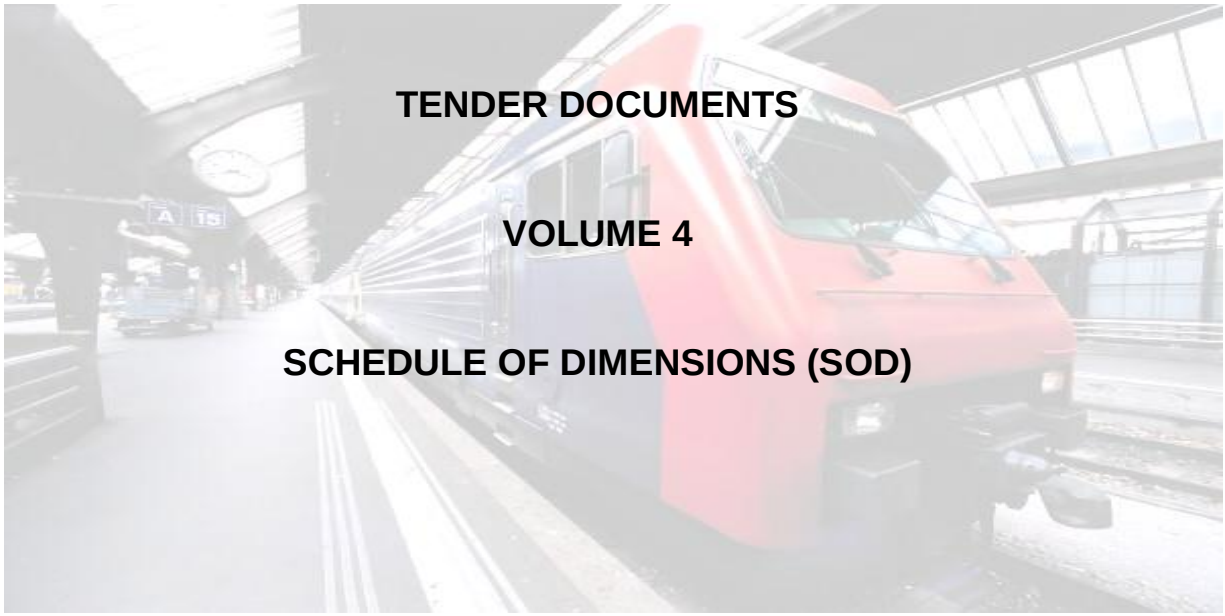
KOLKATA METRO RAIL CORPORATION LIMITED
EAST WEST METRO PROJECT

CONTRACT RS (3R)

DESIGN, MANUFACTURE, SUPPLY, TESTING, COMMISSIONING AND INTEGRATION OF PASSENGER ROLLING STOCK (ELECTRICAL MULTIPLE UNITS), AND TRAINING OF PERSONNEL



TENDER DOCUMENTS

VOLUME 4

SCHEDULE OF DIMENSIONS (SOD)

Date of Issue: January 9, 2015

KOLKATA METRO RAIL CORPORATION LIMITED

KMRCL Bhawan (HRBC Office Complex),

Munshi Premchand Sarani,

Kolkata 700 021

India

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CONTRACT RS (3R)

SUMMARY OF TENDER DOCUMENTS

Volume 1

- Notice of Invitation to Tender
- Instructions to Tenderers (including Annexures)
- Eligibility Criteria Documents
- Form of Tender (including Appendices)

Volume 2

- General Conditions of Contract
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- Employer's Requirements – General Specification
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- Safety, Health and Environment (SHE) Manual
- SHE Conditions of Contract

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SCHEDULE OF DIMENSIONS

FOR

STANDARD GAUGE (1435 mm)

April 2013

KOLKATA METRO RAIL CORPORATION LIMITED
KMRCL Bhawan, (HRBC Office Complex),
Munshi Premchand Sarani,
Kolkata 700 021
India

SCHEDULE OF DIMENSIONS (STANDARD GAUGE, 1435 mm)

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KOLKATA METRO EAST WEST LINE PROJECT

SCHEDULE OF DIMENSIONS – 1435 mm GAUGE

PREAMBLE

The Schedule of Dimensions for Standard Gauge Kolkata East West line has been prepared based on the following:-

1. The dimensions given in this Schedule of Dimensions are to be observed in all works on 1435 mm gauge (Standard Gauge) railway.

2. This Schedule of Dimensions is applicable to Underground, Elevated and Surface (At-Grade) sections with 750 Volt D.C. Traction system and Third Rail for current collection adjacent to the track. The Rolling Stock details are provided in chapter 3 of this Schedule of Dimensions (SOD). The Rolling stock will have sealed windows and doors will be closed while in motion.

3. The Underground system may run within a Circular Tunnel or Rectangular Box or any other suitable shape while Elevated system may run on suitable Over Ground structures such as Viaducts. Both Underground and Elevated systems shall have suitably designed Ballastless (DFF) Track. The At-grade system may have Ballasted Track, or if necessary, Ballastless track.

4. The Kinematic Envelope indicated in the SOD shall not be violated under any circumstances except for designated railway operational structures such as platform edges, platform screen doors, Third rail arrangements.

5. No fixed structure should infringe the Structure Gauge except for designated railway operational structures. Designated railway operational structures include platform edges, platform screen doors, emergency walkways, Third rail arrangements.

The Schedule of Dimensions (SOD) has been divided into four chapters as under

Chapter-1	----------	General
Chapter-2	----------	Station yards
Chapter-3	----------	Rolling Stock
Chapter-4	----------	Electric Traction

CHAPTER-1 GENERAL

1.1 SPACING OF TRACKS

1.1.1 Minimum distance, between centre to centre of tracks on Tangent (Straight) alignment, without any structure located between the tracks, shall be:

a)	Underground Sections	3650 mm
b)	Elevated Sections	3750 mm
c)	Surface (At-Grade) Sections (Ballastless section)	3750 mm
d)	Surface (At-Grade) Sections (Ballasted section)	3800 mm

Note: For minimum track centres on curves, refer to Appendix-1

1.2 CURVES

1.2.1 Minimum radius of curves (horizontal)

i) On main running lines

a) Underground Sections, 200 m (Minimum)

b) Elevated and At-Grade Sections, (without check rails) 190 m (Minimum)

Absolute Minimum radius (with check rails) 120 m

ii) Depot and other Lines, (without check rails) 140 m (Minimum)

(with check rails) 100 m (Minimum)

iii) At passenger Stations, 1000m (Minimum)

1.2.2 Minimum radius of vertical curve, 1500 m

1.3 BUILDINGS AND STRUCTURES

1.3.1 Minimum horizontal distance from centre of track to any structure (except a passenger platform and Conductor Rail (Third Rail) for heights above rail level on tangent track on level/constant grade shall be as under:

a) Underground Sections (Circular Tunnel and Rectangular Box Tunnel)

	Height from rail level	Distance from C.L. of track	
(i)	Up to 75 mm	1670 mm increasing to	1705 mm
(ii)	75 mm to 920 mm	1705 mm	
(iii)	920 mm to 1765 mm	1705 mm increasing to	1770 mm
(iv)	1765 mm to 3150 mm	1770 mm increasing to	1805 mm
(v)	3150 mm to 3550 mm	1805 mm decreasing to	1450 mm
(vi)	3550 mm to 3975 mm	1450 mm decreasing to	610 mm
(vii)	3975 mm	610 mm decreasing to	zero

Also refer to Figure No.2 (TNL)

b) Elevated Sections, At Grade (Ballastless Track) Sections

	Height from rail level	Distance from C.L. of track	
(i)	From R.L. to 360 mm	1755 mm	
(ii)	At 360 mm	1755 mm decreasing to	1650 mm
(iii)	360 mm to 960 mm	1650 mm increasing to	1760 mm
(iv)	960 mm to 1760 mm	1760 mm increasing to	1820 mm
(v)	1760 mm to 3090 mm	1820 mm increasing to	1855 mm
(vi)	3090 mm to 3555 mm	1855 mm decreasing to	1560 mm
(vii)	3555 mm to 4025 mm	1560 mm decreasing to	610 mm
(viii)	At 4025 mm	610 mm decreasing to	zero

Also refer to Figure No.2 (ELE/AG)

c) Surface (At-Grade) Sections (Ballasted Track)

	Height from rail level	Distance from C.L. of track	
(i)	From R.L to 88 mm	1765 mm	
(ii)	From 88 to 3085 mm	1880 mm	
(iii)	3085 mm to 3515 mm	1880 mm decreasing to	1585 mm
(iv)	3515 mm to 4035 mm	1585 mm decreasing to	505 mm
(v)	At 4035 mm	505 mm decreasing to	zero

Also refer to Figure No.2 (AG)

Notes for (a), (b) and (c) above:

i) Extra allowance shall be provided for curves as laid down at para 1.6.

ii) The term ‘structure’ covers any item including light ones like ladders, isolated posts, cables etc. erected alongside the track.

1.4 KINEMATIC ENVELOPE

For Kinematic Envelope for level or constant grade tangent track, refer to:

a) Figure No. 1(TNL/AG/ ELE) for Underground, At-Grade and Elevated Sections with Ballastless Track.

b) Figure No. 1(AG) for Surface (At-Grade) Sections with Ballasted Track.

1.5 STRUCTURE GAUGE

1.5.1 Underground sections

The Structure Gauge (Fixed Structure Line) has been arrived at by allowing a minimum clearance of 100 mm to Kinematic Envelope.

Refer to Figure No.2 (TNL) for Structure Gauge for underground sections (Outside station) with Ballastless Track for level constant grade tangent track.

Note: Extra allowance shall be provided for curves as laid down at para 1.6

1.5.2 Elevated Sections and Surface (At-Grade) section with Ballastless track.

The Structure Gauge (Fixed Structure Line) has been arrived at by allowing a minimum clearance of 150 mm to Kinematic Envelope.

Refer to Figure No.2(ELE/AG) for Structure Gauge on Elevated Sections and At-Grade Sections (outside station) with Ballastless Track for level/constant grade tangent track.

Note: Extra allowance shall be provided for curves as laid down at para 1.6

1.5.3 Surface (At-Grade) Sections (Ballasted Track)

The Structure Gauge (Fixed Structure Line) has been arrived at by allowing a minimum clearance of 150 mm to Kinematic Envelope.

Refer to Figure No.2 (AG) for Structure Gauge on At-Grade sections (outside stations) with Ballasted Track for level/constant grade tangent track.

Note: Extra allowance shall be provided for curves as laid down at para 1.6

1.6 EXTRA CLEARANCES ON CURVES

Following are the extra allowances considered for curves.

Abbreviations used in para 1.6:

- **C** is the distance between centres of bogies in metres,
- **C_1** is the coach (vehicle) length in metres,
- **R** is the radius of curve in metres,
- **Ca** is the Cant applied in mm,
- **h** is the height from rail level in mm and
- **g** is the distance between centres of rails in mm.

1.6.1 Inside of curve

(A) Curvature effect

i) Mid throw at the center of the vehicle = V (in mm)

$= 125 \times C^2/R$

ii) Allowance due to gauge widening on curves

For values of curvature effect, refer to:

Appendix-2(TNL/ELE/AG) for Underground, Elevated/At Grade Ballastless Sections

Appendix-2(AG) for surface (At-Grade) Ballasted Sections

Note:

a) Underground , Elevated and At-Grade Ballastless Sections

A lateral shift of 34 mm due to nosing is included in the Kinematic Envelope for Underground, Elevated and At-Grade Sections with Ballastless Track for tangent track (and as a result, also included in Structure Gauge) which shall be subtracted from the total extra allowance worked out as at para 1.6.1(A) above if the value of mid throw (V) is equal to or greater than 34 mm. However, if the value of mid throw (V) is less than 34 mm, the curvature effect shall be due to widening of the gauge only (Mid throw minus 34 mm shall be taken as zero).

b) At-Grade (Surface) Ballasted Sections

A lateral shift of 37 mm due to nosing is included in the Kinematic Envelope for Surface (At-Grade) Sections with Ballasted Track for tangent track (and as a result, also included in Structure Gauge) which shall be subtracted from the total extra allowance worked out as at para 1.6.1(A) above if the value of mid throw (V) is equal to or greater than 37 mm. However, if the value of mid throw (V) is less than 37 mm, the curvature effect shall be due to widening of the gauge only (Mid throw minus 37 mm shall be taken as zero).

(B) Allowance for Cant

a) Underground (Box structures) Elevated and At-Grade (Surface) sections

The lean 'L' due to Cant at any point at height 'h' above rail level is given by:

L = Ca x h/g (all in mm)

For values of Structure Gauge (E_1) for inside of a curve with only the cant effect, as shown in Figure 4, refer to:

(i) Appendix -3(TNL) for Box structures of Underground Sections

(ii) Appendix -3(ELE/AG) for Elevated and At Grade Ballastless Sections

(iii) Appendix -3(AG) for Surface (At-Grade) Ballasted Sections

b) Circular Tunnels

In the case of Circular Tunnel, the cant is provided by raising the outer rail and suitably shifting the centre of the Circular Tunnel towards inside of curve and upwards. This has same effect as assuming rotation of the Circular Tunnel about midpoint of top of inner rail, resulting in shift of Tunnel centre laterally towards inside of curve and also vertically upwards.

For values of horizontal and vertical shifts of centre of Circular Tunnel for different values of cant, refer to Appendix-4 (TNL) and Figure No.-3.

(C) Vertical Throw (allowance for vertical curve)

Values of Vertical Throw V_1 and V_2 (in mm) for vertical curves shall be calculated as under :

V_1 (with vehicle centre in sag or vehicle end on summit) = $125\frac{C^2}{R}$

V_2 (with vehicle centre on summit or vehicle end in sag) = $\left[125\frac{C_1^{\ 2}}{R}\right] - \left[125\frac{C^2}{R}\right]$

Value of Vertical Throw V_1 & V_2 due to vertical curves of different radii are shown in Figure 5.

1.6.2 OUTSIDE OF CURVE

(A) Curvature effect

(i) End throw at the end of vehicle = Vo (in mm)

= $[125xC_1^2/R]-[125xC^2/R]$

(ii) Allowance due to gauge widening on curves

(iii) Additional nosing due to gauge widening on curves

The values of items (i) to (iii) are shown in Appendix-2(TNL/ELE/AG) and 2(AG).

(B) Allowance for Cant

a) Elevated, Surface and box sections of Underground

The lean 'L' due to Cant at any point at height 'h' above rail level is given by:

L = (-) Ca x h/g (all in mm)

-ve (negative) sign indicates relief due to cant or reduction in clearance required.

Note:

Full relief for lean due to cant (Ca) is to be taken into account only for calculation of track spacing without any structure between tracks. In case there is a structure adjacent to track, relief for lean is to be taken into account only if the cant provided is greater than 50 mm and shall be limited to a value = (Ca - 50) x h/g.

For values of Structure Gauge (F_1) on outside of curve with cant effect only as shown in Figure-4, refer to:

(i) Appendix 3(TNL) for Underground sections(Rectangular Box)

(ii) Appendix 3(ELE/AG) for Elevated and At-Grade Ballastless sections.

(iii) Appendix 3(AG) for Surface (At-Grade) Ballasted sections

b) Circular Tunnels

In the case of Circular Tunnel, the cant is provided by raising the outer rail and suitably shifting the centre of the Circular Tunnel towards inside of curve and upwards. This has same effect as assuming rotation of the Circular Tunnel about midpoint of top of inner rail resulting in shift of Tunnel centre laterally towards inside of curve and also vertically upwards.

For values of horizontal and vertical shifts of centre of Circular Tunnel for different values of cant, refer to Appendix-4 (TNL) and Figure-3.

(C) Allowance for Vertical Curve (Vertical Throw)

The provision at para 1.6.1 (c) above shall be applicable in this case also. Values of vertical throw V_1 and V_2 due to vertical curves of different radii are shown in Figure 5.

1.7 MINIMUM TRACK SPACING ON CURVES

Underground, Elevated and Surface Sections

The worst case will be when the end of a bogie carriage on the inner track is opposite the centre of a similar carriage on the outer track.

1.7.1 Without any structure between tracks

The minimum track spacing on curves without any structure between tracks shall be the sum of the following:

(i) (E + F),

(ii) T_1 (Extra lateral allowance due to curvature on inside of curve)

(iii) T_2 (Extra lateral allowance due to curvature on outside of curve)

(iv) Minimum clearance between adjacent Kinematic Envelopes stipulated as under:

a) 200 mm for Underground Sections

b) 300 mm for Elevated Sections

c) 300 mm for Surface (At-Grade) Sections and

Where,

E is the distance from vertical axis of centre line of tangent track to canted Kinematic Envelope on inside of curve at a height 'h' (from rail level) for a given cant (Figure-4A) and

F is the distance from vertical axis of centre line of tangent track to canted Kinematic Envelope on outside of curve at a height 'h' (from rail level) for a given cant (Figure-4A).

Notes:

a) The value of 'F', calculated from the formula at Figure 4A includes full relief due to Cant.

b) The sum of 'E' and 'F' for same height (which are with cant effect only), shall be the maximum of values calculated for various heights from rail level.

1.7.1.1 For values of E, F, T_1 and T_2, refer to the Appendices as shown below:

	SECTIONS	For E & F	For T_1 &T_2
(i)	UG,Elev,At-Grade BLT	3A(TNL/ELE/AG)	2(TNL/ELE/AG)
(ii)	Surface (At-Grade)Ballasted	3A(AG)	2(AG)

1.7.2 With a structure between adjacent tracks

The minimum track spacing on curves with a structure between tracks shall be the sum of the following:

(i) **(E_1 +T_1)** Minimum clearance to the structure from centre line of track on inside of curve (for outer track)

(ii) **(F_1 +T_2)** Minimum clearance to the structure from centre line of track on outside of curve (for inner track)

(iii) Width of structure between adjacent tracks (measured across the tracks).

Where,

E_1 is the horizontal distance from vertical axis of centre line of tangent track to canted Structure Gauge on inside of curve for a given cant,

F_1 is the horizontal distance from vertical axis of centre line of tangent track to canted Structure Gauge on outside of curve for a given cant,

T_1 is extra lateral allowance due to curvature on inside of curve and

T_2 is extra lateral allowance due to curvature on outside of curve

Notes:

a) The values of **E_1** and **F_1** for a given cant Ca, shall each be the maximum of values at different heights of structure from rail level. In case the cant provided is greater than 50 mm on inner track, the value of **F_1** shall be for the cant of (Ca-50) mm. In case the cant provided is 50 mm or less on inner track, the value of **F_1** shall be for ZERO cant.

b) Minimum track spacing, so worked out with a structure between the adjacent tracks shall not be less than that calculated as per para 1.7.1 for tracks without any structure between adjacent tracks.

For values of **E_1**, **F_1**, **T_1** and **T_2**, refer to the Appendices as shown in Table below:

	SECTIONS	**E_1 & F_1**	**T_1 & T_2**
(i)	Underground	3(TNL)	2(TNL/ELE/AG)
(ii)	Elevated & At Grade BLT	3(ELE/AG)	2(TNL/ELE/AG)
(iii)	At Grade Ballasted	3(AG)	2(AG)

1.8 SPECIAL OPERATING CONDITIONS (COMMON FOR UNDERGROUND, ELEVATED AND AT GRADE)

1.8.1 Scheduled maintenance of permanent wayside assets such as track, signalling, traction equipment etc shall be performed outside service hour only.

1.8.2 No workman/equipment/structure are allowed between vehicle and structure gauge during operation of trains.

1.8.3 At stations provided with Platform Screen Door the maximum operating speed for any train entering, leaving or passing through the station shall be limited to 50 kmph.

1.8.4 In view of chances of collision of derailed train with train coming from other direction, adequate measures shall be taken to restrict lateral movement of derailed vehicles on elevated/at-grade structures. Proper communication facilities should also be available at the station.

1.9 ADDITIONAL OPERATING CONDITION FOR ELEVATED AND AT GRADE SECTION.

1.9.1 In case of elevated corridor, the track is expected to be on the surface at some locations passing through populated areas and there are chances of people passing through the track. Considering this fact to prevent the access to the track by general public, stray, cattle and other animals from the adjacent areas, all at-grade/elevated sections shall be robustly fenced.

1.9.2 As the track will be open to climate, temperature variation will take place in the track, which may require patrolling of the section during extreme winter and summer. For this purpose, provision shall be made for visual inspection from the walk way on the outside of each track permitting safe walking for patrolmen during service hours.

1.10 TECHNICAL STANDARDS FOR TRACK STRUCTURE FOR METRO RAILWAYS/MRTS SYSTEMS

Track Structure shall comply with “Technical Standards for Track Structure for Metro Railways/MRTS systems” issued by Railway Board, under their letter No.2010/Proj./Genl./3/3 dated 23.12.2011. Any deviations therefrom shall require Railway Board’s approval.

1.11 WALKWAYS

Minimum Width of Walkway 550 mm

Note:

a) Extra allowance shall be provided for curves as per Para 1.6

b) Walkway should be used by Metro inspection groups only in non-operation periods.

c) No structure other than signalling and minor signalling equipment post shall be permitted within the minimum width of walkway.

CHAPTER-2 STATIONS

2.1 MINIMUM SPACING OF TRACKS AT STATIONS

Minimum Spacing of tracks at station on straight and on curve of radius of 1000 M and flatter, without any structure between adjoining tracks for:

a)	Underground Section	3650 mm
b)	Elevated Section	3750 mm
c)	At-Grade Section (ballastless track)	3750 mm
d)	At-Grade Section (ballasted track)	3800 mm

2.2 PLATFORMS

2.2.1 Maximum horizontal distance from centre of track to face of passenger platform coping — 1525 mm (A)

2.2.2 Minimum horizontal distance from centre of track to face of passenger platform coping — 1515 mm (B)

Notes:

a) Platform faces shall be flared away smoothly from the centre line of the track at either end for a distance of 1500 mm so as to give from centre of track a dimension :

- 1580 ±5 mm

b) For additional clearance for platforms on curves, refer to para 2.7.

			Ballastless Track	Ballasted Track
2.2.3	(a)	Maximum height above rail level for passenger platform	1085 mm	1095 mm
	(b)	Minimum height above rail level for passenger platform	1075 mm	1085 mm

Note:

The height of platform serving super-elevated track should be in relation to the plane passing through the top of both the rails.

2.2.4	(i)	Minimum horizontal distance of any isolated structure on a passenger platform from the edge of coping	2500 mm
	(ii)	Minimum horizontal distance of any continuous structure on a passenger platform from the edge of coping	3000 mm

Note:

The structure on the platform is treated as isolated if the length along the platform length is 2000 mm or less. Any structure having a length exceeding 2000 mm is treated as continuous structure.

2.2.5 For Structure Gauge at stations, refer to Figures as under:

a)	For Underground Stations	Figure-6(TNL) &6A(TNL)
b)	For Elevated Stations	Figure No.6(ELE)
c)	For Surface (At-Grade) Station	Figure No.6(AG)

2.2.6 Design Criteria Values for Platform Screen Doors/Gates

Sl. No.	Criteria	Design Criteria Value
1	Free Passage	2400 mm (except extremity modules which are 2100 mm in order not to obstruct the cab door).
2	Clear Height	2150 mm
3	Platform Screen Door (PSD) Height	2650 mm
4	Platform Screen Gate (PSG) Height	1700 mm (Half Height)
5	Stoppage Accuracy	All trains in ATO shall stop within ± 300 mm of the stopping position for 99.5% of the station stops and ± 500 mm for 99.98% of the station stops.

Note:

"Platform Screen Doors are under tendering stage and the above dimensions will be validated / modified upon award of Contract."

2.3 GRADIENTS

2.3.1 Station Yards

Gradient in station yards, unless special safety devices are adopted and / or special rules enforced to prevent accidents in accordance with approved special instructions, shall be as under:

a)	Maximum gradient	1 in 1000
b)	Desirable	Level

Note:

There shall be no change of grade / vertical curve within 30 metres of any points or crossings on Ballasted track. In the case of Ballastless track, there shall be no change of grade / vertical curve on the turnout.

2.3.2 Mid Section

Maximum gradient in Mid Section 1 in 25

The gradient will be compensated for curvature at the rate of 0.04% per degree of curve.

2.4 INTERLOCKING AND SIGNAL GEAR

Maximum height above rail level of any part of interlocking or signal gear on either side of centre of track subject to the restrictions embodied in Note below shall be as under:

a) In Underground Stations

- From CL of track to 1150 mm — 25 mm
- From 1150 mm to 1670 mm — 25 mm rising to 65 mm

b) In Elevated Stations

- From C.L. of track to 1150 mm — 25 mm
- From 1150 mm to 1605 mm — 25 mm increasing to 65 mm
- From 1605 mm to 1755 mm — 65 mm increasing to 200 mm

c) In Surface Stations

- From C.L. of track to 1160 mm — 25 mm
- From 1160 mm to 1615 mm — 25 mm increasing to 65 mm
- From 1615 mm to 1880 mm — 65 mm increasing to 200 m

Note:

Except for check rails of ordinary and diamond crossings, or wing rails and point rails of crossings leading to snag dead ends, or such parts of signalling gear as are required to be actuated by the wheels, no gear or track fittings shall project above rail level for a distance of 229 mm outside and 140 mm inside the gauge face of the rails.

2.5 POINTS & CROSSING

2.5.1	Maximum clearance of check rail opposite nose of crossing	44 mm
2.5.2	Minimum clearance of check rail opposite nose of crossings and at heel of switch rail	41 mm
2.5.3	Maximum clearance of wing rail at nose of crossing	44 mm
2.5.4	Minimum clearance of wing rail at nose of crossings.	41 mm
2.5.5	Minimum clearance between toe of open switch and stock rail	115 mm
2.5.6	Minimum radius of curvature for slip points, turnouts of crossover roads.	
	a) For passenger running lines	120 metres
	b) For Depot lines and other than passenger running lines	100 metres
2.5.7	Minimum angle of crossing (ordinary) for passenger running lines	1 in 7
2.5.8	Diamond crossings not to be flatter than	1 in 6

Notes:

a) The above restrictions shall not apply to moveable diamond crossings

b) There must be no change of super-elevation (of outer over inner rail) between points 18 metres outside toe of switch rail and nose of crossings respectively, except in the case of special crossing leading to snag dead-ends or under circumstances as provided for in item 2.6 below.

2.5.9	Minimum length of tongue rail.	3660 mm

2.6 SUPERELEVATION AND SPEED AT STATIONS ON CURVES WITH TURNOUTS OF CONTRARY AND SIMILAR FLEXURE.

2.6.1 Main Line:

Subject to the permissible run through speed based on the standard of interlocking, the equilibrium super-elevation, calculated for the speed of the fastest train may be reduced by a maximum amount of 100 mm without reducing speed on the main line.

2.6.2 Turnouts:

i) Curves of contrary flexure

The equilibrium super-elevation (**s**) in mm should be = $\{(1435+c)/127)\}(V^2 / R)$

Where, c= Rail head width, R = radius of turnout in metres and V is speed on turnout in Kmph. The permissible negative super-elevation on the turnout (which is also the actual super-elevation of the main line) may then be =(100 – **s**) mm.

ii) Curves of Similar flexure

The question of reduction or otherwise of super-elevation on the main line must necessarily be determined by the administration concerned. In the case of a reverse curve close behind the crossing of a turnout, the super-elevation may be run out at the maximum of 1 mm in 440 mm.

2.7 ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES

The additional clearance for platforms on curves is to be provided as under:

2.7.1 On inside of curve: Mid throw

2.7.2 On outside of curve: End throw

The additional clearance for platforms on curves is shown at Appendix-5

Note:

1. As the minimum radius of Curve for stations is 1000 m, there will be no gauge widening at stations.
2. No super-elevation will be provided in passenger platform lines.

CHAPTER-3 ROLLING STOCK

3.1 PASSENGER ELECTRIC MULTIPLE UNITS.

1)	Coach width		2880 ± 20 mm
2)	Length of the coach body (maximum) (*The length of the Driving Motor Car may be increased up to 21050 mm, without exceeding the Kinematic Envelope given in this Schedule of Dimensions)		20800* mm
3)	Distance between bogie centres		14700 ± 250 mm
4)	Kinematic Envelope for level tangent track		
	(i)	For Underground and Elevated Sections	Figure No. 1(TNL/AG/ELE)
	(ii)	For Surface (At-Grade) Sections	Figure No. 1(AG)
5)	Minimum clearance above Rail level under dynamic condition of fully loaded vehicle under worst condition * for bogie mounted equipment		65 mm
6)	Minimum clearance above Rail level under dynamic condition of fully loaded vehicle under worst condition * for body mounted equipment		102 mm

* The “worst condition” means that it is with the deflection of primary springs with maximum tread wear.

7)	Wheel		
	(a)	Maximum wheel gauge back to back distance	1360 mm
	(b)	Minimum wheel gauge back to back distance	1358 mm
8)	(a)	Maximum diameter on the tread measured at 70 mm from the wheel gauge face	860 mm
	(b)	Minimum diameter on the tread measured at 70 mm from the wheel gauge face	780 mm
9)	(a)	Minimum projection for flange of new wheel measured from tread at 70 mm from the wheel gauge face	28 mm
	(b)	Maximum projection for flange of worn wheel measured from tread at 70 mm from the wheel gauge face	36 mm

10)	(a)	Maximum thickness of flange of wheel measured from wheel gauge face at 18 mm from outer edge of flange.	32.5 mm
	(b)	Minimum thickness of flange of wheel measured from wheel gauge face at 18 mm from outer edge of flange.	22 mm
11)		Minimum width of wheel	134 mm
12)		Incline of tread	1 in 20
13)		Floor Height	
	(a)	Maximum height above rail level for floor of any unloaded vehicle	1130 mm
	(b)	Minimum height above rail level for floor of any loaded vehicle under operating conditions	1100 mm
14)	(a)	Maximum height of centre couplers above rail level for unloaded vehicle	815 mm
	(b)	Minimum height of centre couplers above rail level for unloaded vehicle	740 mm
15)		Length over buffers/couplers	21900 mm
16)		Adjacent axles (maximum)	12750 mm
17)		Length of rigid wheel base for single bogie	2200 to 2400 mm

3.2 LOCOMOTIVES AND ENGINEERING SERVICE VEHICLES

Other items of rolling stock, viz. shunting locomotives and inspection cars, emergency re-railing van, track machines, etc., used on Kolkata Metro System, will conform with the Kinematic Envelope of the Passenger Electric Multiple Units as shown in Figure-1(TNL/AG/ELE) for Underground, Elevated and At-Grade ballastless sections and Figure-1(AG) for Surface (At-Grade) ballasted Sections.

CHAPTER-4 ELECTRIC TRACTION

4.1 ELECTRIC TRACTION 750 V DC (THIRD RAIL WITH TOP CURRENT COLLECTION)

Bidder may offer his design following criteria laid down as under:

4.1.1 (a) Maximum distance of centre line of the conductor rail from the track centre — 1380 mm

(b) Minimum distance of centre line of the conductor rail from the track centre — 1360 mm

4.1.2 Minimum distance between the bottom of the shroud and the top of the conductor rail — 100 mm

4.1.3 Minimum distance between the centre line of the conductor rail and the shroud structure — 110 mm

4.1.4 (a) Conductor rail electrical clearances

i) The static distance between any exposed conductor rail, including all metalwork connected thereto, and any other fixed metalwork shall be at least 75mm

ii) The 75mm referred to in i) may be infringed where insulation is located between such metal parts and the conductor rail.

iii) The minimum vertical clearance between the lowest part of any collector shoe and the running rail shall be 25mm.

iv) The exception to iii) is fourth rail systems where the potential of a set of collector shoes does not, except under fault conditions, exceed 250v and therefore the minimum vertical clearance may be reduced to 10mm for those shoes.

v) Under all circumstances the distance between any conductor rail and another conductor rail, whether or not it is connected to the same power source, shall not be less than 200mm.

Appendix-1

PERMISSIBLE SPEED, CANT AND MINIMUM TRACK SPACING ON CURVES.

UNDER GROUND (TUNNELS), ELEVATED AND SURFACE (AT-GRADE) SECTIONS

(REFERENCE: PARA 1.1)

RADIUS OF CURVE	CANT	MAXIMUM PERMISSIBLE SPEED	MINIMUM DISTANCE BETWEEN ADJACENT TRACKS See note (a)		
			UNDER GROUND	ELEVATED & AT GRADE BALLASTLESS	AT-GRADE BALLASTED
metres	mm	kmph	mm	mm	mm
3000	15	80	3650	3750	3800
2800	15	80	3650	3750	3800
2400	20	80	3650	3750	3800
2000	20	80	3650	3750	3800
1600	25	80	3650	3750	3800
1500	30	80	3650	3750	3800
1200	35	80	3650	3750	3800
1000	40	80	3650	3750	3800
800	55	80	3650	3750	3850
600	70	80	3700	3800	3850
500	85	80	3700	3800	3850
450	95	80	3750	3850	3900
400	105	80	3750	3850	3900
350	125	80	3800	3900	3950
300	125	75	3800	3900	3950
200	125	60	3900	4000	4050
175	125	55	NA	4050	4100
150	125	50	NA	4100	4150
120	125	45	NA	4200	4250

Notes:

(a) The track spacing shown in the table above is without any column/structure between two tracks and is with equal cant for both outer and inner tracks.

b) Track spacing shown in Table above is not applicable to stations which should be calculated depending on specific requirement.

c) Figures for any intermediate radius of curvature may be obtained by interpolating between two adjacent radii. For higher radii, values may be extrapolated

APPENDIX-2(TNL/ELE/AG)
HORIZONTAL SHIFT ON CURVES - (CURVATURE EFFECT)
TUNNEL/ELEVATED/AT GRADE BALLASTLESS SECTIONS
INSIDE OF CURVE REFERENCE: PARA 1.6

RADIUS (METERS) R	MID-THROW (27940/R) (mm) (V)	NOSING INCLUDED IN K.E/STRUCTURE GAUGE FOR TANGENT TRACK (mm) (N)	EXTRA GAUGE TOLERANCE ON CURVES (mm) (G)	EXTRA HORIZONTAL SHIFT ON CURVE (mm) (T1)	REMARKS
120	232.8	34.0	9.0	208	
150	186.3	34.0	9.0	161	GAUGE WIDENING ON
175	159.7	34.0	9.0	135	CURVES = 9 mm FOR CURVES
200	139.7	34.0	9.0	115	SHARPER THAN 500 M RADIUS
250	111.8	34.0	9.0	87	AND 3mm FOR CURVES WITH
300	93.1	34.0	9.0	68	RADIUS OF 500 M TO LESS THAN 1000 M
350	79.8	34.0	9.0	55	
400	69.9	34.0	9.0	45	
450	62.1	34.0	9.0	37	
500	55.9	34.0	3.0	25	
600	46.6	34.0	3.0	16	
700	39.9	34.0	3.0	9	T1=V-N+G for V EQUAL TO OR
800	34.9	34.0	3.0	4	GREATER THAN (N) AND
900	31.0	34.0	3.0	3	T1= G for V < (N)
1000	27.9	34.0	0.0	0.0	
1200	23.3	34.0	0.0	0.0	
1500	18.6	34.0	0.0	0.0	
1600	17.5	34.0	0.0	0.0	
2000	14.0	34.0	0.0	0.0	
2400	11.6	34.0	0.0	0.0	
2800	10.0	34.0	0.0	0.0	
3000	9.3	34.0	0.0	0.0	

Mid throw (in mm) V = (125 x C^2) /R= 27940/R
Where 'C' is the distance between bogie centers = 14.700+0.250=14.950m OR 14.700 - 0.250=14.450 m. .
The worst case will be with C=14.950 m m
R is the radius of curve in metres.
Mid throw (in mm) V = (125 x C^2) /R= 27940/R

OUTSIDE OF CURVE

RADIUS (METERS) R	END-THROW (30610/R) (mm) (V0)	EXTRA GAUGE TOLERANCE ON CURVES (mm) (G)	EXTRA NOSING DUE TO EXTRA GAUGE TOLERANCE (mm) (EN)=Gx0,219723183	EXTRA HORIZONTAL SHIFT ON CURVE (mm) T2=Vo+G+EN	REMARKS
120	255.1	9.0	2.0	266	
150	204.1	9.0	2.0	215	
175	174.9	9.0	2.0	186	GAUGE WIDENING ON
200	153.1	9.0	2.0	164	CURVES = 9 mm FOR CURVES
250	122.4	9.0	2.0	133	SHARPER THAN 500 M RADIUS
300	102.0	9.0	2.0	113	AND 3mm FOR CURVES WITH
350	87.5	9.0	2.0	98	RADIUS OF 500 M TO LESS THAN 1000 M
400	76.5	9.0	2.0	88	
450	68.0	9.0	2.0	79	
500	61.2	3.0	0.7	65	
600	51.0	3.0	0.7	55	
700	43.7	3.0	0.7	47	
800	38.3	3.0	0.7	42	
900	34.0	3.0	0.7	38	
1000	30.6	0.0	0.7	31	
1200	25.5	0.0	0.7	26	
1500	20.4	0.0	0.7	21	
1600	19.1	0.0	0.7	20	
2000	15.3	0.0	0.7	16	
2400	12.8	0.0	0.7	13	
2800	10.9	0.0	0.7	12	
3000	10.2	0.0	0.7	11	

End Throw (in mm) Vo= (125 x C_1^2) /R - (125xC^2)/R = 30610/R

Where 'C' is the distance between bogie centers = 14.700+0,250=14.950m OR 14.700-0.250=14.450m .

Worst case will be with C=14.450

'C_1' is length of coach in meters = 21.30 m and 'R' is radius 0f curve in meters.

COACH LENGTH=	20800	
FOR DMC IT CAN INCREASE TO	21050	
DIFFERENCE IN LENGTH	250	THIS INCREASE WILL BE ON ONE SIDE FOR DRIVING CAB
HALF LENGTH FROM CENTRE OF 2 BOGIES	10650	((20800)/2)+250)
LENGTH FOR CALCULATIONS OF END THROW	21300	

APPENDIX-2(AG)

HORIZONTAL SHIFT ON CURVES - (CURVATURE EFFECT) - SURFACE (AT-GRADE) BALLASTED SECTIONS

INSIDE OF CURVE

REFERENCE PARA 1.6

RADIUS (METERS) R	MID-THROW (27940/R) (mm) (V)	NOSING INCLUDED IN K.E/STRUCTURE GAUGE FOR TANGENT TRACK (mm) (N)	EXTRA GAUGE TOLERANCE ON CURVES (mm) (G)	EXTRA HORIZONTAL SHIFT ON CURVE (mm) (T1)	REMARKS
120	232.8	37	9.0	205	
150	186.3	37	9.0	158	
175	159.7	37	9.0	132	
200	139.7	37	9.0	112	GAUGE WIDENING ON
250	111.8	37	9.0	65	CURVES = 9 mm FOR CURVES
300	93.1	37	9.0	52	SHARPER THAN 500 M RADIUS
350	79.8	37	9.0	42	AND 3mm FOR CURVES WITH
400	69.9	37	9.0	34	RADIUS OF 500 M TO LESS THAN 1000 M
450	62.1	37	9.0	28	
500	55.9	37	3.0	13	
600	46.6	37	3.0	6	T1=V-N+G for V EQUAL TO OR
700	39.9	37	3.0	1	GREATER THAN (N) AND
800	34.9	37	3.0	3	T1= G for V < (N)
900	31.0	37	3.0	3	
1000	27.9	37	0.0	0.0	
1200	23.3	37	0.0	0.0	
1500	18.6	37	0.0	0.0	
1600	17.5	37	0.0	0.0	
2000	14.0	37	0.0	0.0	
2400	11.6	37	0.0	0.0	
2800	10.0	37	0.0	0.0	
3000	9.3	37	0.0	0.0	

Mid throw (in mm) V = (125 x C^2) /R= 27940/R
Where 'C' is the distance between bogie centers = 14.700+0.250=14.950m OR 14.700 - 0.250=14.450 m. .
The worst case will be with C=14.950 mm
R is the radius of curve in metres.
Mid throw (in mm) V = (125 x C^2) /R= 27940/R

OUTSIDE OF CURVE

RADIUS (METERS) R	END-THROW (30610/R) (mm) (V0)	EXTRA GAUGE TOLERANCE ON CURVES (mm) (G)	EXTRA NOSING DUE TO EXTRA GAUGE TOLERANCE (mm) (EN)=G x 0.219723183	EXTRA HORIZONTAL SHIFT ON CURVE (mm) T2=Vo+G+EN	REMARKS
120	255.1	9.0	2.0	266	
150	204.1	9.0	2.0	215	
175	174.9	9.0	2.0	186	
200	153.1	9.0	2.0	164	GAUGE WIDENING ON
250	122.4	9.0	2.0	133	CURVES = 9 mm FOR CURVES
300	102.0	9.0	2.0	113	SHARPER THAN 500 M RADIUS
350	87.5	9.0	2.0	98	AND 3mm FOR CURVES WITH
400	76.5	9.0	2.0	88	RADIUS OF 500 M TO LESS THAN 1000 M
450	68.0	9.0	2.0	79	
500	61.2	3.0	0.7	65	
600	51.0	3.0	0.7	55	
700	43.7	3.0	0.7	47	
800	38.3	3.0	0.7	42	
900	34.0	3.0	0.7	38	
1000	30.6	0.0	0.7	31	
1200	25.5	0.0	0.7	26	
1500	20.4	0.0	0.7	21	
1600	19.1	0.0	0.7	20	
2000	15.3	0.0	0.7	16	
2400	12.8	0.0	0.7	13	
2800	10.9	0.0	0.7	12	
3000	10.2	0.0	0.7	11	

End Throw (in mm) Vo= $(125 \times C_1^2) /R - (125xC^2)/R = 30610/R$
Where 'C' is the distance between bogie centers = 14.700+0,250=14.950m OR 14.700-0.250=14.450m .
Worst case will be with C=14.450
'C1' is length of coach in meters = 21.30 m and 'R' is radius of curve in meters.

COACH LENGTH=	20800	
FOR DMC IT CAN INCREASE TO	21050	
DIFFERENCE IN LENGTH	250	THIS INCREASE WILL BE ON ONE SIDE FOR DRIVING CAB
HALF LENGTH FROM CENTRE OF 2 BOGIES	10650	((20800)/2)+250)
LENGTH FOR CALCULATIONS OF END THROW	21300	

APPENDIX-3(TNL)

CANT EFFECT ON STRUCTURE GAUGE-HORIZONTAL
UNDER GROUND SECTIONS (RECTANGULAR BOX TUNNELS)

Height above rail level measured perpendicular to plane of track →						h= 0				h= 75				h= 920				h= 1765				h= 3150				h= 3550				h= 3975				h= 3975			
Distance from center line of track to Structure Gauge for tangent track. →						ab= 1670				ab= 1705				ab= 1705				ab= 1770				ab= 1805				ab= 1450				ab= 610				ab= 0			
Cant	**Angle α**	**Sin α**	**cos α**	**tan α**		**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**
125	4.764	0.083	0.997	0.08334		1664	1664	201	-76	1705	1693	279	-4	1776	1623	1121	838	1910	1617	1968	1674	2060	1537	3352	3336	1740	1150	3721	3480	938	278	4074	3973	330	-330	4024	4024
120	4.573	0.080	0.997	0.07999		1665	1665	193	-73	1706	1694	271	-1	1773	1626	1113	841	1905	1624	1961	1678	2050	1548	3344	3056	1728	1162	3714	3483	925	291	4071	3974	317	-317	4022	4022
115	4.382	0.076	0.997	0.07664		1665	1665	185	-70	1706	1694	263	2	1770	1630	1105	845	1900	1630	1953	1682	2040	1559	3336	3060	1717	1174	3708	3486	912	304	4067	3974	304	-304	4021	4021
110	4.191	0.073	0.997	0.07329		1666	1666	177	-67	1706	1695	254	5	1768	1633	1097	848	1894	1636	1945	1686	2030	1570	3329	3065	1706	1187	3701	3490	899	318	4064	3975	291	-291	4019	4019
105	4.001	0.070	0.998	0.06994		1666	1666	169	-64	1706	1696	246	8	1765	1637	1089	851	1889	1643	1937	1690	2020	1581	3321	3069	1694	1199	3695	3493	886	331	4060	3975	277	-277	4018	4018
100	3.810	0.066	0.998	0.06659		1666	1666	161	-61	1706	1696	238	12	1762	1640	1081	855	1883	1649	1929	1693	2010	1592	3313	3073	1683	1211	3689	3496	873	345	4057	3976	264	-264	4016	4016
95	3.619	0.063	0.998	0.06325		1667	1667	153	-58	1706	1697	230	15	1760	1644	1073	858	1878	1655	1921	1697	2000	1603	3305	3077	1671	1223	3682	3499	860	358	4053	3976	251	-251	4015	4015
90	3.428	0.060	0.998	0.05991		1667	1667	145	-55	1706	1697	222	18	1757	1647	1065	861	1872	1661	1913	1701	1990	1613	3297	3081	1660	1235	3675	3502	847	371	4049	3976	238	-238	4013	4013
85	3.238	0.056	0.998	0.05657		1667	1667	137	-52	1707	1698	214	21	1754	1650	1057	865	1867	1667	1905	1705	1980	1624	3289	3086	1648	1247	3669	3505	834	385	4046	3977	225	-225	4011	4011
80	3.047	0.053	0.999	0.05323		1668	1668	129	-49	1707	1699	206	24	1751	1654	1049	868	1861	1674	1897	1708	1970	1635	3281	3090	1637	1259	3662	3508	820	398	4042	3977	211	-211	4009	4009
75	2.856	0.050	0.999	0.04990		1668	1668	121	-46	1707	1699	197	27	1749	1657	1041	871	1856	1680	1889	1712	1960	1646	3274	3094	1625	1271	3655	3511	807	411	4038	3977	198	-198	4008	4008
70	2.666	0.047	0.999	0.04656		1668	1668	113	-43	1707	1700	189	31	1746	1660	1033	875	1850	1686	1880	1716	1950	1657	3266	3098	1614	1283	3649	3514	794	424	4034	3977	185	-185	4006	4006
65	2.475	0.043	0.999	0.04323		1668	1668	105	-40	1707	1700	181	34	1743	1664	1025	878	1845	1692	1872	1719	1939	1667	3258	3102	1602	1295	3642	3517	781	438	4030	3977	172	-172	4004	4004
60	2.285	0.040	0.999	0.03990		1669	1669	97	-37	1707	1701	173	37	1740	1667	1017	881	1839	1698	1864	1723	1929	1678	3249	3106	1590	1307	3635	3519	768	451	4026	3978	158	-158	4002	4002
55	2.094	0.037	0.999	0.03657		1669	1669	89	-34	1707	1701	165	40	1737	1670	1009	885	1833	1704	1856	1727	1919	1689	3241	3109	1579	1319	3628	3522	755	464	4022	3978	145	-145	4000	4000
50	1.904	0.033	0.999	0.03324		1669	1669	80	-30	1707	1702	157	43	1735	1673	1001	888	1828	1710	1848	1730	1909	1699	3233	3113	1567	1331	3621	3525	742	478	4018	3978	132	-132	3998	3998
45	1.713	0.030	1.000	0.02991		1669	1669	72	-27	1706	1702	148	46	1732	1677	993	891	1822	1716	1840	1734	1898	1710	3225	3117	1555	1343	3614	3528	729	491	4014	3977	119	-119	3996	3996
40	1.523	0.027	1.000	0.02659		1669	1669	64	-24	1706	1702	140	50	1729	1680	985	894	1816	1722	1831	1737	1888	1721	3217	3121	1544	1355	3607	3530	715	504	4010	3977	106	-106	3994	3994
35	1.333	0.023	1.000	0.02326		1670	1670	56	-21	1706	1703	132	53	1726	1683	977	898	1811	1728	1823	1741	1878	1731	3209	3125	1532	1367	3600	3533	702	517	4006	3977	92	-92	3991	3991
30	1.142	0.020	1.000	0.01994		1670	1670	48	-18	1706	1703	124	56	1723	1686	969	901	1805	1734	1815	1744	1867	1742	3200	3128	1520	1379	3593	3535	689	531	4001	3977	79	-79	3989	3989
25	0.952	0.017	1.000	0.01661		1670	1670	40	-15	1706	1704	116	59	1720	1689	961	904	1799	1740	1807	1748	1857	1752	3192	3132	1509	1391	3586	3538	676	544	3997	3977	66	-66	3987	3987
20	0.761	0.013	1.000	0.01329		1670	1670	32	-12	1706	1704	108	62	1717	1693	953	907	1793	1746	1798	1751	1847	1763	3184	3136	1497	1403	3579	3540	663	557	3993	3977	53	-53	3985	3985
15	0.571	0.010	1.000	0.00997		1670	1670	24	-9	1706	1704	99	66	1714	1696	944	910	1788	1752	1790	1755	1836	1774	3175	3139	1485	1415	3572	3543	650	570	3988	3976	40	-40	3982	3982
10	0.381	0.007	1.000	0.00664		1670	1670	16	-6	1705	1704	91	69	1711	1699	936	914	1782	1758	1782	1758	1826	1784	3167	3143	1474	1426	3565	3545	636	584	3984	3976	26	-26	3980	3980
5	0.190	0.003	1.000	0.00332		1670	1670	8	-3	1705	1705	83	72	1708	1702	928	917	1776	1764	1773	1762	1815	1795	3158	3146	1462	1438	3557	3548	623	597	3980	3975	13	-13	3977	3977
0	0.000	0.000	1.000	0.00000		1670	1670	0	0	1705	1705	75	75	1705	1705	920	920	1770	1770	1765	1765	1805	1805	3150	3150	1450	1450	3550	3550	610	610	3975	3975	0	0	3975	3975

REFER TO FIGURE-4
E1=[ab+(h x tan α)] x cos α
F1=[ab- (h x tan α)] x cos α
H1=(Ca/2)+(h / cos α)+(Ab-h x tan α)xsin α
H2=(Ca/2)+(h/ cos α)-(ab+h x tan α)xsin α

ab=Ab=Distance from center line of vehicle to Structure gauge for Tangent track at height 'h' from rail level
ac=Distance from center line of Tangent tack to Structure Gauge for Canted track at height 'h' from rail level.
bc=hxtan α=Lateral increment due to cant (measured along the line parallel to line joining top of rails).

APPENDIX-3(ELE/AG)

CANT EFFECT ON STRUCTURE GAUGE-HORIZONTAL
ELEVATED AND AT GRADE SECTIONS (BALLASTLESS)

Height above rail level measured perpendicular to plane of track → / Distance from center line of track to Structure Gauge for tangent track. →					h= 0				h= 360				h= 360				h= 960				h= 1760				h= 3090				h= 3555				h= 4025				h= 4025			
					ab= 1755				ab= 1755				ab= 1650				ab= 1760				ab= 1820				ab= 1855				ab= 1560				ab= 610				ab= 0			
Cant	**Angle α**	**Sin α**	**cos α**	**tan α**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**
125	4.764	0.083	0.997	0.0833	1749	1749	208	-83	1779	1719	567	275	1674	1614	558	284	1834	1674	1165	873	1960	1668	1968	1951	2105	1592	3296	2988	1850	1259	3735	3476	942	274	4124	4023	334	-334	4074	4074
120	4.573	0.080	0.997	0.0800	1749	1749	200	-80	1778	1721	559	279	1673	1616	550	287	1831	1678	1157	877	1955	1674	1960	1669	2095	1603	3288	2992	1838	1272	3728	3479	929	287	4121	4024	321	-321	4072	4072
115	4.382	0.076	0.997	0.0766	1750	1750	192	-77	1777	1722	551	282	1673	1618	543	290	1828	1681	1149	880	1949	1680	1951	1673	2086	1613	3280	2997	1827	1284	3721	3483	916	301	4117	4024	308	-308	4071	4071
110	4.191	0.073	0.997	0.0733	1750	1750	183	-73	1777	1724	542	286	1672	1619	535	293	1825	1685	1141	884	1944	1686	1943	1677	2076	1624	3272	3001	1816	1296	3715	3486	903	314	4114	4025	294	-294	4069	4069
105	4.001	0.070	0.998	0.0699	1751	1751	175	-70	1776	1726	534	289	1671	1621	527	297	1823	1689	1133	887	1938	1693	1935	1681	2066	1635	3264	3006	1804	1308	3708	3490	889	328	4110	4025	281	-281	4068	4068
100	3.810	0.066	0.998	0.0666	1751	1751	167	-67	1775	1727	526	293	1670	1622	519	300	1820	1692	1125	891	1933	1699	1927	1685	2056	1646	3256	3010	1793	1320	3701	3493	876	341	4107	4026	267	-267	4066	4066
95	3.619	0.063	0.998	0.0632	1752	1752	158	-63	1774	1729	518	296	1669	1624	511	303	1817	1696	1117	894	1927	1705	1919	1689	2046	1656	3248	3014	1781	1332	3694	3497	863	355	4103	4026	254	-254	4064	4064
90	3.428	0.060	0.998	0.0599	1752	1752	150	-60	1773	1730	509	299	1669	1626	503	306	1814	1699	1109	898	1922	1711	1911	1693	2036	1667	3240	3019	1770	1345	3687	3500	850	368	4099	4026	241	-241	4063	4063
85	3.238	0.056	0.998	0.0566	1752	1752	142	-57	1773	1732	501	303	1668	1627	495	309	1811	1703	1100	902	1916	1718	1902	1697	2027	1678	3232	3023	1758	1357	3680	3504	836	382	4096	4027	227	-227	4061	4061
80	3.047	0.053	0.999	0.0532	1753	1753	133	-53	1772	1733	493	306	1667	1629	487	312	1809	1706	1092	905	1911	1724	1894	1701	2017	1688	3224	3027	1747	1369	3673	3507	823	395	4092	4027	214	-214	4059	4059
75	2.856	0.050	0.999	0.0499	1753	1753	125	-50	1771	1735	485	310	1666	1630	479	315	1806	1710	1084	909	1905	1730	1886	1705	2007	1699	3216	3031	1735	1381	3666	3510	810	409	4088	4027	201	-201	4057	4057
70	2.666	0.047	0.999	0.0466	1753	1753	117	-47	1770	1736	476	313	1665	1631	471	318	1803	1713	1076	912	1900	1736	1878	1708	1997	1709	3208	3035	1724	1393	3659	3514	797	422	4084	4027	187	-187	4056	4056
65	2.475	0.043	0.999	0.0432	1753	1753	108	-43	1769	1738	468	316	1664	1633	463	321	1800	1717	1068	916	1894	1742	1869	1712	1987	1720	3200	3040	1712	1405	3652	3517	783	436	4080	4027	174	-174	4054	4054
60	2.285	0.040	0.999	0.0399	1754	1754	100	-40	1768	1739	460	320	1663	1634	455	324	1797	1720	1059	919	1889	1748	1861	1716	1977	1730	3191	3044	1700	1417	3644	3520	770	449	4076	4027	160	-160	4052	4052
55	2.094	0.037	0.999	0.0366	1754	1754	92	-37	1767	1741	451	323	1662	1636	448	327	1794	1724	1051	923	1883	1754	1853	1720	1967	1741	3183	3048	1689	1429	3637	3523	757	462	4072	4028	147	-147	4050	4050
50	1.904	0.033	0.999	0.0332	1754	1754	83	-33	1766	1742	443	326	1661	1637	440	330	1791	1727	1043	926	1877	1761	1844	1724	1957	1751	3175	3052	1677	1441	3630	3526	743	476	4068	4028	134	-134	4048	4048
45	1.713	0.030	1.000	0.0299	1754	1754	75	-30	1765	1743	435	330	1660	1638	432	333	1788	1731	1035	929	1872	1767	1836	1727	1947	1762	3167	3056	1666	1453	3623	3529	730	489	4064	4027	120	-120	4046	4046
40	1.523	0.027	1.000	0.0266	1754	1754	67	-27	1764	1745	427	333	1659	1640	424	336	1785	1734	1026	933	1866	1773	1828	1731	1936	1772	3158	3060	1654	1465	3615	3532	717	503	4060	4027	107	-107	4044	4044
35	1.333	0.023	1.000	0.0233	1755	1755	58	-23	1763	1746	418	337	1658	1641	416	339	1782	1737	1018	936	1860	1779	1819	1735	1926	1783	3150	3064	1642	1477	3608	3535	703	516	4056	4027	94	-94	4041	4041
30	1.142	0.020	1.000	0.0199	1755	1755	50	-20	1762	1747	410	340	1657	1642	408	342	1779	1741	1010	940	1855	1785	1811	1738	1916	1793	3141	3067	1631	1489	3600	3538	690	530	4051	4027	80	-80	4039	4039
25	0.952	0.017	1.000	0.0166	1755	1755	42	-17	1761	1749	402	343	1656	1644	400	345	1776	1744	1002	943	1849	1791	1802	1742	1906	1803	3133	3071	1619	1501	3593	3541	677	543	4047	4027	67	-67	4037	4037
20	0.761	0.013	1.000	0.0133	1755	1755	33	-13	1760	1750	393	347	1655	1645	392	348	1773	1747	993	947	1843	1796	1794	1746	1896	1814	3124	3075	1607	1513	3585	3544	663	556	4043	4027	53	-53	4035	4035
15	0.571	0.010	1.000	0.0100	1755	1755	25	-10	1759	1751	385	350	1654	1646	384	351	1769	1750	985	950	1837	1802	1786	1749	1886	1824	3116	3079	1595	1524	3578	3547	650	570	4038	4026	40	-40	4032	4032
10	0.381	0.007	1.000	0.0066	1755	1755	17	-7	1757	1753	377	353	1652	1648	376	354	1766	1754	977	953	1832	1808	1777	1753	1875	1834	3107	3083	1584	1536	3570	3550	637	583	4034	4026	27	-27	4030	4030
5	0.190	0.003	1.000	0.0033	1755	1755	8	-3	1756	1754	368	357	1651	1649	368	357	1763	1757	968	957	1826	1814	1769	1756	1865	1845	3099	3086	1572	1548	3563	3552	623	597	4030	4025	13	-13	4027	4027
0	0.000	0.000	1.000	0.0000	1755	1755	0	0	1755	1755	360	360	1650	1650	360	360	1760	1760	960	960	1820	1820	1760	1760	1855	1855	3090	3090	1560	1560	3555	3555	610	610	4025	4025	0	0	4025	4025

REFER TO FIGURE-4
E1=[ab+(h x tan a)] x cos a
F1=[ab- (h x tan a)] x cos a
H1=(Ca/2)+(h / cos a)+(Ab-h x tan a)xsin a
H2=(Ca/2)+(h/ cos a)-(ab+h x tan a)xsin a
ab=Ab=Distance from center line of vehicle to Structure gauge for Tangent track at height 'h' from rail level
ac=Distance from center line of tangent tack to Structure Gauge for Canted track at height 'h' from rail level.
bc=hxtan α=Lateral increment due to cant (measured along the line parallel to line joining top of rails.

APPENDIX-3(AG)

CANT EFFECT ON STRUCTURE GAUGE-HORIZONTAL AT-GRADE SECTIONS (BALLASTED TRACK)

ALL FIGURES ARE IN mm

Height above rail level measured						h= 0				h= 88				h= 88				h= 228				h= 3085				h= 3515				h= 4035				h= 4035			
Distance from center line of track to Structure Gauge for →						ab= 1765				ab= 1765				ab= 1880				ab= 1880				ab= 1880				ab= 1585				ab= 505				ab= 0			
Cant	Angle α Degrees	Sin α	Angle α (RADIANS)	cos α	tan α	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2
125	4.764	0.083	0.083	0.997	0.083	1759	1759	209	-84	1766	1752	297	4	1881	1866	306	-6	1892	1855	446	134	2130	1617	3293	2981	1871	1288	3697	3434	838	168	4126	4042	335	-335	4084	4081
120	4.573	0.080	0.080	0.997	0.080	1759	1759	201	-81	1766	1752	288	7	1881	1867	298	-2	1892	1856	437	137	2120	1628	3285	2985	1860	1300	3690	3437	825	182	4122	4042	322	-322	4082	4082
115	4.382	0.076	0.076	0.997	0.077	1760	1760	192	-77	1767	1753	280	10	1881	1868	289	2	1892	1857	428	141	2110	1639	3277	2990	1849	1312	3683	3441	812	195	4119	4042	308	-308	4081	4081
110	4.191	0.073	0.073	0.997	0.073	1760	1760	184	-74	1767	1754	272	14	1881	1869	280	5	1892	1858	420	145	2100	1649	3269	2994	1838	1324	3676	3445	799	209	4116	4042	295	-295	4079	4079
105	4.001	0.070	0.070	0.998	0.070	1761	1761	176	-71	1767	1755	263	17	1882	1869	271	9	1891	1860	411	149	2091	1660	3261	2999	1826	1336	3670	3448	785	222	4113	4042	282	-282	4078	4078
100	3.810	0.066	0.066	0.998	0.067	1761	1761	167	-67	1767	1755	255	21	1882	1870	263	13	1891	1861	402	153	2081	1671	3253	3003	1815	1348	3663	3452	772	236	4110	4043	268	-268	4076	4076
95	3.619	0.063	0.063	0.998	0.063	1761	1761	159	-64	1767	1756	247	24	1882	1871	254	17	1891	1862	394	156	2071	1682	3245	3008	1804	1360	3656	3455	759	249	4106	4043	255	-255	4074	4074
90	3.428	0.060	0.060	0.998	0.060	1762	1762	151	-61	1767	1757	238	27	1882	1871	245	20	1890	1863	385	160	2061	1692	3237	3012	1792	1372	3648	3459	745	263	4103	4043	241	-241	4073	4073
85	3.238	0.056	0.057	0.998	0.057	1762	1762	142	-57	1767	1757	230	31	1882	1872	237	24	1890	1864	376	164	2051	1703	3229	3016	1781	1384	3641	3462	732	276	4100	4043	228	-228	4071	4071
80	3.047	0.053	0.053	0.999	0.053	1763	1763	134	-54	1767	1758	222	34	1882	1873	228	28	1889	1865	368	168	2041	1713	3221	3021	1770	1396	3634	3466	719	290	4096	4042	214	-214	4069	4069
75	2.856	0.050	0.050	0.999	0.050	1763	1763	125	-50	1767	1758	213	37	1882	1873	219	32	1889	1866	359	172	2031	1724	3212	3025	1758	1408	3627	3469	705	303	4093	4042	201	-201	4067	4067
70	2.666	0.047	0.047	0.999	0.047	1763	1763	117	-47	1767	1759	205	41	1882	1874	210	35	1889	1867	350	175	2021	1734	3204	3029	1747	1420	3620	3472	692	317	4089	4042	188	-188	4066	4066
65	2.475	0.043	0.043	0.999	0.043	1763	1763	109	-44	1767	1760	197	44	1882	1874	202	39	1888	1868	341	179	2011	1745	3196	3033	1735	1432	3613	3476	679	330	4086	4042	174	-174	4064	4064
60	2.285	0.040	0.040	0.999	0.040	1764	1764	100	-40	1767	1760	188	48	1882	1875	193	43	1888	1869	333	183	2001	1756	3187	3038	1724	1444	3605	3479	665	344	4082	4042	161	-161	4062	4062
55	2.094	0.037	0.037	0.999	0.037	1764	1764	92	-37	1767	1761	180	51	1882	1876	184	47	1887	1870	324	187	1991	1766	3179	3042	1712	1455	3598	3482	652	357	4078	4041	147	-147	4060	4060
50	1.904	0.033	0.033	0.999	0.033	1764	1764	84	-34	1767	1761	172	54	1882	1876	175	50	1887	1871	315	190	1981	1776	3171	3046	1701	1467	3591	3485	639	371	4075	4041	134	-134	4058	4058
45	1.713	0.030	0.030	1.000	0.030	1764	1764	75	-30	1767	1762	163	58	1882	1877	167	54	1886	1872	307	194	1971	1787	3162	3050	1689	1479	3583	3489	625	384	4071	4041	121	-121	4056	4056
40	1.523	0.027	0.027	1.000	0.027	1764	1764	67	-27	1767	1762	155	61	1882	1877	158	58	1885	1873	298	198	1961	1797	3154	3054	1678	1491	3576	3492	612	398	4067	4040	107	-107	4054	4054
35	1.333	0.023	0.023	1.000	0.023	1765	1765	59	-24	1767	1762	147	64	1882	1877	149	62	1885	1874	289	202	1951	1808	3145	3058	1666	1503	3568	3495	599	411	4063	4040	94	-94	4051	4051
30	1.142	0.020	0.020	1.000	0.020	1765	1765	50	-20	1766	1763	138	68	1881	1878	140	66	1884	1875	280	205	1941	1818	3137	3062	1655	1515	3561	3498	585	424	4059	4039	80	-80	4049	4049
25	0.952	0.017	0.017	1.000	0.017	1765	1765	42	-17	1766	1763	130	71	1881	1878	132	69	1884	1876	272	209	1931	1828	3128	3066	1643	1526	3553	3501	572	438	4055	4039	67	-67	4047	4047
20	0.761	0.013	0.013	1.000	0.013	1765	1765	33	-13	1766	1764	121	75	1881	1879	123	73	1883	1877	263	213	1921	1839	3120	3070	1632	1538	3546	3504	559	451	4051	4038	54	-54	4045	4045
15	0.571	0.010	0.010	1.000	0.010	1765	1765	25	-10	1766	1764	113	78	1881	1879	114	77	1882	1878	254	217	1911	1849	3111	3074	1620	1550	3538	3507	545	465	4047	4037	40	-40	4042	4042
10	0.381	0.007	0.007	1.000	0.007	1765	1765	17	-7	1766	1764	105	81	1881	1879	105	81	1881	1878	245	221	1900	1859	3102	3077	1608	1562	3530	3509	532	478	4043	4037	27	-27	4040	4040
5	0.190	0.003	0.003	1.000	0.003	1765	1765	8	-3	1765	1765	96	85	1880	1880	97	84	1881	1879	237	224	1890	1870	3094	3081	1597	1573	3523	3512	518	492	4039	4036	13	-13	4037	4037
0	0.000	0.000	0.000	1.000	0.000	1765	1765	0	0	1765	1765	88	88	1880	1880	88	88	1880	1880	228	228	1880	1880	3085	3085	1585	1585	3515	3515	505	505	4035	4035	0	0	4035	4035

REFER TO FIGURE-4

$E1=[ab+(h \times \tan \alpha)] \times \cos \alpha$

$F1=[ab-(h \times \tan \alpha)] \times \cos \alpha$

$H1=(Ca/2)+(h / \cos \alpha)+(Ab-h \times \tan \alpha) \times \sin \alpha$

$H2=(Ca/2)+(h/ \cos \alpha)-(ab+h \times \tan \alpha) \times \sin \alpha$

ab=Ab=Distance from center line of vehicle to Structure gauge for Tangent track at height 'h' from rail level

ac=Distance from center line of Tangent track to Structure Gauge for Canted track at height 'h' from rail level.

bc=hxtan α=Lateral increment due to cant (measured along the line parallel to line joining top of rails).

APPENDIX- 3A(TNL/ELE/AG)

CANT EFFECT ON KINEMATIC ENVELOPE-HORIZONTAL
ELEVATED, UNDERGROUND AND AT GRADE BALLASTLESS SECTIONS

Height above rail level measured perpendicular to plane of track →						h=	996			h=	1769			h=	3051			h=	3266			h=	3430			h=	3486			h=	3681			h=	3873		
Distance from center line of track to K.E for tangent track. →						ab=	1610			ab=	1667			ab=	1701			ab=	1565			ab=	1351			ab=	1351			ab=	965			ab=	574		
Cant	Angle	Sin a	Angle a (RADIANS)	cos a	tan a	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2
125	4.764	0.083	0.083	0.997	0.083	1687	1522	1189	921	1808	1514	1964	1687	1949	1442	3244	2962	1831	1288	3447	3187	1631	1061	3593	3581	1636	1057	3649	3424	1267	656	3811	3651	894	250	3970	3874
120	4.573	0.080	0.080	0.997	0.080	1684	1525	1181	924	1803	1521	1956	1690	1939	1452	3237	2966	1820	1300	3440	3191	1620	1073	3587	3371	1625	1069	3643	3427	1255	668	3806	3652	881	263	3966	3875
115	4.382	0.076	0.076	0.997	0.077	1681	1529	1174	928	1797	1527	1949	1694	1929	1463	3230	2970	1810	1311	3434	3194	1609	1085	3581	3374	1613	1081	3637	3430	1243	681	3801	3654	868	276	3963	3875
110	4.191	0.073	0.073	0.997	0.073	1678	1533	1166	931	1792	1533	1941	1697	1919	1473	3222	2974	1800	1322	3427	3198	1598	1097	3575	3377	1602	1093	3630	3433	1231	693	3797	3656	856	289	3960	3876
105	4.001	0.070	0.070	0.998	0.070	1676	1537	1158	934	1786	1540	1933	1701	1910	1484	3215	2977	1789	1333	3420	3201	1587	1108	3568	3380	1591	1104	3624	3436	1219	706	3792	3657	843	302	3956	3876
100	3.810	0.066	0.066	0.998	0.067	1673	1540	1151	937	1781	1546	1926	1704	1900	1495	3207	2981	1779	1345	3413	3205	1576	1120	3562	3383	1580	1116	3618	3439	1207	718	3787	3659	830	315	3953	3876
95	3.619	0.063	0.063	0.998	0.063	1670	1544	1143	940	1775	1552	1918	1708	1890	1505	3200	2985	1768	1356	3406	3208	1565	1132	3556	3385	1568	1128	3612	3441	1195	731	3782	3660	817	328	3949	3877
90	3.428	0.060	0.060	0.998	0.060	1667	1548	1135	943	1770	1558	1911	1711	1880	1516	3192	2989	1758	1367	3399	3212	1554	1143	3550	3388	1557	1140	3606	3444	1183	743	3777	3662	805	341	3945	3877
85	3.238	0.056	0.057	0.998	0.057	1664	1551	1128	946	1764	1564	1903	1715	1871	1526	3185	2993	1747	1378	3392	3215	1543	1155	3543	3391	1546	1152	3599	3447	1171	756	3772	3663	792	354	3942	3877
80	3.047	0.053	0.053	0.999	0.053	1661	1555	1120	949	1759	1571	1895	1718	1861	1536	3177	2996	1736	1389	3385	3218	1531	1167	3537	3393	1534	1164	3593	3449	1159	768	3767	3665	779	367	3938	3877
75	2.856	0.050	0.050	0.999	0.050	1658	1558	1112	952	1753	1577	1887	1721	1851	1547	3169	3000	1726	1400	3377	3221	1520	1178	3531	3396	1523	1176	3586	3452	1147	780	3762	3666	766	380	3934	3877
70	2.666	0.047	0.047	0.999	0.047	1655	1562	1105	955	1747	1583	1880	1725	1841	1557	3162	3004	1715	1411	3370	3225	1509	1190	3524	3398	1512	1187	3580	3454	1135	793	3757	3667	754	393	3931	3877
65	2.475	0.043	0.043	0.999	0.043	1652	1565	1097	958	1742	1589	1872	1728	1831	1568	3154	3007	1705	1422	3363	3228	1498	1202	3518	3401	1500	1199	3574	3457	1123	805	3752	3668	741	406	3927	3877
60	2.285	0.040	0.040	0.999	0.040	1648	1569	1089	961	1736	1595	1864	1731	1821	1578	3146	3011	1694	1434	3356	3231	1487	1213	3511	3403	1489	1211	3567	3459	1111	817	3747	3670	728	419	3923	3877
55	2.094	0.037	0.037	0.999	0.037	1645	1573	1082	964	1731	1601	1856	1734	1811	1588	3139	3014	1683	1445	3349	3234	1475	1225	3505	3406	1477	1223	3561	3462	1099	830	3741	3671	715	432	3919	3877
50	1.904	0.033	0.033	0.999	0.033	1642	1576	1074	967	1725	1607	1848	1738	1801	1599	3131	3018	1673	1456	3341	3237	1464	1236	3498	3408	1466	1234	3554	3464	1087	842	3736	3672	702	445	3915	3877
45	1.713	0.030	0.030	1.000	0.030	1639	1579	1066	970	1719	1613	1841	1741	1791	1609	3123	3021	1662	1467	3334	3240	1453	1248	3491	3411	1455	1246	3547	3467	1075	855	3731	3673	690	458	3911	3877
40	1.523	0.027	0.027	1.000	0.027	1636	1583	1058	973	1713	1619	1833	1744	1781	1619	3115	3025	1651	1478	3326	3243	1442	1259	3485	3413	1443	1258	3541	3469	1062	867	3725	3674	677	471	3907	3876
35	1.333	0.023	0.023	1.000	0.023	1633	1586	1051	976	1708	1625	1825	1747	1771	1630	3107	3028	1641	1489	3319	3246	1430	1271	3478	3415	1432	1270	3534	3471	1050	879	3720	3675	664	484	3903	3876
30	1.142	0.020	0.020	1.000	0.020	1630	1590	1043	979	1702	1631	1817	1750	1761	1640	3099	3031	1630	1500	3312	3249	1419	1282	3471	3417	1420	1281	3527	3473	1038	891	3715	3676	651	497	3899	3876
25	0.952	0.017	0.017	1.000	0.017	1626	1593	1035	982	1696	1637	1809	1754	1751	1650	3091	3035	1619	1511	3304	3252	1408	1294	3464	3420	1409	1293	3520	3476	1026	904	3709	3677	638	510	3895	3875
20	0.761	0.013	0.013	1.000	0.013	1623	1597	1027	985	1690	1643	1801	1757	1741	1660	3083	3038	1608	1521	3297	3255	1396	1305	3458	3422	1397	1305	3514	3478	1014	916	3703	3678	625	522	3890	3875
15	0.571	0.010	0.010	1.000	0.010	1620	1600	1019	987	1685	1649	1793	1760	1731	1671	3075	3041	1597	1532	3289	3258	1385	1317	3451	3424	1386	1316	3507	3480	1002	928	3698	3679	613	535	3886	3875
10	0.381	0.007	0.007	1.000	0.007	1617	1603	1012	990	1679	1655	1785	1763	1721	1681	3067	3045	1587	1543	3281	3261	1374	1328	3444	3426	1374	1328	3500	3482	989	941	3692	3680	600	548	3882	3874
5	0.190	0.003	0.003	1.000	0.003	1613	1607	1004	993	1673	1661	1777	1766	1711	1691	3059	3048	1576	1554	3274	3263	1362	1340	3437	3428	1363	1339	3493	3484	977	953	3687	3680	587	561	3877	3874
0	0.000	0.000	0.000	1.000	0.000	1610	1610	996	996	1667	1667	1769	1769	1701	1701	3051	3051	1565	1565	3266	3266	1351	1351	3430	3430	1351	1351	3486	3486	965	965	3681	3681	574	574	3873	3873

REFER TO FIGURE-4A
E=[ab+(h x tan α)] x cos α
F=[ab- (h x tan α)] x cos α
H1=(Ca/2)+(h / cos α)+(Ab-h x tan α)xsin α
H2=(Ca/2)+(h/ cos α)-(ab+h x tan α)xsin α

ab=Ab=Distance from center line of vehicle to K.E for Tangent track at height 'h' from rail level
ac=Distance from center line of Tangent track to K.E for Canted track at height 'h' from rail level.
bc=hxtan α=Lateral increment due to cant(measured along the line parallel to line joining top of rails.

APPENDIX-3A(AG)

CANT EFFECT ON KINEMATIC ENVELOPE-HORIZONTAL SURFACE (AT-GRADE) SECTIONS- BALLASTED TRACK

Height above rail level measured perpendicular to plane of track →							h= 987				h= 1760				h= 3040				h= 3241				h= 3295				h= 3390				h= 3446				h= 3885			
Distance from center line of track to K.E for tangent track. →							ab= 1625				ab= 1686				ab= 1730				ab= 1591				ab= 1530				ab= 1380				ab= 1380				ab= 470			
Cant	Angle a	Sin a	Angle a	cos a	tan a		E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2
125	4.764	0.083	0.083	0.997	0.083		1701	1537	1181	911	1826	1534	1956	1676	1977	1472	3236	2948	1855	1316	3424	3160	1798	1251	3473	3460	1657	1094	3555	3326	1661	1089	3611	3382	791	146	3973	3895
120	4.573	0.080	0.080	0.997	0.080		1699	1541	1173	914	1821	1540	1949	1680	1967	1482	3228	2952	1844	1328	3418	3164	1788	1262	3467	3223	1646	1105	3549	3329	1650	1101	3605	3385	778	159	3970	3895
115	4.382	0.076	0.076	0.997	0.077		1696	1545	1166	917	1816	1547	1941	1684	1957	1493	3221	2956	1834	1339	3411	3167	1777	1274	3460	3226	1635	1117	3543	3332	1639	1113	3599	3388	765	172	3967	3895
110	4.191	0.073	0.073	0.997	0.073		1693	1549	1158	921	1810	1553	1934	1687	1948	1503	3213	2960	1824	1350	3404	3171	1767	1285	3453	3229	1624	1129	3537	3335	1628	1124	3593	3391	753	185	3964	3895
105	4.001	0.070	0.070	0.998	0.070		1690	1552	1150	924	1805	1559	1926	1691	1938	1514	3206	2964	1813	1361	3397	3175	1756	1296	3446	3233	1613	1140	3531	3338	1617	1136	3586	3394	740	198	3961	3895
100	3.810	0.066	0.066	0.998	0.067		1687	1556	1143	927	1799	1565	1918	1694	1928	1524	3198	2968	1803	1372	3390	3178	1746	1308	3439	3236	1602	1152	3524	3341	1606	1148	3580	3397	727	211	3958	3895
95	3.619	0.063	0.063	0.998	0.063		1684	1559	1135	930	1794	1572	1910	1698	1918	1535	3191	2972	1792	1383	3382	3182	1735	1319	3433	3239	1591	1163	3518	3344	1595	1160	3574	3400	714	224	3954	3895
90	3.428	0.060	0.060	0.998	0.060		1681	1563	1127	933	1788	1578	1903	1701	1909	1545	3183	2976	1782	1394	3375	3185	1724	1330	3426	3243	1580	1175	3511	3346	1584	1171	3567	3402	701	237	3951	3895
85	3.238	0.056	0.057	0.998	0.057		1678	1567	1120	936	1783	1584	1895	1704	1899	1556	3175	2980	1772	1405	3368	3188	1714	1341	3419	3246	1569	1186	3505	3349	1572	1183	3561	3405	689	250	3948	3895
80	3.047	0.053	0.053	0.999	0.053		1675	1570	1112	939	1777	1590	1887	1708	1889	1566	3168	2984	1761	1416	3361	3192	1703	1353	3412	3249	1558	1198	3499	3352	1561	1195	3554	3408	676	263	3944	3895
75	2.856	0.050	0.050	0.999	0.050		1672	1574	1104	942	1772	1596	1879	1711	1879	1576	3160	2988	1751	1428	3354	3195	1692	1364	3405	3252	1547	1209	3492	3355	1550	1207	3548	3410	663	276	3941	3894
70	2.666	0.047	0.047	0.999	0.047		1669	1577	1097	945	1766	1602	1872	1715	1870	1587	3152	2991	1740	1439	3346	3198	1682	1375	3398	3255	1536	1221	3486	3357	1539	1218	3541	3413	650	289	3938	3894
65	2.475	0.043	0.043	0.999	0.043		1666	1581	1089	948	1760	1608	1864	1718	1860	1597	3144	2995	1729	1450	3339	3202	1671	1386	3391	3258	1525	1232	3479	3360	1528	1230	3535	3416	637	302	3934	3894
60	2.285	0.040	0.040	0.999	0.040		1663	1584	1081	951	1755	1614	1856	1721	1850	1607	3137	2999	1719	1461	3332	3205	1660	1397	3383	3261	1514	1244	3472	3362	1516	1242	3528	3418	625	315	3931	3893
55	2.094	0.037	0.037	0.999	0.037		1660	1588	1073	954	1749	1621	1848	1725	1840	1618	3129	3002	1708	1471	3324	3208	1649	1409	3376	3264	1503	1255	3466	3365	1505	1253	3522	3421	612	328	3927	3893
50	1.904	0.033	0.033	0.999	0.033		1657	1591	1065	957	1744	1627	1840	1728	1830	1628	3121	3006	1698	1482	3317	3211	1639	1420	3369	3267	1492	1267	3459	3367	1494	1265	3515	3423	599	341	3923	3892
45	1.713	0.030	0.030	1.000	0.030		1654	1595	1058	960	1738	1633	1832	1731	1820	1638	3113	3009	1687	1493	3310	3214	1628	1431	3362	3270	1481	1278	3452	3370	1482	1276	3508	3426	586	354	3920	3892
40	1.523	0.027	0.027	1.000	0.027		1651	1598	1050	963	1732	1639	1824	1735	1810	1649	3105	3013	1677	1504	3302	3218	1617	1442	3355	3273	1470	1289	3445	3372	1471	1288	3501	3428	573	367	3916	3891
35	1.333	0.023	0.023	1.000	0.023		1648	1602	1042	966	1726	1645	1816	1738	1800	1659	3097	3016	1666	1515	3295	3221	1606	1453	3347	3276	1458	1301	3439	3374	1460	1299	3495	3430	560	380	3912	3891
30	1.142	0.020	0.020	1.000	0.020		1644	1605	1034	969	1721	1651	1808	1741	1790	1669	3089	3020	1655	1526	3287	3224	1595	1464	3340	3279	1447	1312	3432	3377	1448	1311	3488	3433	547	392	3909	3890
25	0.952	0.017	0.017	1.000	0.017		1641	1608	1026	972	1715	1657	1800	1744	1780	1679	3081	3023	1645	1537	3279	3227	1585	1475	3332	3282	1436	1323	3425	3379	1437	1323	3481	3435	534	405	3905	3889
20	0.761	0.013	0.013	1.000	0.013		1638	1612	1019	975	1709	1662	1792	1747	1770	1689	3073	3027	1634	1548	3272	3230	1574	1486	3325	3284	1425	1335	3418	3381	1426	1334	3474	3437	522	418	3901	3888
15	0.571	0.010	0.010	1.000	0.010		1635	1615	1011	978	1703	1668	1784	1751	1760	1700	3065	3030	1623	1559	3264	3232	1563	1497	3318	3287	1414	1346	3411	3384	1414	1346	3467	3440	509	431	3897	3888
10	0.381	0.007	0.007	1.000	0.007		1632	1618	1003	981	1698	1674	1776	1754	1750	1710	3056	3033	1612	1569	3256	3235	1552	1508	3310	3290	1402	1357	3404	3386	1403	1357	3460	3442	496	444	3893	3887
5	0.190	0.003	0.003	1.000	0.003		1628	1622	995	984	1692	1680	1768	1757	1740	1720	3048	3037	1602	1580	3249	3238	1541	1519	3303	3292	1391	1369	3397	3388	1391	1369	3453	3444	483	457	3889	3886
0	0.000	0.000	0.000	1.000	0.000		1625	1625	987	987	1686	1686	1760	1760	1730	1730	3040	3040	1591	1591	3241	3241	1530	1530	3295	3295	1380	1380	3390	3390	1380	1380	3446	3446	470	470	3885	3885

REFER TO FIGURE-4A

E=[ab+(h x tan α)] x cos α

F=[ab- (h x tan α)] x cos α

H1=(Ca/2)+(h / cos α)+(Ab-h x tan α)xsin α

H2=(Ca/2)+(h/ cos α)-(ab+h x tan α)xsin α

ab=Ab=Distance from center line of vehicle to K.E for Tangent track at height 'h' from rail level

ac=Distance from center line of Tangent tack to K.E for Canted track at height 'h' from rail level.

bc=hxtan α=Lateral increment due to cant(measured along the line parallel to line joining top of rails.

APPENDIX-4 (TNL)

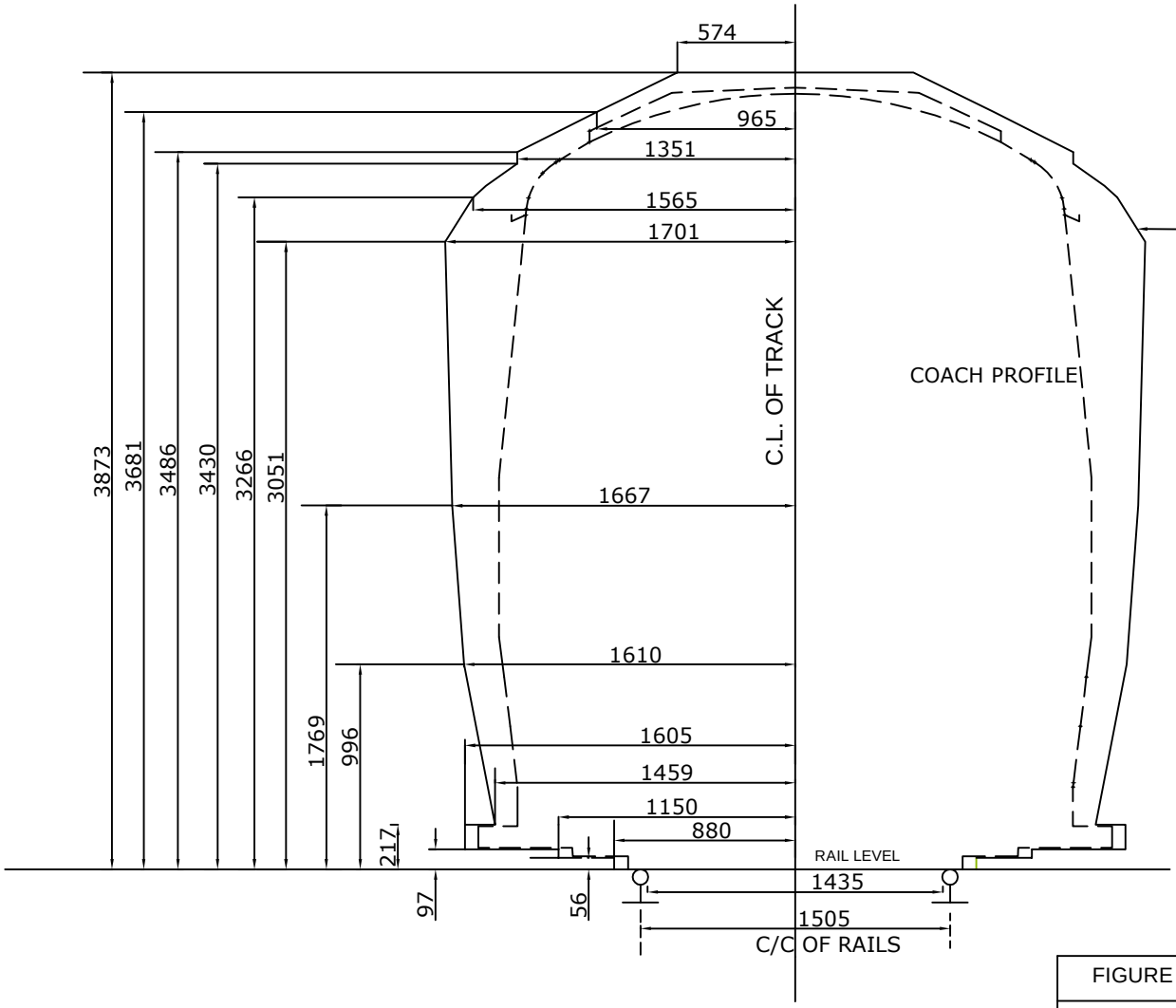
LATERAL AND VERTICAL SHIFT OF CENTRE OF CICULAR TUNNEL
FOR DIFFERENT CANT VALUES (WITH D1=760 mm)
REFER TO FIGURE-3 AND PARAs 1.6.1 (B)-b AND 1.6.2 (B)-b

All figures are in mm

CANT (mm)	Angle α in degrees	Lateral shift of tunnel centre=X	Vertical shift of tunnel centre=Y	REMARKS
125	4.764	155	56	
120	4.573	149	54	(a) THE CANT IS PROVIDED BY ROTATING THE TUNNEL ABOUT THE MID POINT OF TOP OF INNER RAIL
115	4.382	143	52	THIS WILL RESULT IN LATERAL AND VERTICAL SHIFT OF THE CENTRE OF THE CIRCULAR TUNNEL.
110	4.191	136	50	
105	4.001	130	48	(b) LATERAL SHIFT OF THE CENTRE OF TUNNEL (TOWARDS INSIDE OF CURVE)
100	3.81	124	46	X= [{2 x (r-D1)/sin θ} x { sin α/2}] x cos (90- θ - α/2)
95	3.619	118	44	(c) VERTICAL SHIFT OF THE CENTRE OF TUNNEL (UPWARDS)
90	3.428	111	42	Y=[{2 X (r-D1)/sin θ} x { sin α/2}] x sin (90- θ- α/2)
85	3.238	105	40	Where 'r' is internal radius of the circular tunnel=2600 mm
80	3.047	99	37	D1 = depth from rail level to invert of circular tunnel=760 mm
75	2.856	93	35	α= angle of rotation=sin-1 (Cant/g) and
70	2.666	86	33	θ= angle subtended by line joining top of two rails and the line joining mid point of top of inner rail and the centre of circular Tunnel
65	2.475	80	31	
60	2.285	74	29	= tan-1[(r-D1) / (g/2)] in degrees=
55	2.094	68	26	67.75703907
50	1.904	62	24	g= Centre to centre of rails = 1505 mm
45	1.713	55	22	
40	1.523	49	19	
35	1.333	43	17	
30	1.142	37	15	
25	0.952	31	12	
20	0.761	25	10	
15	0.571	18	7	
10	0.381	12	5	
5	0.19	6	2	
0	0	0	0	

APPENDIX-5
UNDER GROUND, ELEVATED AND SURFACE STATIONS
ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES
REFERENCE: PARA 2.7

RADIUS (meters)	CANT Ca (mm)	EXTRA ALLOWANCE (mm)		REMARKS
		INSIDE OF CURVE	OUTSIDE OF CURVE	
3000	0	9	10	Extra allowance for curves:
2400	0	12	13	(a) Inside of curve := Midthrow
2000	0	14	15	= (27940/R)
1800	0	16	17	b) Outside of curve: = End throw
1600	0	17	19	=(30610/R)
1500	0	19	20	Additional sway has not been taken to reduce the extra clearance on curved
1200	0	23	26	platforms for the safety of the passengers.
1000	0	28	31	Distance between bogie centers=C.C=14700+/- 250 mm.
				For worst condition:
				C for midthrow is taken as 14.95 M & for end throw as 14.45 M
				C1= Length of vehicle = 21.3 M
				No Cant or Gauge widening is to be provided



NOTES:
1. ALL DIMENSIONS ARE IN mm
2. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVES INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA
3. KINEMATIC ENVELOPE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION

FIGURE NO. 1(TNL/AG/ELE)	REFERENCE: PARA NO. 1.4 (a), 3.1(4) (i), 3.2

KOLKATA METRO RAIL CORPORATION LTD.

STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

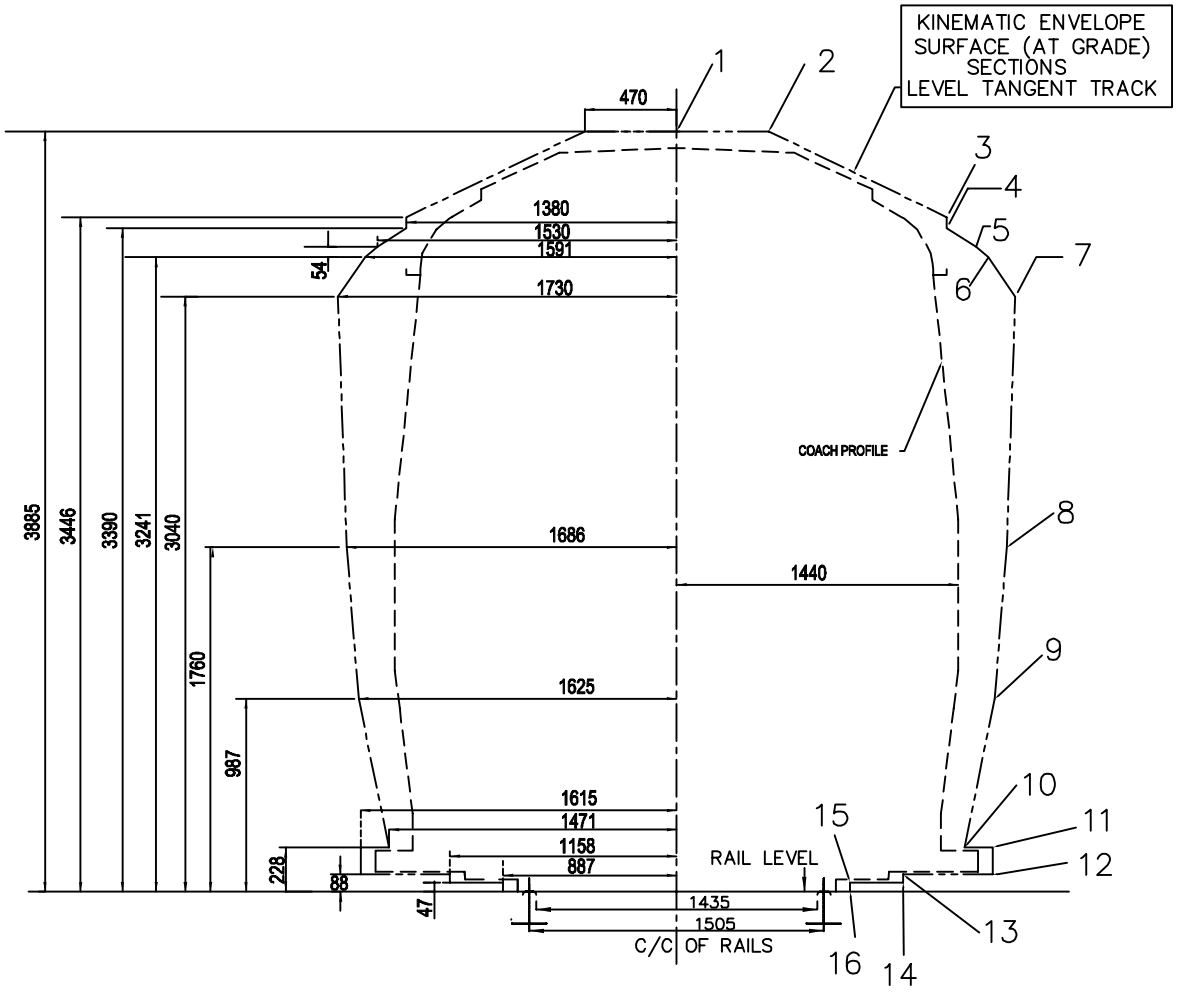
CONSULTANTS

MAUNSELL AECOM | yec | egis Rail | LHPA

DATE: June 2011

SCALE: NOT TO SCALE

KINEMATIC ENVELOPE FOR
UNDER GROUND, AT GRADE AND ELEVATED SECTIONS WITH BALLASTLESS TRACK ON LEVEL/CONSTANT GRADE TANGENT TRACK



NOTES

1. ALL DIMENSIONS ARE IN mm
2. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA
3. KINEMATIC ENVELOPE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION

FIGURE NO. 1(AG)	REFERENCE: PARA NO. 1.4 (b), 3.1 (4) (ii), 3.2

KOLKATA METRO RAIL CORPORATION LTD.

STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

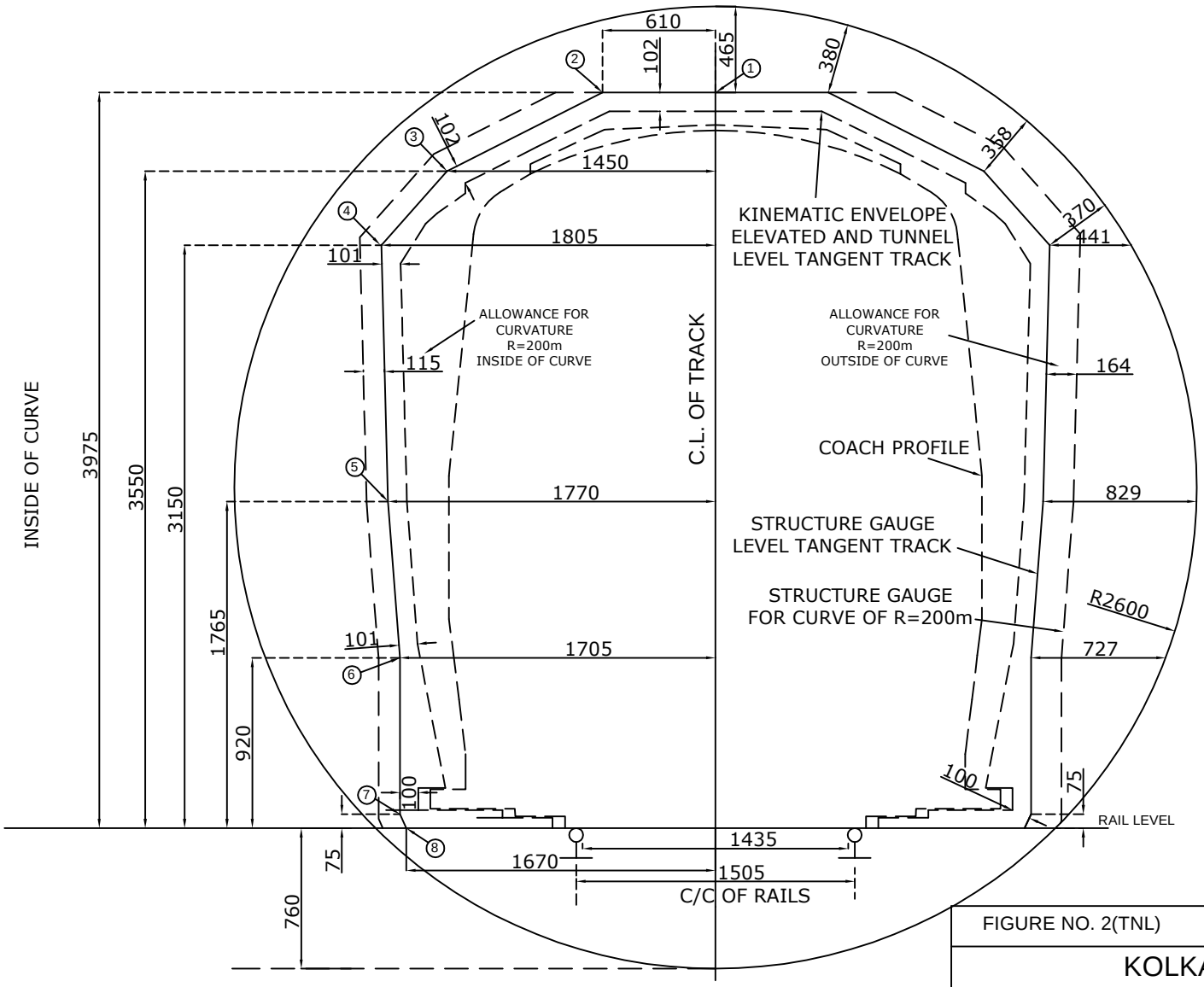
CONSULTANTS

MAUNSELL AECOM ysc egis rail LHPA

DATE: August 2010

SCALE: NOT TO SCALE

KINEMATIC ENVELOPE FOR SURFACE (AT–GRADE) SECTIONS BALLASTED TRACK ON LEVEL/ CONSTANT GRADE TANGENT TRACK



COORDINATES

POINT	X	Y
1	0	3975
2	610	3975
3	1450	3550
4	1805	3150
5	1770	1765
6	1705	920
7	1705	75
8	1670	0

NOTES:

1. ALL DIMENSIONS ARE IN mm
2. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVE (INCLUDING VERTICAL CURVE) AND CANT SHALL BE EXTRA
3. CANT WILL BE PROVIDED BY RAISING OUTER RAIL AND SHIFTING OF THE CENTRE OF CIRCULAR TUNNEL TOWARDS INSIDE OF CURVE AND UPWARDS.THIS WILL HAVE SAME EFFECT AS ROTATING THE CIRCULAR TUNNEL ABOUT THE MID POINT OF TOP OF INNER RAIL
4. STRUCTURE GAUGE AND KINEMATIC ENVELOPE ARE VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION
5. MINIMUM CLEARANCE BETWEEN KINEMATIC ENVELOPE AND STRUCTURE GAUGE IS 100mm
6. FOR DETAILS OF KINEMATIC ENVELOPE, REFER TO FIGURE NO. 1 - (TNL/AG/ELE)

FIGURE NO. 2(TNL) | REFERENCE: PARA NO. 1.3.1(a), 1.5.1

KOLKATA METRO RAIL CORPORATION LTD.

STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

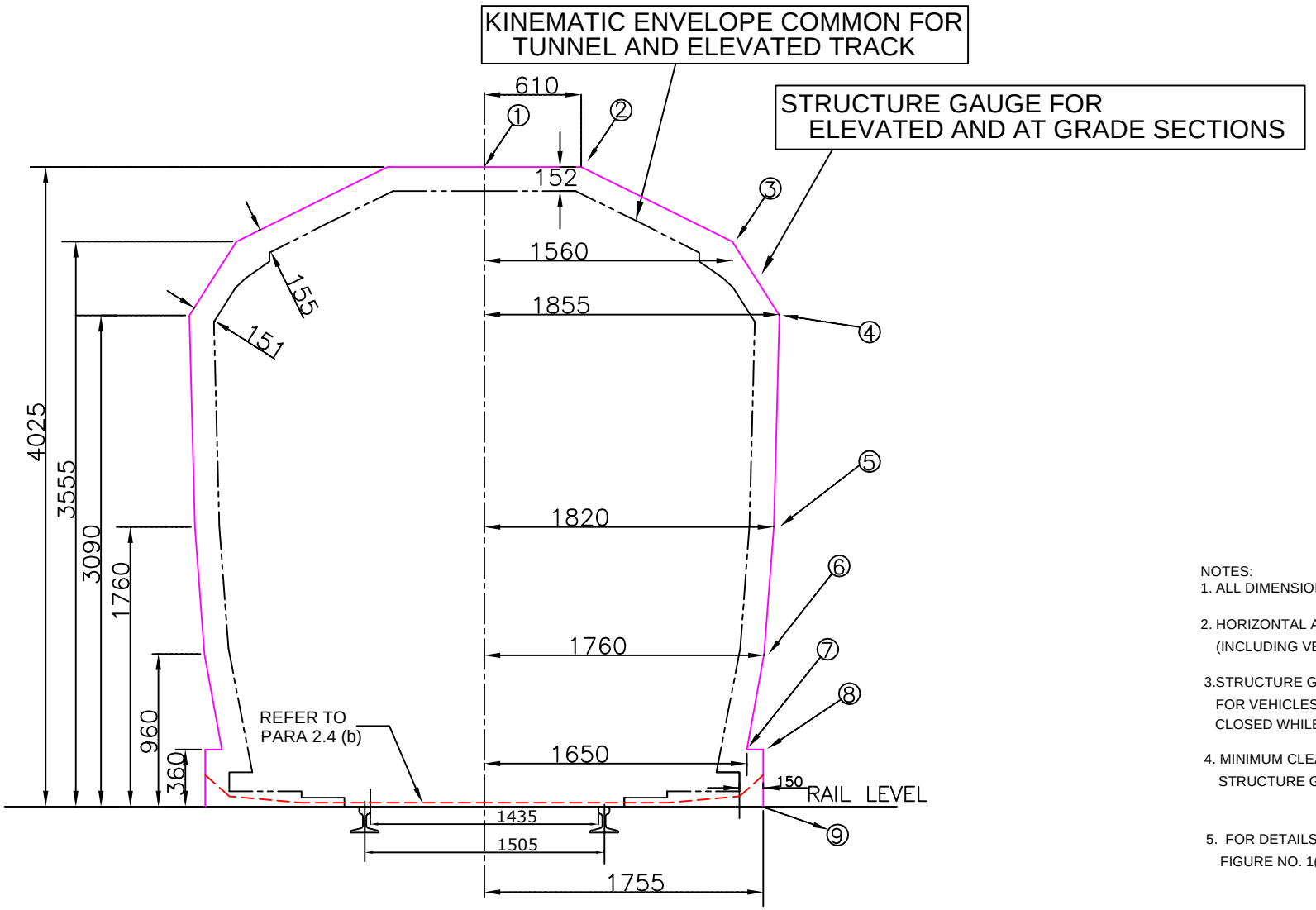
CONSULTANTS

MAUNSELL AECOM | yec | egis Rail | LHPA

DATE: June 2011

SCALE: NOT TO SCALE

STRUCTURE GAUGE FOR
LEVEL/CONSTANT GRADE TANGENT TRACK AND CURVED TRACK WITH RADIUS = 200m CIRCULAR TUNNEL (5200 mm DIA) RECTANGULAR BOX TUNNEL OUTSIDE STATIONS



COORDINATES

POINT	X	Y
1	0	4025
2	610	4025
3	1560	3555
4	1855	3090
5	1820	1760
6	1760	960
7	1650	360
8	1755	360
9	1755	0

NOTES:
1. ALL DIMENSION ARE IN mm.

2. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVE (INCLUDING VERTICAL CURVE) AND CANT SHALL BE EXTRA.

3.STRUCTURE GAUGE AND KINEMATIC ENVELOPE ARE VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED CLOSED WHILE IN MOTION

4. MINIMUM CLEARANCE BETWEEN KINEMATIC ENVELOPE AND STRUCTURE GAUGE IS 150 mm

5. FOR DETAILS OF KINEMATIC ENVELOPE, REFER TO FIGURE NO. 1(TNL/ELE)

FIGURE No. 2(ELE/AG) | REFERENCE : PARA 1.3.1 (b), 1.5.2

KLOKATA METRO RAIL CORPORATION LTD.

STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

STRUCTURE GAUGE

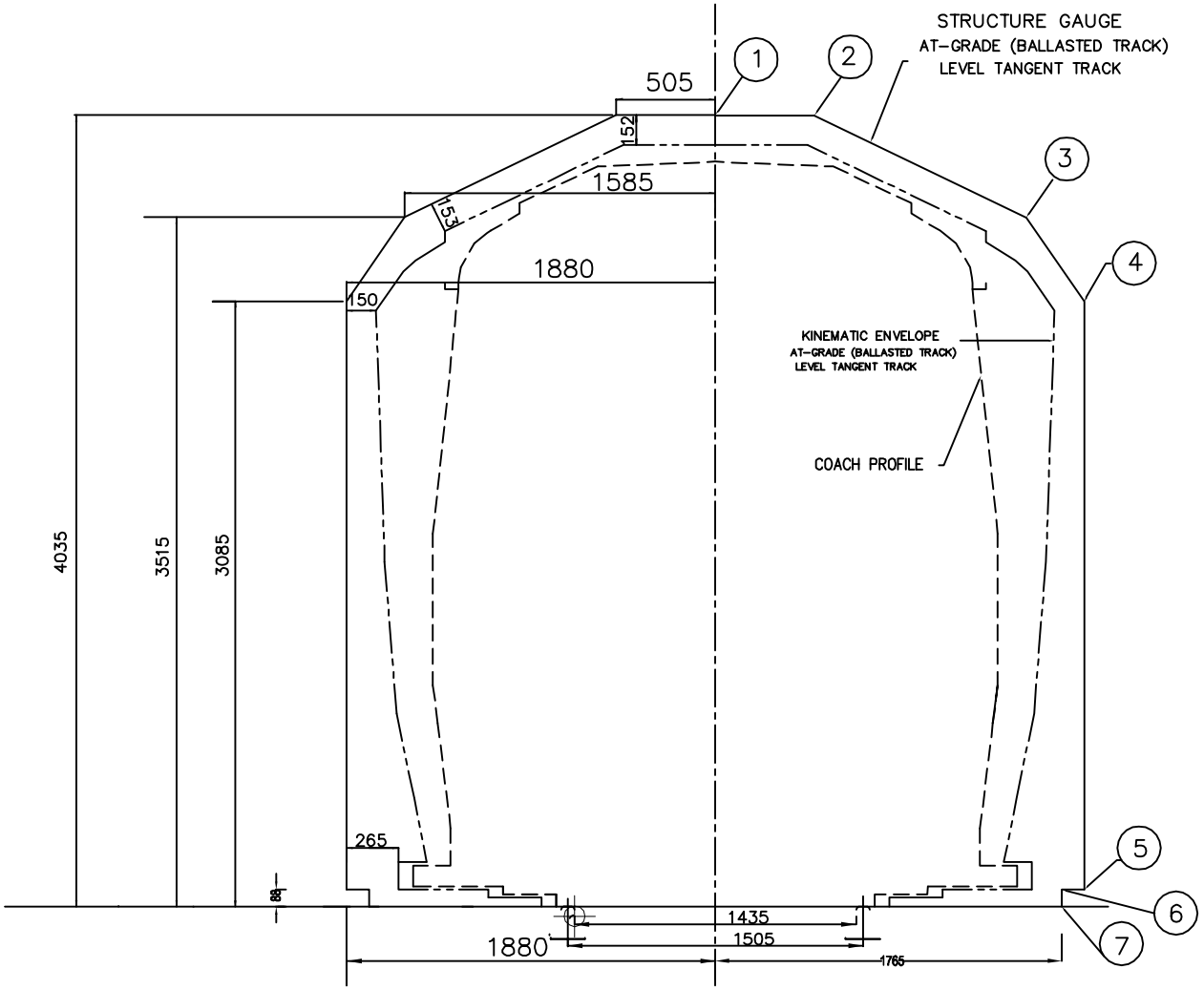
ON ELEVATED AND AT GRADE SECTIONS (BALLASTLESS TRACK) LEVEL/ CONSTANT GRADE TANGENT TRACK

OUTSIDE STATIONS

CONSULTANTS

DATE: June 2011

SCALE: NOT TO SCALE



COORDINATES

POINT	X	Y
1	0	4035
2	505	4035
3	1585	3515
4	1880	3085
5	1880	88
6	1765	88
7	1765	0

NOTES

1. ALL DIMENSIONS ARE IN mm
2. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA
3. STRUCTURE GAUGE AND KINEMATIC ENVELOPE ARE VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION
4. MINIMUM CLEARANCE BETWEEN KINEMATIC ENVELOPE AND STRUCTURE GAUGE IS 150 mm.
5. FOR DETAILS OF KINEMATIC ENVELOPE REFER TO FIGURE NO. 1(AG)

FIGURE NO.2(AG)	REFERENCE: PARA NO. 1.3.1(c), 1.5.3

KOLKATA METRO RAIL CORPORATION LTD.

STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

CONSULTANTS

MAUNSELL AECOM ybc egis Rail LHPA

DATE: June 2011

SCALE: NOT TO SCALE

STRUCTURE GAUGE FOR AT-GRADE SECTIONS (BALLASTED TRACK)

ON LEVEL/ CONSTANT GRADE TANGENT TRACK

OUTSIDE STATIONS

$\tan\theta = (r-D_1)/(g/2)$

$\theta = \tan^{-1}[(r-D_1)/(g/2)]$

$\sin\alpha = \text{cant}/g$

$\alpha = \sin^{-1}(\text{cant}/g)$

Chord $C_1C_2 = 2 \times [(r-D_1)/\sin\theta) \times (\sin\ \alpha/2)]$

$X = C_1C_2 \times \cos(90 - \theta - \alpha/2)$

$= 2 \times [\{(r-D_1)/\sin\theta\} \times (\sin\alpha/2)] \times \cos(90 - \theta - \alpha/2)$

$Y = 2 \times [\{(r-D_1)/\sin\theta\} \times (\sin\alpha/2)] \times \sin(90 - \theta - \alpha/2)$

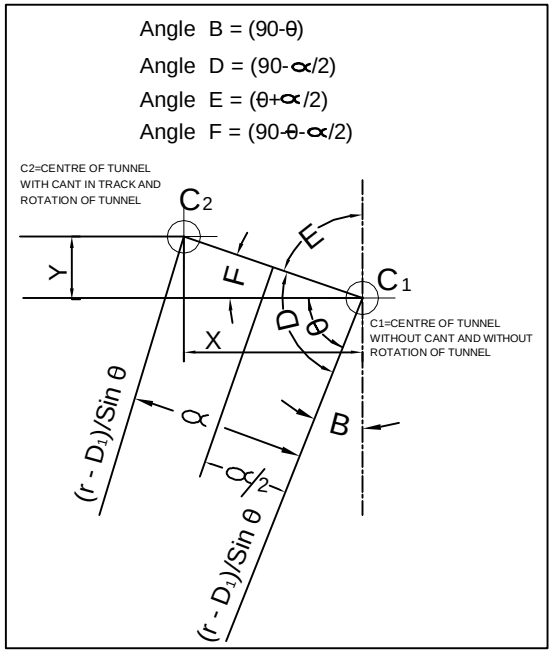
Where 'r' is internal radius of tunnel,

D_1 = depth from Rail level to invert of tunnel

g = distance between centres of rails

= 1505 mm

DETAIL AT CENTRE OF TUNNEL



NOTES:

1. THE CIRCULAR TUNNEL IS ROTATED ABOUT CENTRE OF TOP OF INNER RAIL
2. FOR VALUES OF SHIFT 'X' AND 'Y' FOR VARIOUS VALUES OF CANT, REFER TO APPENDIX -4(TNL)

POSITION OF TUNNEL WITH CANT AND ROTATION OF TUNNEL

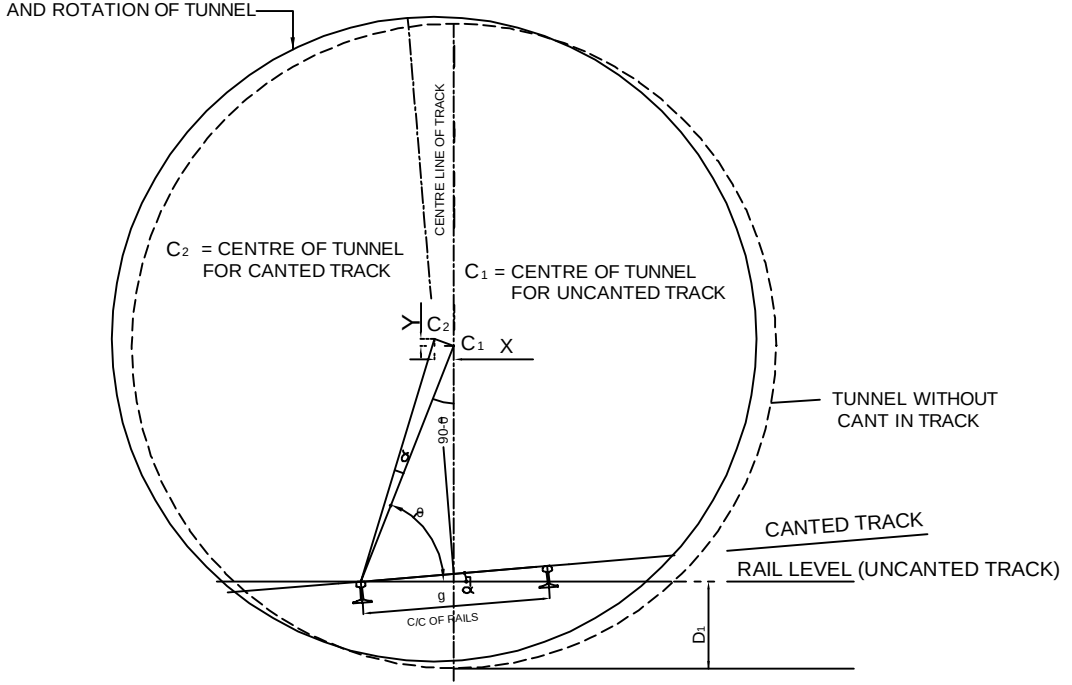


FIGURE No. 3	REFERENCE: PARA 1.6.1(B) (b) & 1.6.2(B) (b)

KOLKATA METRO RAIL CORPORATION LTD.

STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

CONSULTANTS

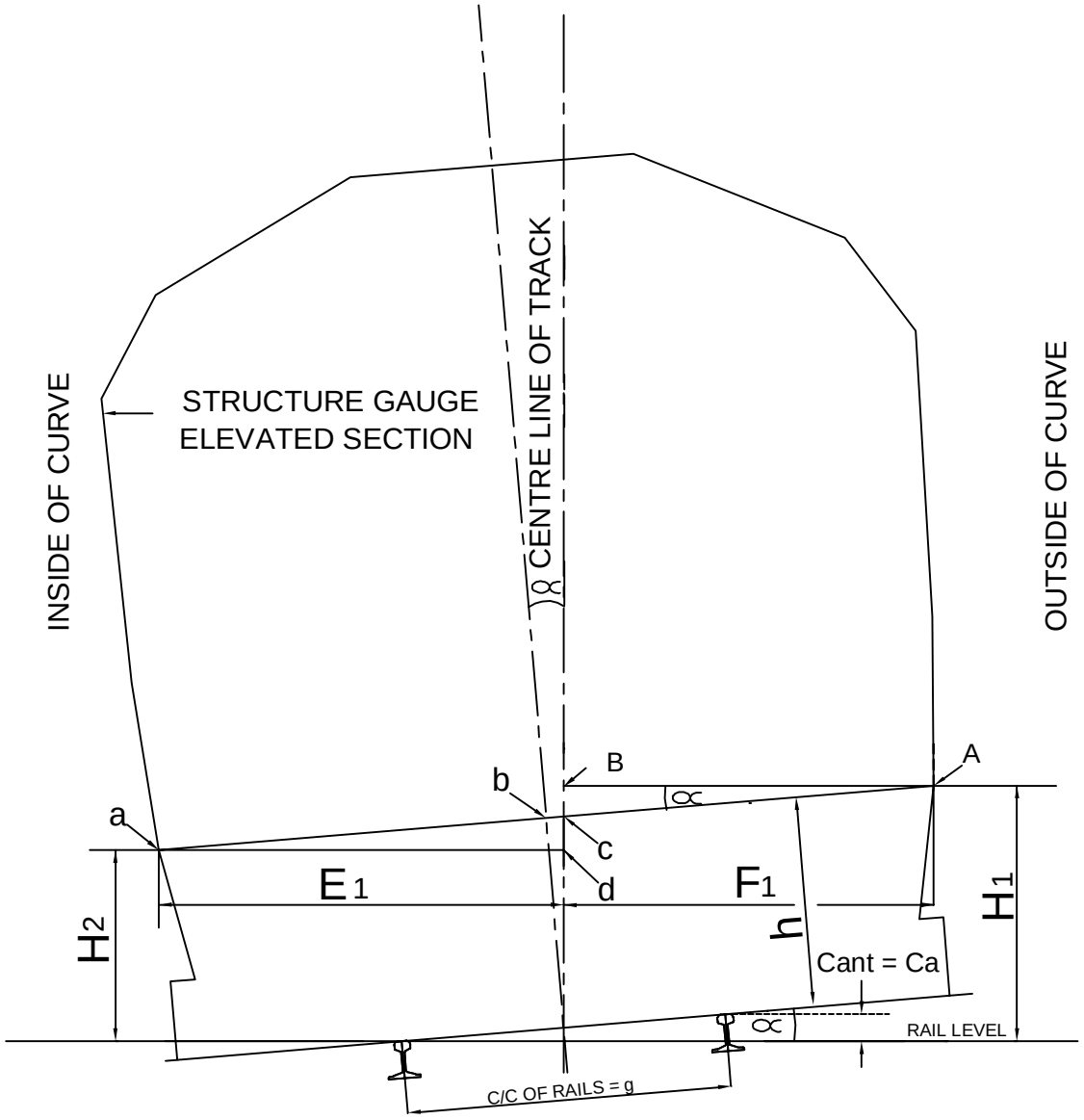
MAUNSELL AECOM | yec | egis Rail | LHPA

DATE: August 2010

SCALE: NOT TO SCALE

SHIFT OF THE CENTRE OF CIRCULAR TUNNEL

DUE TO ROTATION OF TUNNEL FOR CANT



ab=Ab= Distance from centerline of track to Structure Gauge for Tangent Track at height 'h'

$\sin \alpha$ = cant/g

g= 1505 mm

Ca = Cant applied

$E_1 = [ab + (h \times \tan \alpha)] \times \cos \alpha$

$F_1 = [Ab - (h \times \tan \alpha)] \times \cos \alpha$

$H_1 = (Ca/2) + (h/\cos \alpha) + (Ab - h \times \tan \alpha) \times \sin \alpha$

$H_2 = (Ca/2) + (h/\cos \alpha) - (ab + h \times \tan \alpha) \times \sin \alpha$

For values of E_1, F_1, H_1 AND H_2, refer to Appendix 3(TNL), 3(ELE) AND 3(AG).

NOTES:

1. STRUCTURE GAUGE FOR ELEVATED SECTION HAS BEEN SHOWN AS A TYPICAL FIGURE.

2. THE FORMULAE FOR E_1, F_1, H_1 AND H_2 SHOWN IN THIS FIGURE WILL ALSO APPLY TO UNDER GROUND (BOX STRUCTURES) AND SURFACE SECTIONS TOO.

FIGURE No. 4	REFERENCE : PARAS 1.6.1(B)(a) & 1.6.2(B)(a)

KOLKATA METRO RAIL CORPORATION LTD.

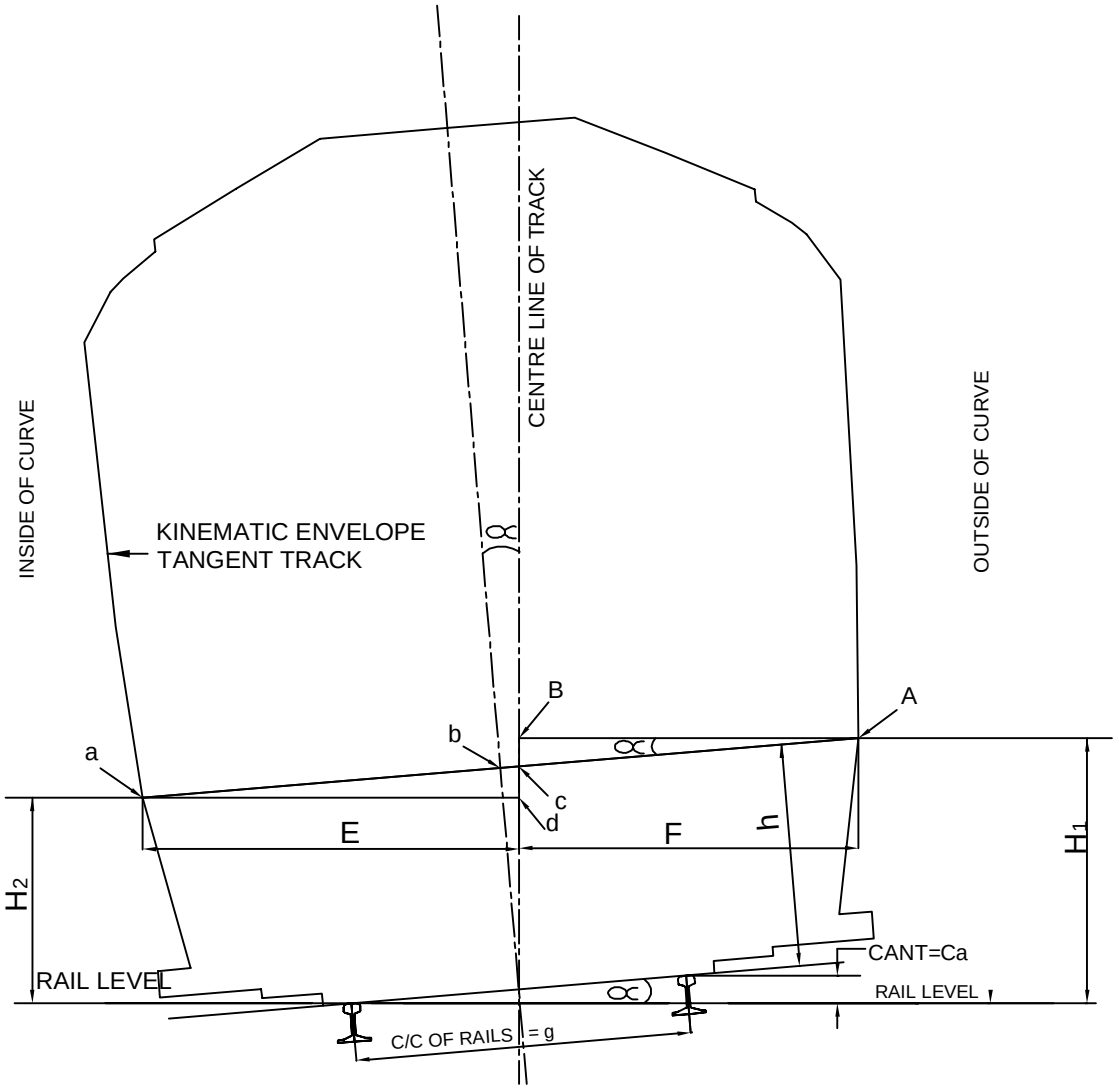
STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

CONSULTANTS

DATE: July 2009

SCALE: NOT TO SCALE

EFFECT OF CANT ON STRUCTURE GAUGE



ab=Ab= Distance from centerline of track to Kinematic Envelope for Tangent Track at height 'h'

$\sin\alpha$ = cant/g

g= 1505 mm

Ca = Cant applied

$E=[ab+(h \times \tan\alpha)] \times \cos\alpha$

$F=[Ab-(h \times \tan\alpha)] \times \cos\alpha$

$H_1=(Ca/2)+(h/\cos\alpha)+(Ab-h \times \tan\alpha) \times \sin\alpha$

$H_2=(Ca/2)+(h/\cos\alpha)-(ab+h \times \tan\alpha) \times \sin\alpha$

For values of E,F,H_1 and H_2, refer to Appendix - 3A(TNL/ELE) & 3A(AG)

NOTES:

1. THE KINEMATIC ENVELOPE SHOWN IN THIS IS FOR UNDER GROUND AND ELEVATED SECTIONS
2. THE FORMULAE USED IN THIS FIGURE, SHALL ALSO APPLICABLE TO BALLASTED TRACK ON SURFACE SECTIONS.

FIGURE NO. 4A	REFERENCE: PARA NO: 1.7.1
KOLKATA METRO RAIL COPORATION LTD.	
STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION	

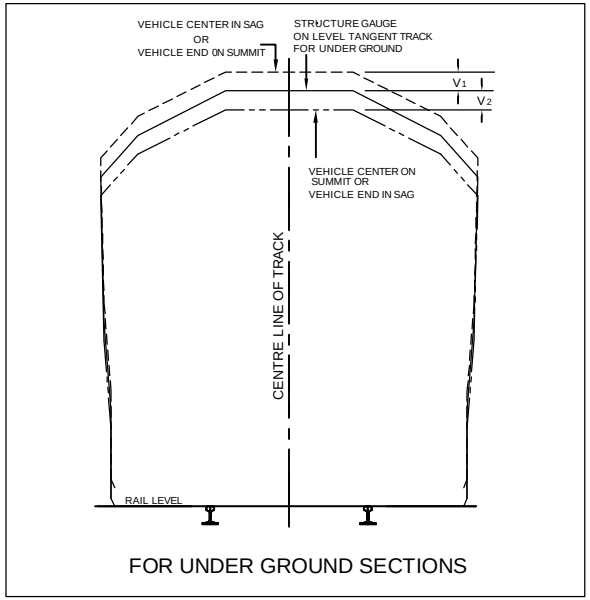
CONSULTANTS

MAUNSELL AECOM yec egis rail LHPA

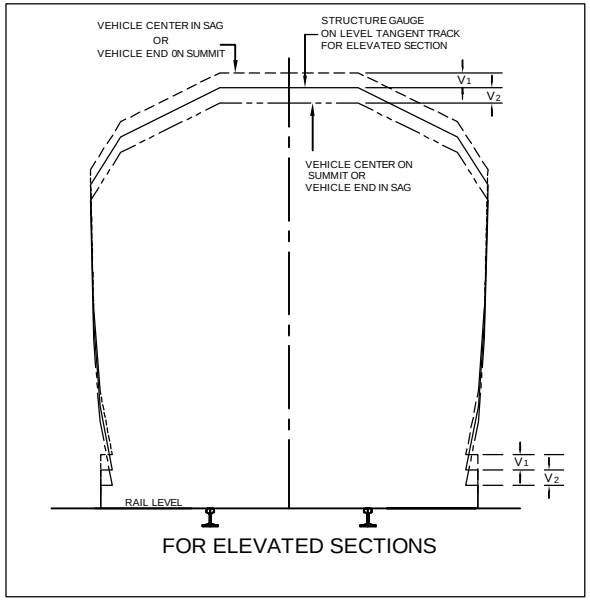
DATE: July 2009

SCALE: NOT TO SCALE

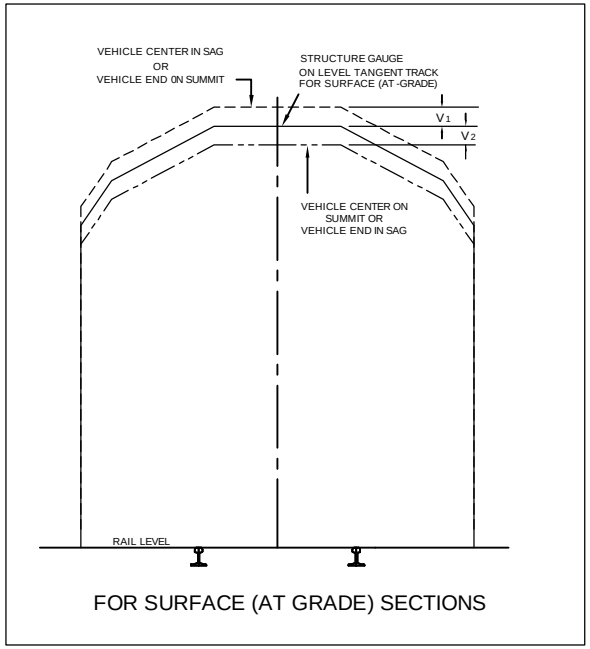
EFFECT OF CANT ON KINEMATIC ENEVELOPE



FOR UNDER GROUND SECTIONS



FOR ELEVATED SECTIONS



FOR SURFACE (AT GRADE) SECTIONS

NOTE:

THE VALUES OF V1 AND V2 ARE APPROXIMATELY EQUAL AND APPLY TO UNDER GROUND, ELEVATED AND SURFACE SECTIONS

VERTICAL THROW

RADIUS OF VERTICAL CURVE(M)	V_1 mm
1500	20
1600	19
1700	18
1800	17
1900	16
2000	15
2100	15
2200	14
2300	13
2400	13
2500	12
2600	12
2700	11
2800	11
2900	10
3000	10

FIGURE No. 5	REFERENCE PARA NO: 1.6.1(C) & 1.6.2(C)
KOLKATA METRO RAIL CORPORATION LTD.	
STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION	
EFFECT OF VERTICAL CURVE ON STRUCTURE GAUGE	

CONSULTANTS

MAUNSELL AECOM yec egis Rail LHPA

DATE: July 2009

SCALE: NOT TO SCALE

NOTE:

1. ALL DIMENSION ARE IN mm.
2. FOR STATION ON CURVE, EXTRA CLEARANCES FOR CURVATURE AND CANT SHALL BE PROVIDED
3. VERTICAL THROW DUE TO VERTICAL CURVE IF ANY SHALL BE EXTRA
4. THE STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
5. CLEARANCES 'A1' AND 'A2' SHALL BE AS APPROVED / REQUIRED
6. FOR KINEMATIC ENVELOPE, REFER TO FIGURE-1(TNL/ELE)

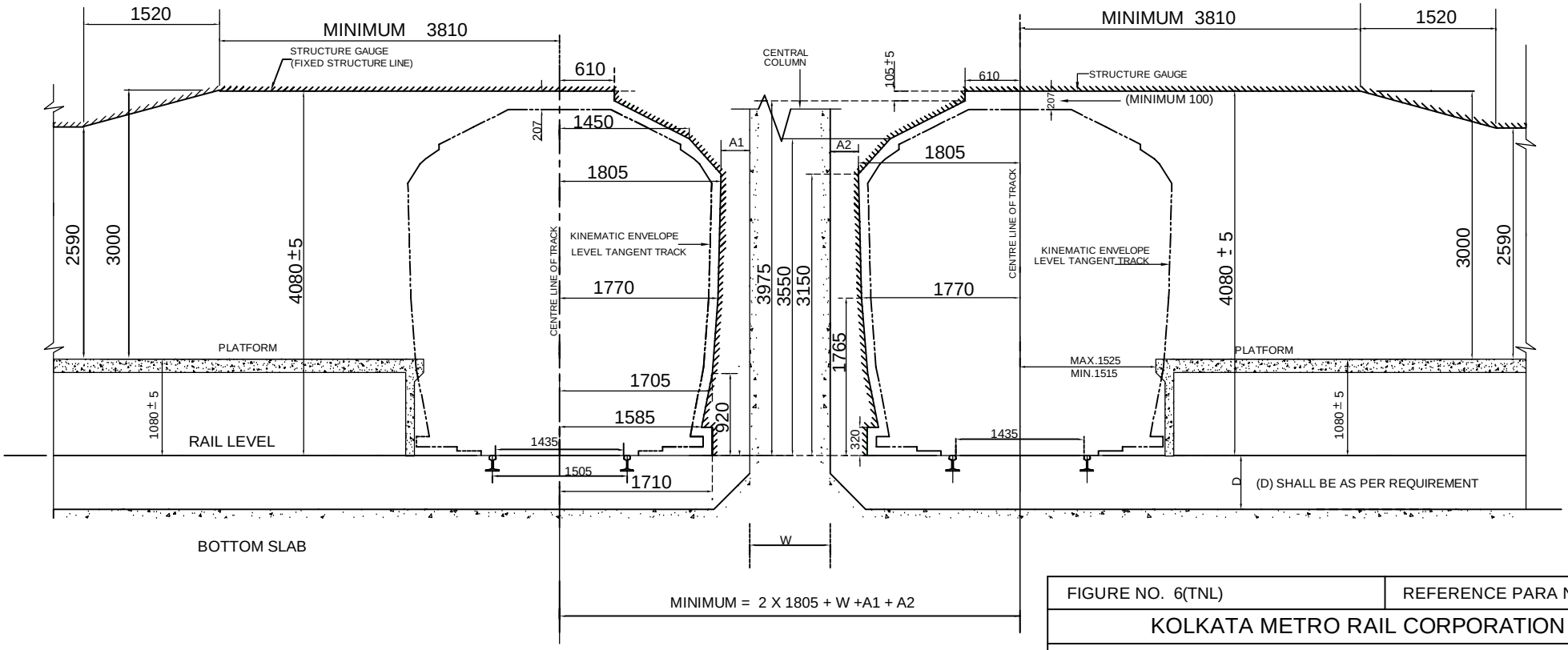


FIGURE NO. 6(TNL)	REFERENCE PARA NO: 2.2.5 (a)

KOLKATA METRO RAIL CORPORATION LTD.

STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

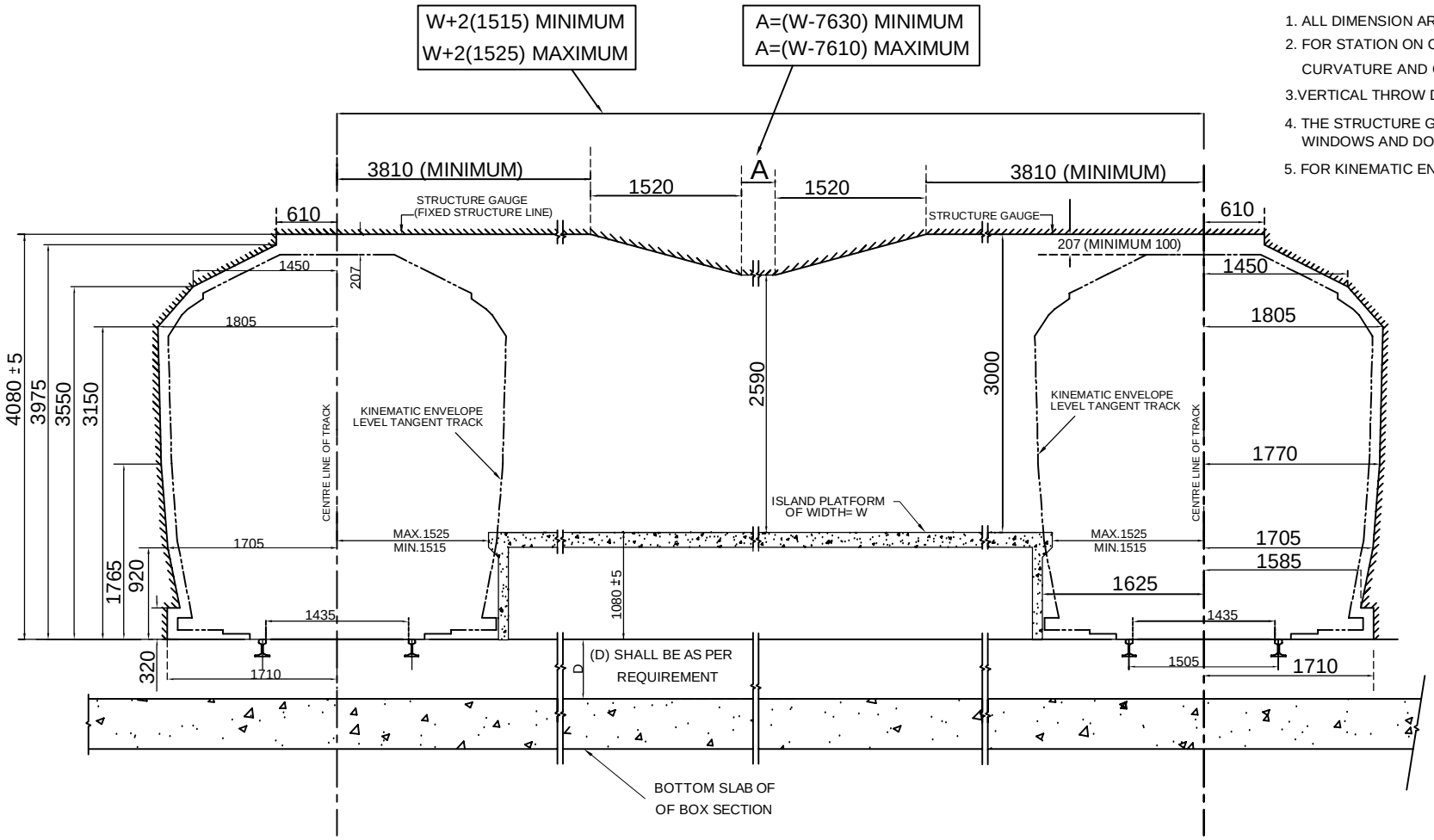
CONSULTANTS

MAUNSELL AECOM ysc egis Rail LHPA

DATE: July 2009

SCALE: NOT TO SCALE

STRUCTURE GAUGE FOR
UNDER GROUND STATION WITH SIDE PLATFORMS ON LEVEL/CONSTANT GRADE TANGENT TRACK
(RECTANGULAR BOX TUNNEL)



NOTE:

1. ALL DIMENSION ARE IN mm.
2. FOR STATION ON CURVE, EXTRA CLEARANCES FOR CURVATURE AND CANT SHALL BE PROVIDED
3. VERTICAL THROW DUE TO VERTICAL CURVE IF ANY SHALL BE EXTRA
4. THE STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
5. FOR KINEMATIC ENVELOPE, REFER TO FIGURE-1(TNL/ELE)

FIGURE NO. 6A(TNL)	REFERENCE PARA NO: 2.2.5 (a)

KOLKATA METRO RAIL CORPORATION LTD

STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION

CONSULTANTS

DATE: July 2009

SCALE: NOT TO SCALE

STRUCTURE GAUGE FOR
UNDER GROUND STATION
WITH AN ISLAND PLATFORM ON LEVEL/CONSTANT GRADE TANGENT TRACK

CLEARANCE BETWEEN ADJOINING STRUCTURE GAUGES FOR DIFFERENT TRACK CENTRES

TRACK CENTRES (A)	B	C	D	E	F
3800	290	500	280	160	90
3900	390	600	380	260	190
4000	490	700	480	360	290
4100	590	800	580	460	390
4150	640	850	630	510	440
4200	690	900	680	560	490
4250	740	950	730	610	540

NOTES :

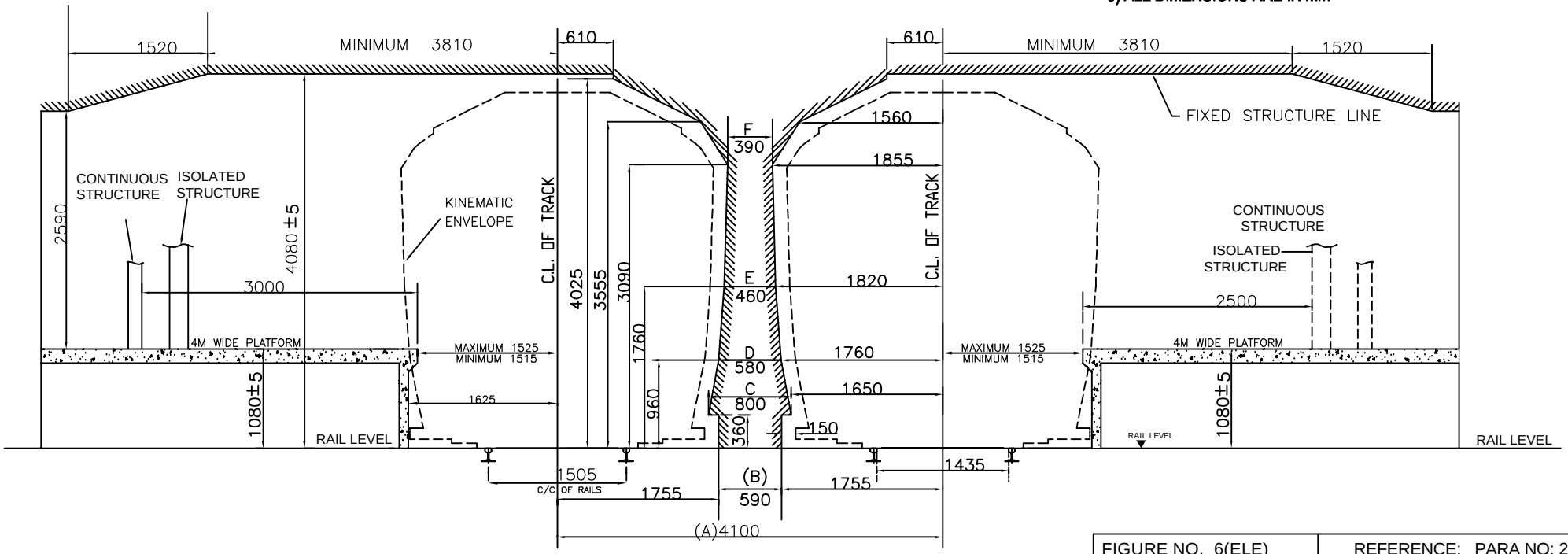
1) ALLOWANCE FOR CURVE SHALL BE EXTRA. HOWEVER THE TRACK CENTRES (A) WILL NOT BE AFFECTED FOR CURVES OF RADII 1000 M AND FLATTER IF THERE IS NO STRUCTURE BETWEEN THE TRACKS. IN CASE OF A STRUCTURE BETWEEN THE TRACKS, (A) SHALL BE CALCULATED.

2) VERTICAL THROW DUE TO VERTICAL CURVE IF ANY SHALL BE EXTRA

3) STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSEDWHILE IN MOTION

4) THE TRACK CENTRES DOES NOT ACCOUNT FOR PROVISION OF CROSS OVERS, STRUCTURES & OTHER SERVICES, IF REQUIRED, IN BETWEEN THE TRACKS

5) ALL DIMENSIONS ARE IN mm



TYPICAL FOR 4 M WIDE SIDE PLATFORMS.

FIGURE NO. 6(ELE)	REFERENCE: PARA NO: 2.2.5 (b)
KOLKATA METRO CORPRATION LTD.	
STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION	

CONSULTANTS

MAUNSELL AECOM yec egis Rail LHPA

DATE: July 2009

SCALE: NOT TO SCALE

STRUCTURE GAUGE AT
ELEVATED STATION
WITH 4 M WIDE SIDE PLATFORMS
ON LEVEL /CONSTANT GRADE TRACK

STATEMENT SHOWING CLEARANCES BETWEEN ADJOINING STRUCTURE GAUGES FOR DIFFERENT TRACK CENTRES

A	B	C	D	E	F
3800	270	490	260	40	40
3900	370	590	360	140	140
4000	470	690	460	240	240
4100	570	790	560	340	340
4150	620	810	610	390	390
4200	670	860	660	440	440
4250	720	910	710	490	490

NOTES :

1. ALLOWANCE FOR CURVE/CANT SHALL BE EXTRA.
   HOWEVER THE TRACK CENTRES WILL NOT INCREASE FOR PERMISSIBLE CURVES UPTO RADIUS OF 1000 M.
2. VERTICAL THROW DUE TO VERTICAL CURVES SHALL BE EXTRA.
3. STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION
4. THE TRACK CENTRES DOES NOT ACCOUNT FOR PROVISION OF CROSS OVERS, STRUCTURES & OTHER SERVICES, IF REQUIRED IN BETWEEN TRACKS
5. ALL DIMENSIONS ARE IN mm.

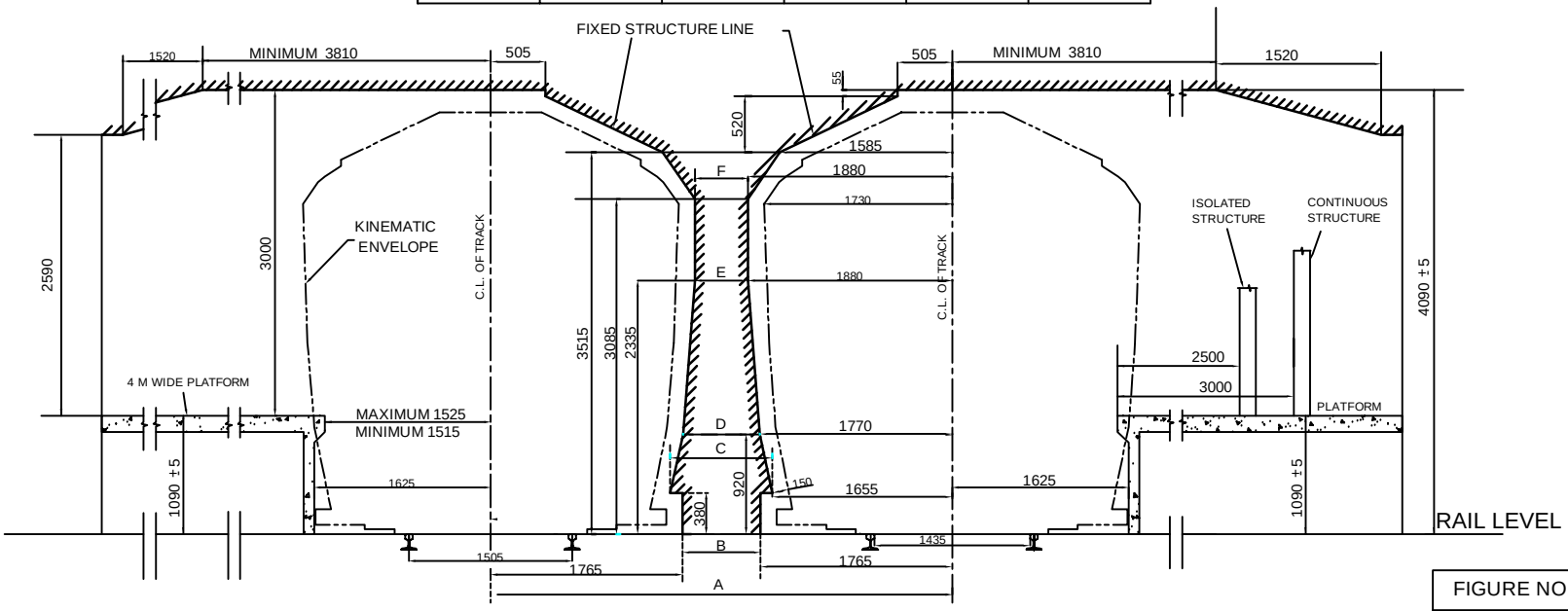
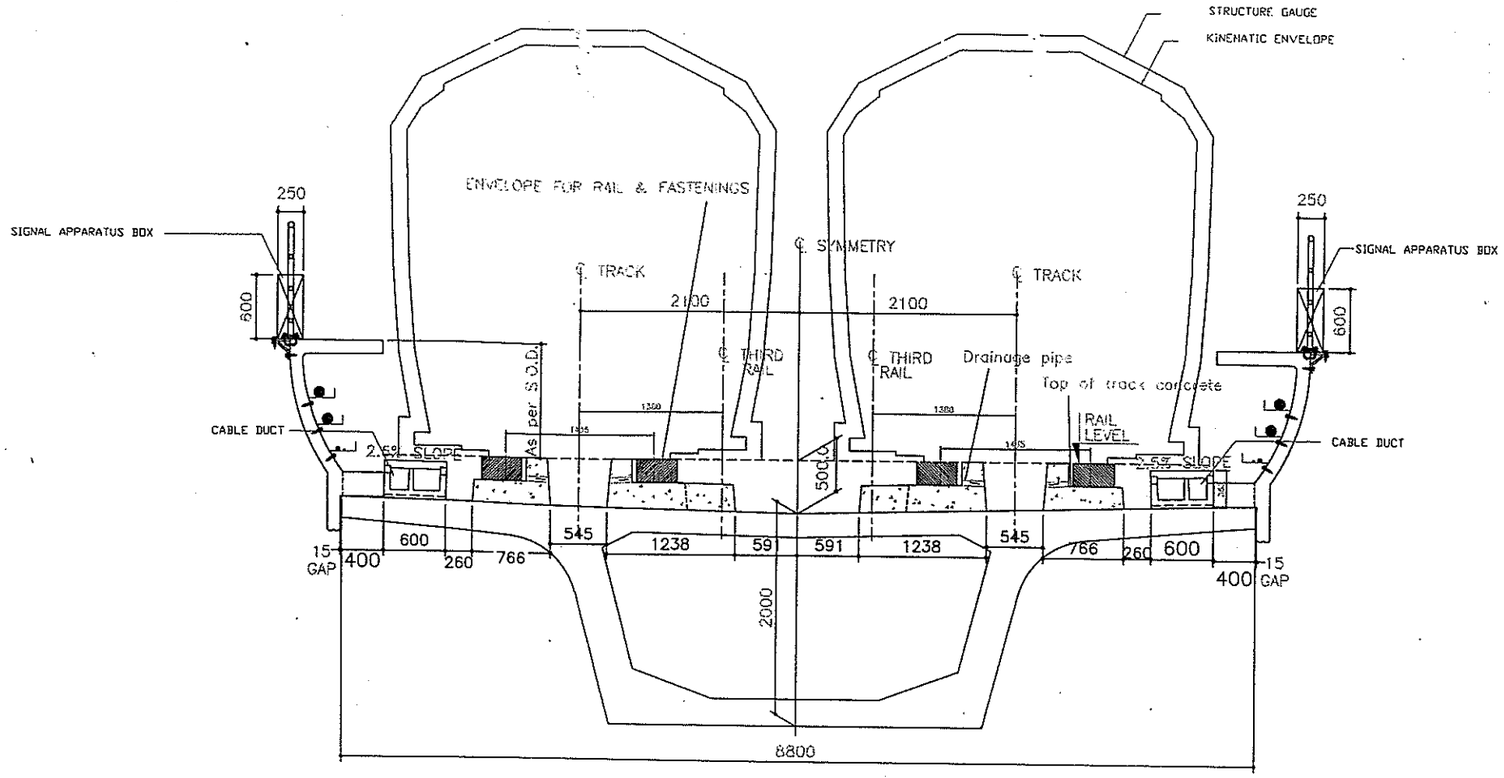
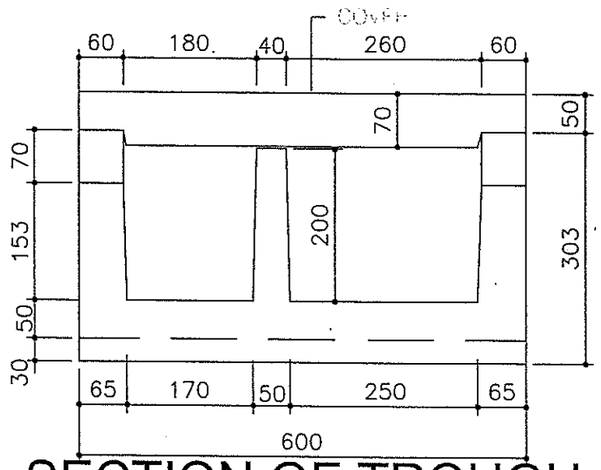


FIGURE NO.6(AG)	REFERENCE PARA NO: 2.2.5 (c)
KOLKATA METRO RAIL CORPORATION LTD.	
CONSULTANTS	STANDARD GAUGE (1435 mm)- 750 VOLT D.C. TRACTION
DATE: July 2009	STRUCTURE GAUGE
SCALE: NOT TO SCALE	AT-GRADE STATION (WITH BALLASTED TRACK) 4M WIDE SIDE PLATFORMS LEVEL/ CONSTANT GRADE TRACK





SECTION OF TROUGH

CONCEPTUAL DRAWING SHOWING VARIOUS SYSTEMS ON ELEVATED VIADUCT (with 4.2 m Track Centre)

0019

Rev	Date	By	Description	Checked	Approved
A	17.09.2011	SC	Revised Cable Trough Dimension	RM	DD

KOLKATA METRO RAIL CORPN. LTD.

Project Title: EAST-WEST METRO PROJECT

Consultants: LHPA

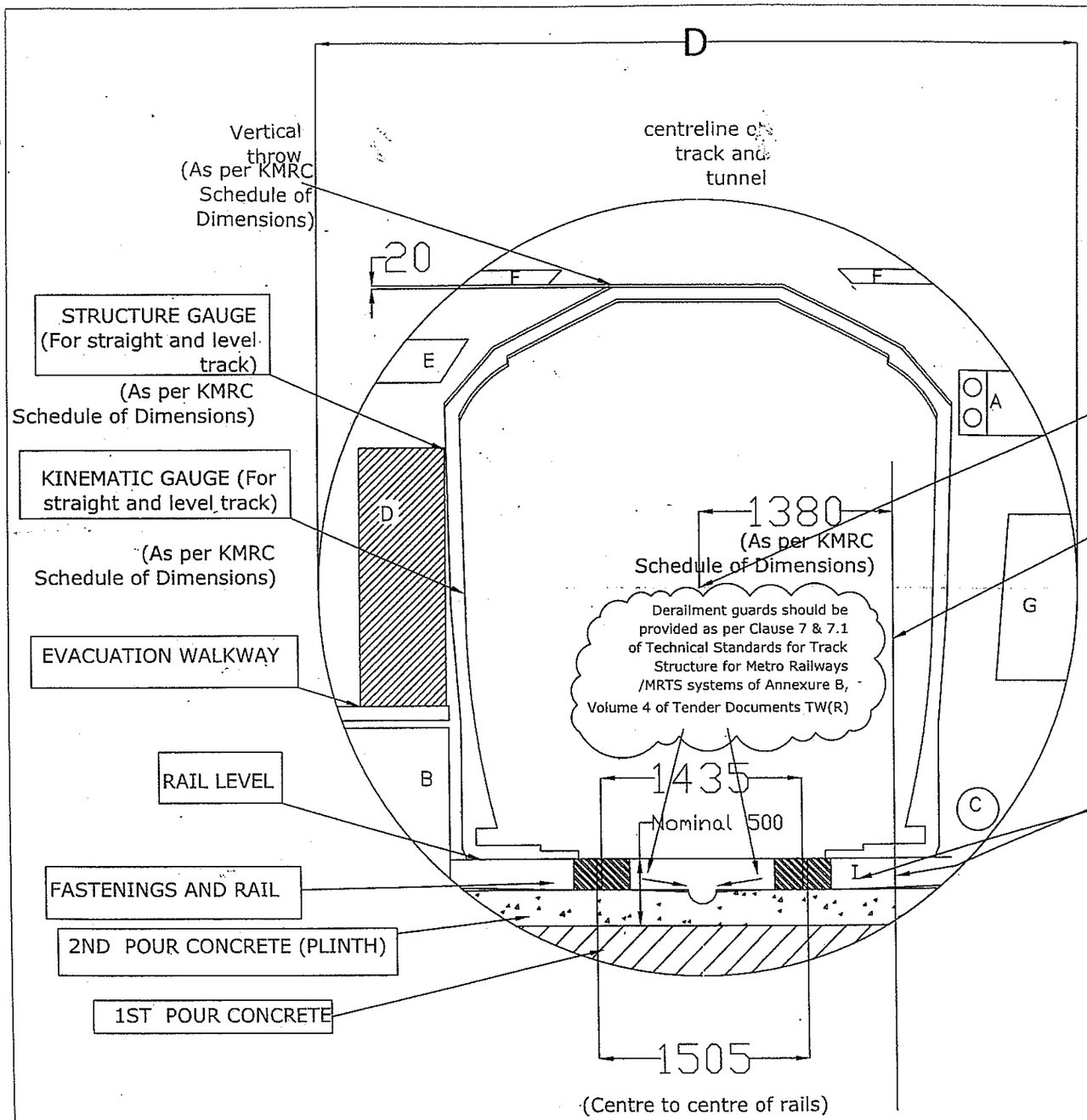
Designed: RM | Checked: JMC | Approved: LCL

Scale: NTS | Drawn: SC | Date: 28/05/10

Drawing Title: CONCEPTUAL DRAWING SHOWING VARIOUS SYSTEMS ON ELEVATED VIADUCT

Drawing No: EW/SW/VIA/T/1801 | Rev: A

CAD File Name: EW 1801



D = Nominal inside diameter of tunnel subject to tolerances

= 5550 mm from tentative Chainage -1160m to Chainage 2500m
and
5800 mm from tentative Chainage 2500m to Chainage 7763m

(Minimum available inside diameter of tunnel shall not be less than 5400 mm)

TUNNEL CENTRE

THIRD RAIL CENTRE LINE

CABLES (ELECT OR S&T) IF NECESSARY WILL BE CROSSED FROM ONE SIDE OF THE TRACK TO THE OTHER THROUGH DEPRESSIONS TO BE PROVIDED ON TOP OF TRACK BED

SUITABLE GRADE FOR DRAINAGE

LEGEND

A - SIGNAL
B - 33KV (HIGH) & MEDIUM VOLTAGE CABLES
C - FIRE HYDRANT PIPE
D - EVACUATION WALKWAY
E - EARTH CABLES
F - LEAKY FEEDER
G - LOW CURRENT ,SIGNAL CABLES
I - CABLE CROSSINGS @ REQUIRED LOCATIONS

(Straight & Level track)

Conceptual drawing showing various systems inside tunnel

0050

All Dimensions in millimetres

NOTES:

KEY PLAN

Rev.	Date	By	Description	Checked	Approved
D	14/03/12	SC	Note regarding derailment guards added	RM	RM
C	24/09/10	SC	Note regarding revised Tunnel Diameter introduced etc	RM	LC
B	23/08/10	SC	Dimension of Depth of 2nd pour concrete deleted & Depth of 1st pour 10C & Rail Level added	RM	LC
A	12/09/09	SC	General Revision		

KMRC KOLKATA METRO RAIL CORPN. LTD.

Project Title : EAST-WEST METRO PROJECT

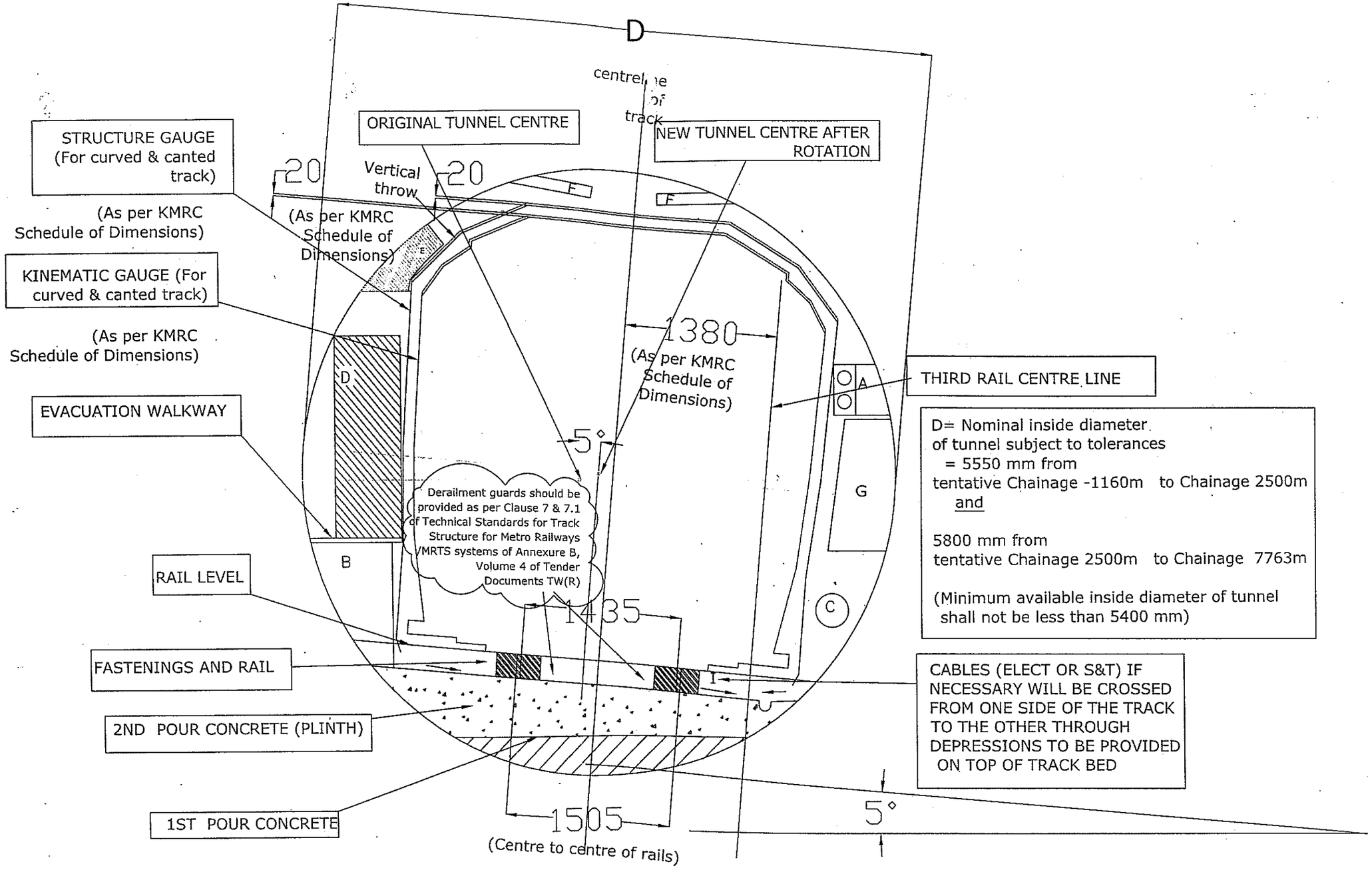
Consultants :

Drawing Title : TUNNEL STRUCTURE SECTION SHOWING SYSTEM EQUIPMENTS FOR GENERAL -(STRAIGHT & LEVEL)

Designed	Checked	Approved
RM	JM	LC
Scale NTS	Drawn SC	Date 12/09/09

Drawing No. UG-CIV-TUN-R-1103 Rev. D

CAD File Name UG-1103.dwg



(Curved track with 120mm Cant)

Conceptual drawing showing various systems inside tunnel

0052

All Dimensions in millimetres

NOTES:

KEY PLAN

Rev.	Date	By	Description	Checked	Approved
B	14/03/12	SC	Note regarding derailment guards added	RM	RM
A	24/09/10	SC	Note regarding Tunnel Diameter introduced	RM	LC.

KMRC KOLKATA METRO RAIL CORPN. LTD.

Project Title : EAST-WEST METRO PROJECT

Consultants : YSC LHPA

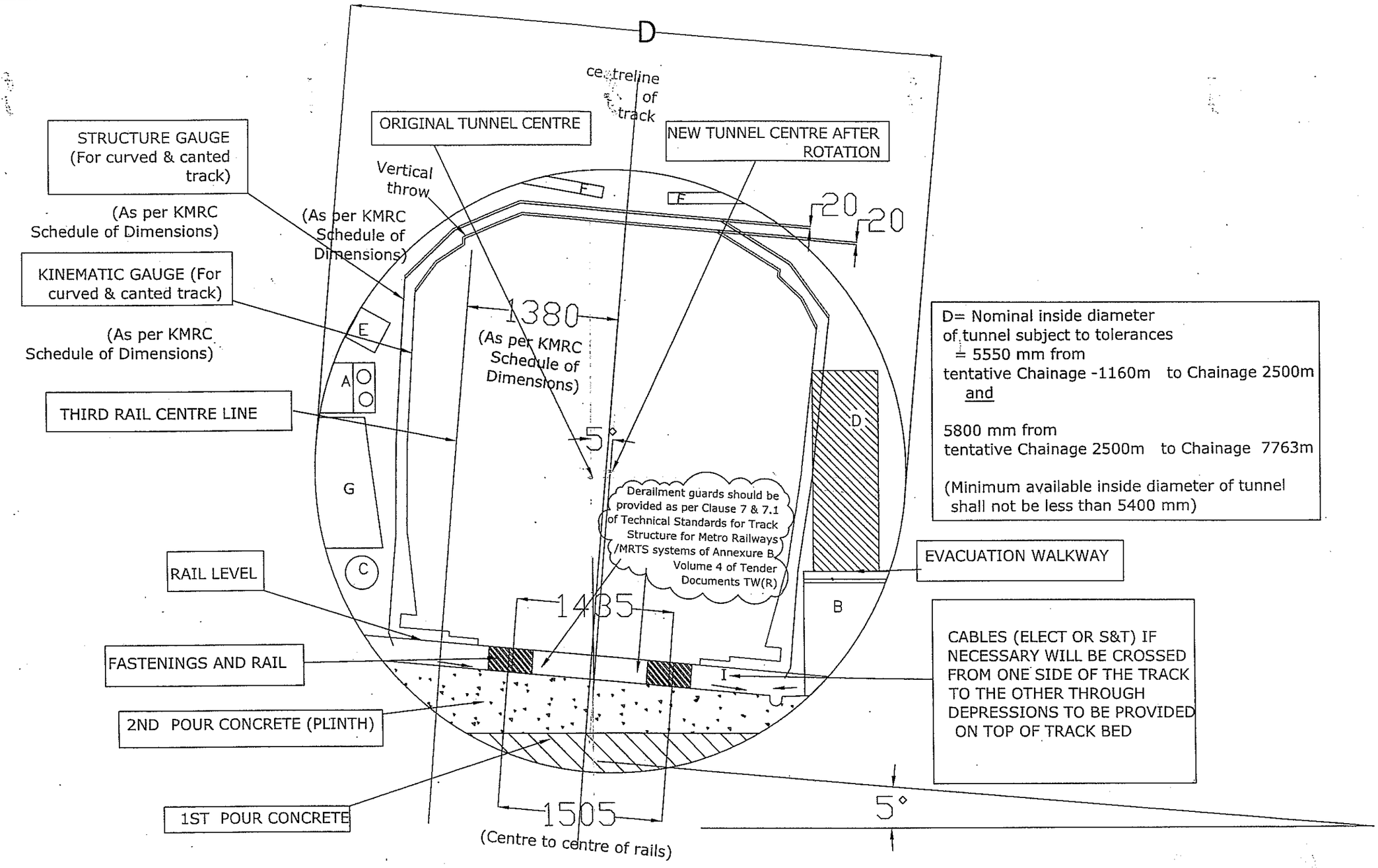
Drawing Title : TUNNEL STRUCTURE SECTION SHOWING SYSTEM EQUIPMENTS FOR GENERAL (CURVED) (walkway LHS)

Designed	Checked	Approved
RM	JM	LC

Drawing No. : UG-CIV-TUN-R-1104 Rev. B

Scale NTS | Drawn SC | Date 12/09/09

CAD File Name : UG-1104



D= Nominal inside diameter of tunnel subject to tolerances
= 5550 mm from tentative Chainage -1160m to Chainage 2500m
and

5800 mm from tentative Chainage 2500m to Chainage 7763m

(Minimum available inside diameter of tunnel shall not be less than 5400 mm)

(Curved track with 120mm Cant)

Conceptual drawing showing various systems inside tunnel

0054

All Dimensions in millimetres

NOTES:

KEY PLAN

Rev.	Date	By	Description	Checked	Approved
B	14/03/12	SC	Note regarding derailment guards added	RM	RM
A	24/09/10	SC	Note regarding tunnel diameter introduced	RM	LC

KOLKATA METRO RAIL CORPN. LTD.

Project Title : EAST-WEST METRO PROJECT

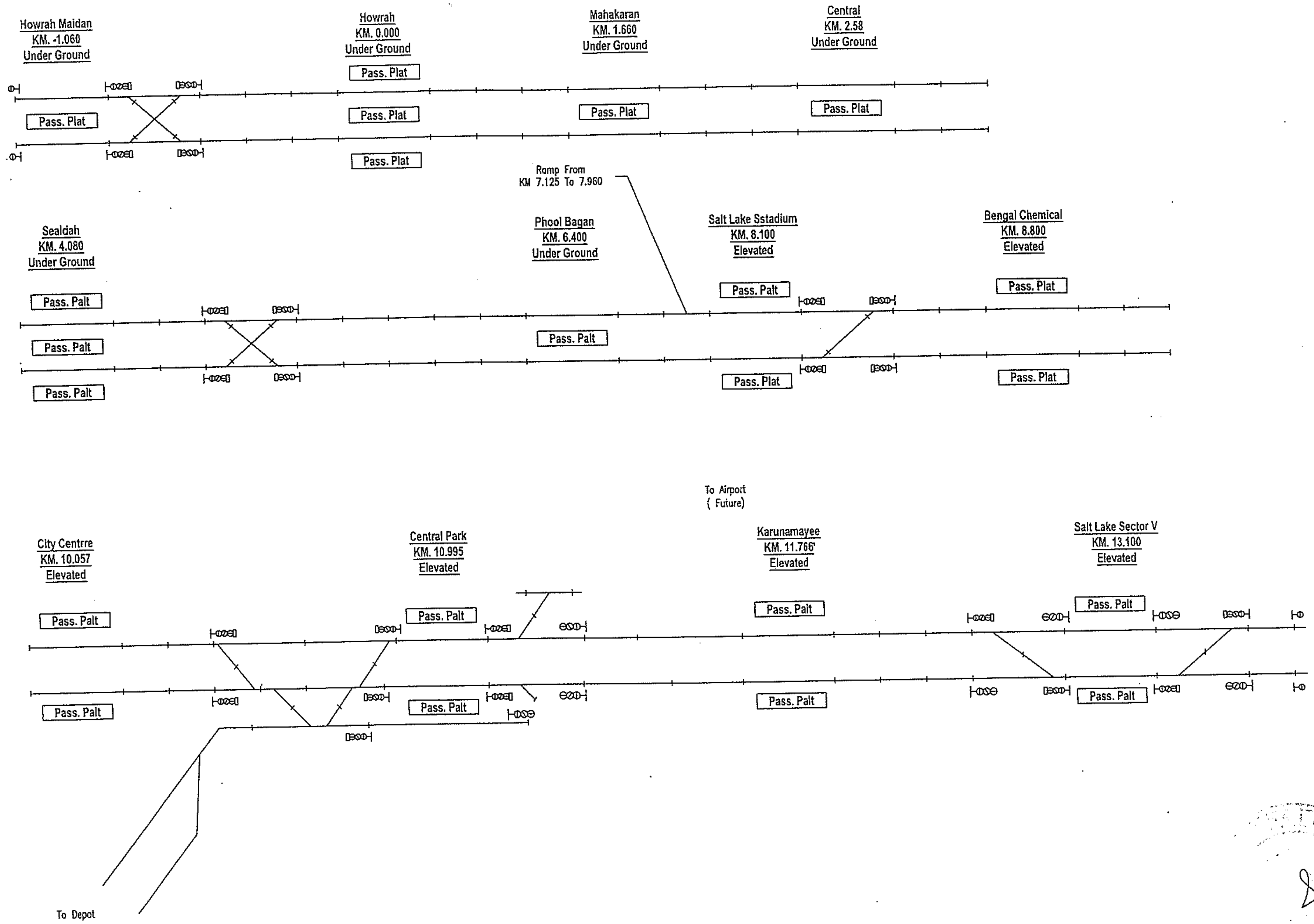
Consultants :

Drawing Title : TUNNEL STRUCTURE SECTION SHOWING SYSTEM EQUIPMENTS FOR GENERAL - (CURVED)(Walkway on RHS)

Designed	Checked	Approved
RM	JM	LC
Scale. NTS	Drawn SC	Date 12/09/09

Drawing No. : UG-CIV-TUN-R-1105 Rev B

CAD File Name : UG-1105.dwg



NOTES.

Rev	Date	By	Description	Checked	Approved
A3	20/01/12	SKS	Fourth Revision	PC	DCH
A3	20/03/10	SKS	Third Revision	JMC	
A2	26/10/09	AD	Second Revision	JMC	
A1		AD	First Revision	JMC	
-	10.10.09	AD	ORIGINAL	JMC	LCL

KMRC KOLKATA METRO RAIL CORPN. LTD.

Project Title: EAST-WEST METRO PROJECT

Consultants:

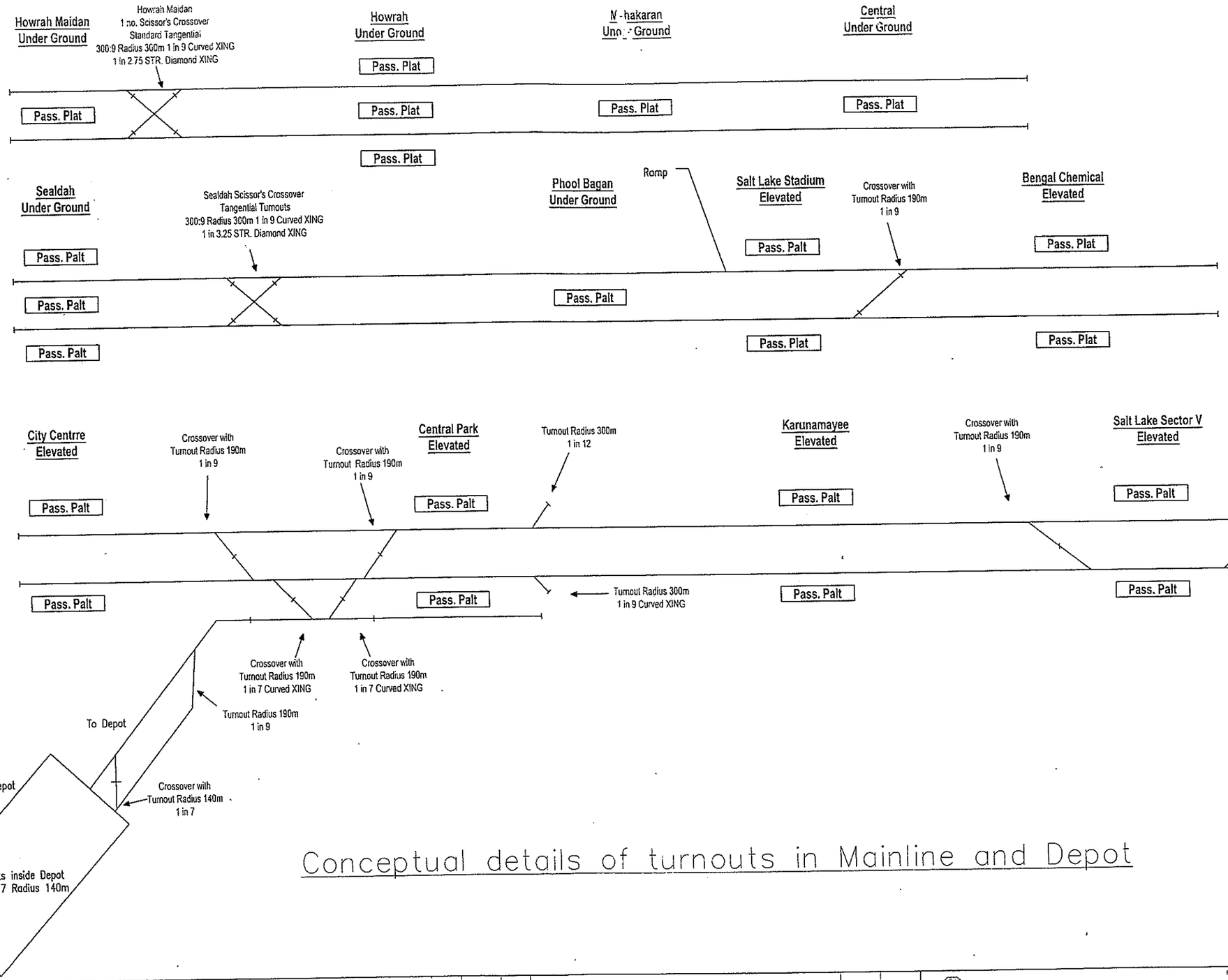
Drawing Title: Conceptual Signaling Plan (HWM - SLV)

Designed SKS	Checked JMC	Approved LCL
Scale NTS	Drawn AD	Date 10.10.09

Drawing No: ST / RS / ALL / T / 1503

CAD File Name: ST-RS-ALL-T-1503-RevA4

0078



Conceptual details of turnouts in Mainline and Depot

NOTES:

Rev	Date	By	Description	Checked	Approved

KMRC KOLKATA METRO RAIL CORPN. LTD.

Project Title: EAST-WEST METRO PROJECT

Consultants: [illegible] RITES

Drawing Title: Conceptual details of turnouts in Mainline & Depot

Designed	Checked	Approved
SC	RM	RM

Scale: NTS | Drawn: SC | Date: 29.02.2012

Drawing No: GCC-2070-TW_-DTP-EDP-DWG-120009

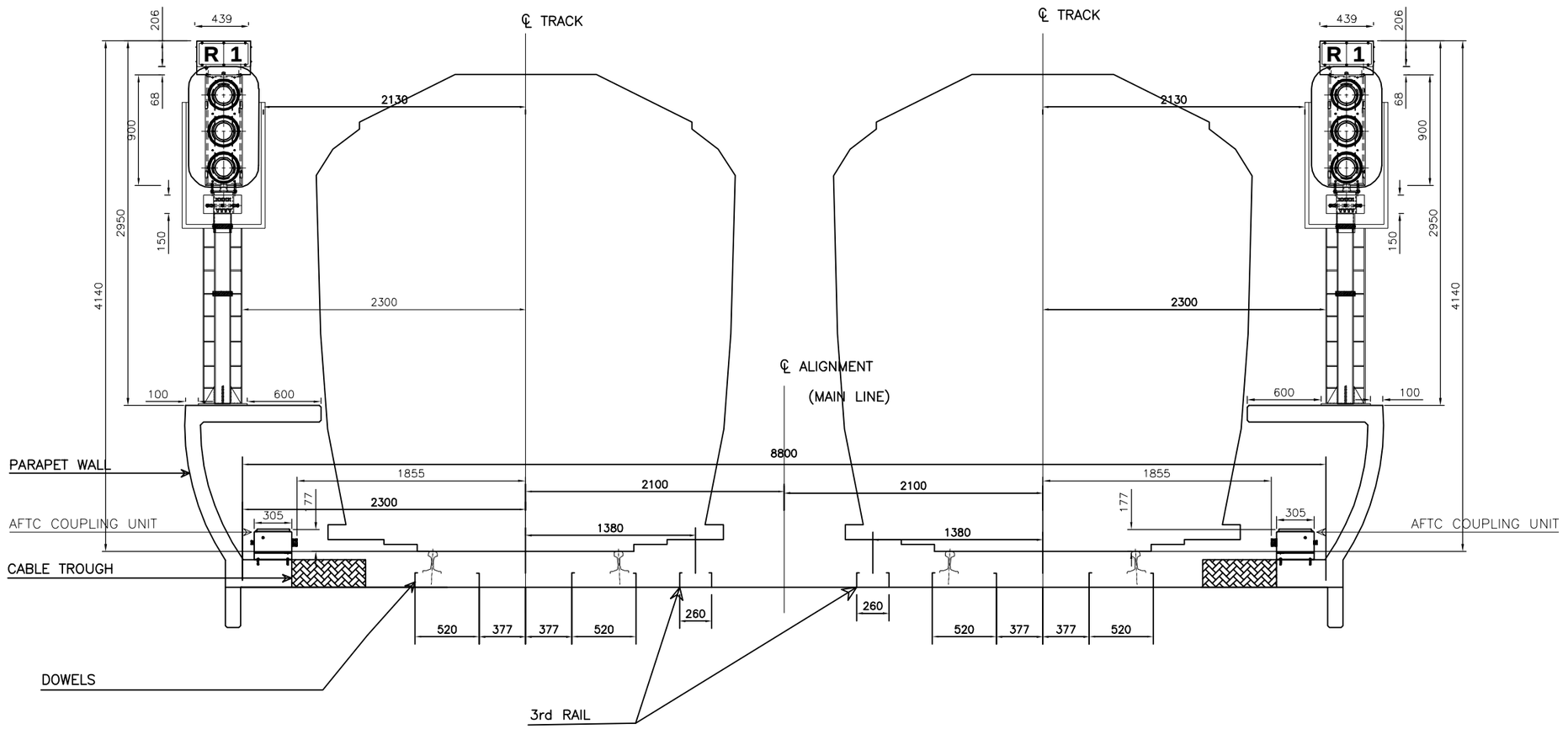
Rev: A

CAD File Name: TW-120009

MALLINDEE ARAH

0019

ATTACHMENT A
Interim drawings for installation of signaling gears



NOTE:

1. **ALL DIMENSIONS ARE IN MM.**
2. **THE DETAILS PROVIDED ARE PRELIMINARY.**

MARKER BOARD SPECIFICATION:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	XXXX	INTERLOCKING AREA CODE
2.	YYYY	SIGNAL NUMBER

ASTS RECORD		
DESIGNED	AG	25-04-2013
DRAWN	PM	25-04-2013
CHECKED	AN/AH	25-04-2013
APPROVED	PKB	25-04-2013

REV	DATE	DESIGNED	CHECKED	APPROVED	MODIFICATION
Q2	25-04-2013				PRELIMINARY DESIGN
Q1	26-10-2012				PRELIMINARY DESIGN

C.A.No :- KMRCL/CE/S&T/01/2011, Dated. 10.10.2011

DRAWING NO.: KMRC-2B303-02-WI46

AUTOCAD SCALE : NTS

CONT'D ON KMRC-2B303-02-WI47

EMPLOYER

KMRC

KOLKATA METRO RAIL CORPORATION LIMITED

CONTRACTOR

Ansaldo STS Consortium

No. 35, SLV Complex, AVS Compound, 4th Block
80 Feet Road, Koramangala, Bangalore 560 034, India

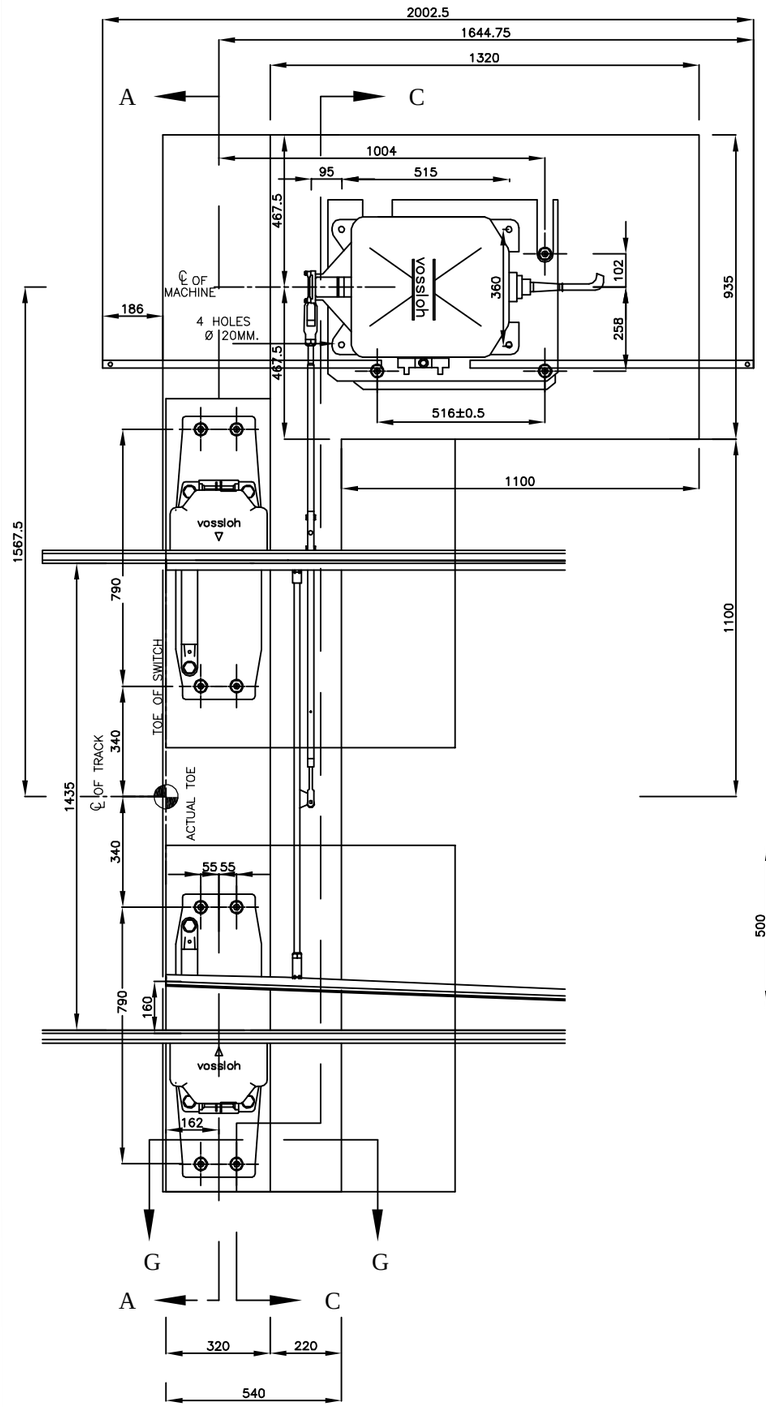
AnsaldoSTS
A Finmeccanica Company

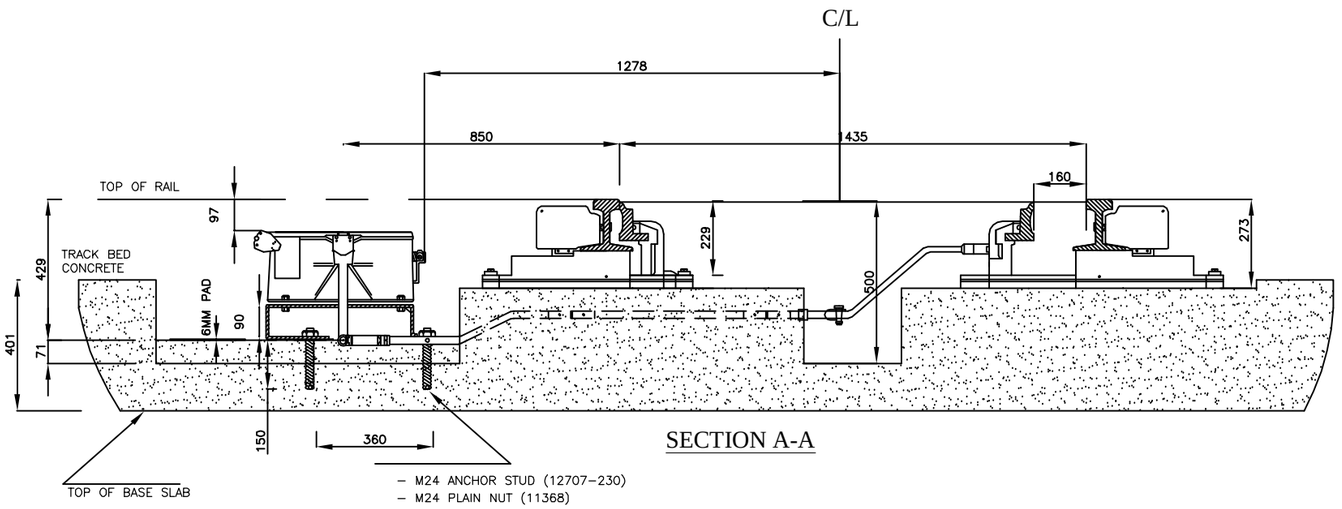
TITLE:

TYPICAL 3 ASPECT SIGNAL WITH ROUTE INDICATOR MECHANICAL ARRANGEMENT & AFTC COUPLING UNIT OVER VIADUCT

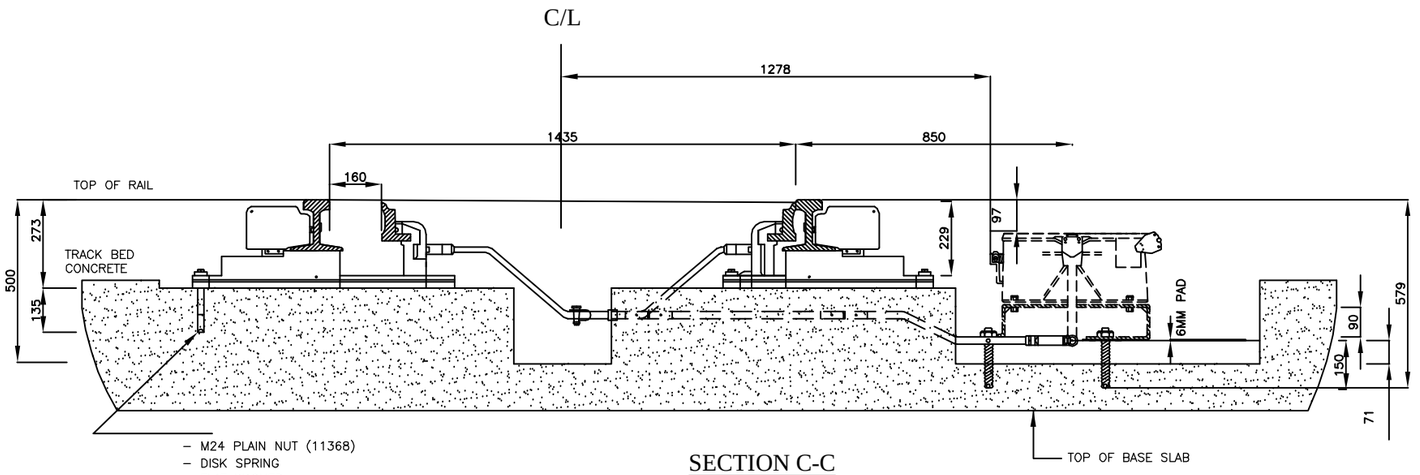
TYPICAL
WAYSIDE INSTALLATION
DRAWING

CAD FILE: KMRC-2B303-02-WI46.DWG

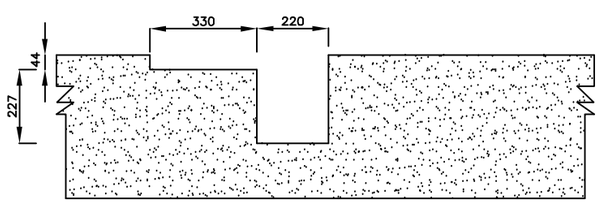




SECTION A-A



SECTION C-C



SECTION G-G

NOTE:–

1. ALL DIMENSIONS ARE IN MM.
2. M24 ANCHOR STUD (12707–230) M24 PLAIN NUT (11368)
3. THE DETAILS PROVIDED ARE PRELIMINARY

ASTS RECORD		
DESIGNED	AG	25–04–2013
DRAWN	PM	25–04–2013
CHECKED	AN/AH	25–04–2013
APPROVED	PKB	25–04–2013

REV	DATE	DESIGNED	CHECKED	APPROVED	MODIFICATION
02	25–04–2013				PRELIMINARY DESIGN
01	26–10–2012				PRELIMINARY DESIGN

C.A.No :– KMRCL/CE/S&T/01/2011

DRAWING NO.:
KMRC-2B303-02-WI60

AUTOCAD SCALE : NTS

CONT'D ON KMRC-2B303-02-WI61

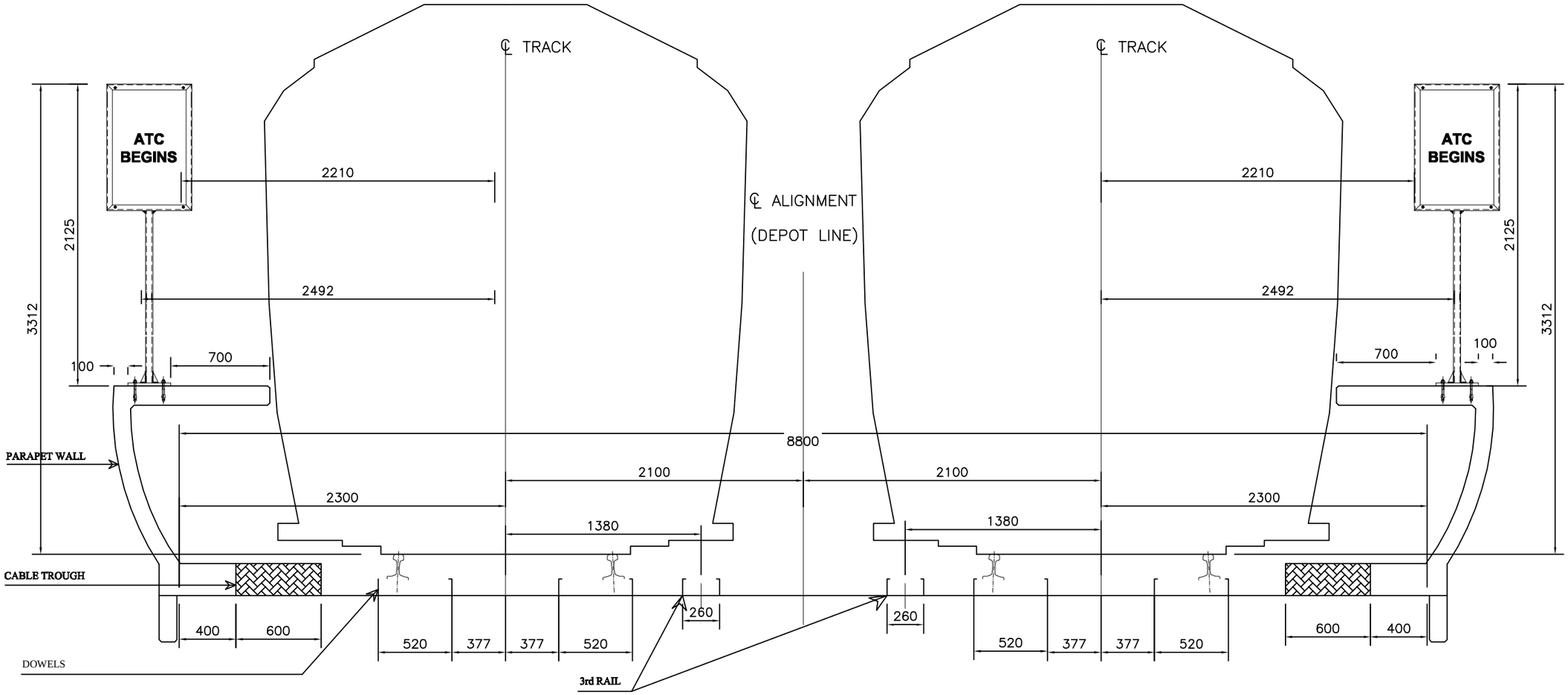
EMPLOYER
KMRC
KOLKATA METRO RAIL CORPORATION LIMITED

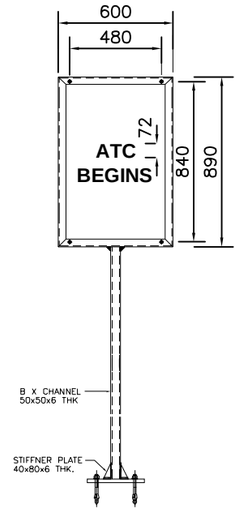
CONTRACTOR
Ansaldo STS Consortium
No. 35, SLV Complex, AVS Compound, 4th Block
80 Feet Road, Koramangala, Bangalore 560 034, India
AnsaldoSTS
A Finmeccanica Company

TITLE:
TYPICAL LAYOUT DRAWINGS FOR THE POINT MACHINE VOSSLOH COGIFER MCEM91 (FOR MAIN LINE)

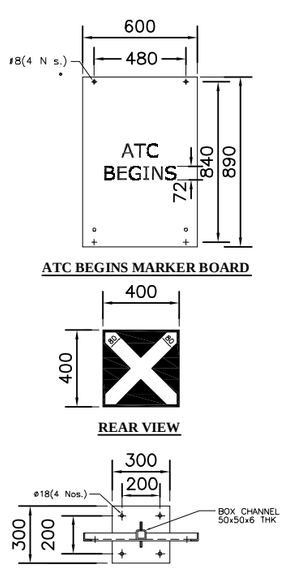
TYPICAL
WAYSIDE INSTALLATION
DRAWING

CAD FILE: KMRC–2B303–02–WI60.DWG





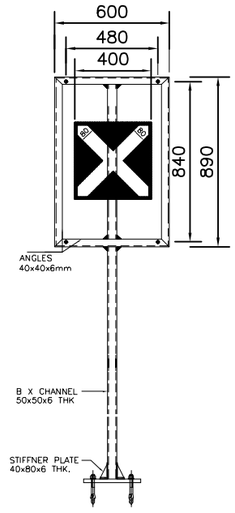
FRONT VIEW



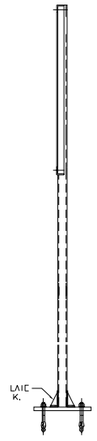
ATC BEGINS MARKER BOARD

REAR VIEW

PLAN VIEW



REAR VIEW



SIDE VIEW

NOTE:

1. **ALL DIMENSIONS ARE IN MM.**
2. **THE DETAILS PROVIDED ARE PRELIMINARY.**

IMPORTANT NOTES:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	INSCRIPTION	BLACK COLOUR
2.	BACK GROUND	WHITE COLOUR
3.	BAND	RED COLOUR

MATERIAL SPECIFICATIONS:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	MARKER BOARD	2 mm THK SHEET ALUMINIUM.
2.	INSCRIPTION & BACKGROUND	HARD PRESSED RETRO REFLECTIVE SHEET DIAMOND GRADE VIP
3.	SUPPORT & ACCESSORIES	HOT DIP GALVANISED.
4.	REAR VIEW CROSS	BLACK OPAQUE FILM.
5.	LETTERS	SCREEN PRINTED.

ASTS RECORD		
DESIGNED	AG	25-04-2013
DRAWN	PM	25-04-2013
CHECKED	AN/AH	25-04-2013
APPROVED	PKB	25-04-2013

REV	DATE	DESIGNED	CHECKED	APPROVED	MODIFICATION
02	25-04-2013				PRELIMINARY DESIGN
01	26-10-2012				PRELIMINARY DESIGN

C.A.No :- KMRCL/CE/S&T/01/2011, Dated. 10.10.2011

DRAWING NO.: KMRC-2B303-02-WI70

AUTOCAD SCALE : NTS

CONT'D ON KMRC-2B303-02-WI71

EMPLOYER

KMRC

KOLKATA METRO RAIL CORPORATION LIMITED

CONTRACTOR

Ansaldo STS Consortium

No. 35, SLV Complex, AVS Compound, 4th Block
80 Feet Road, Koramangala, Bangalore 560 034, India

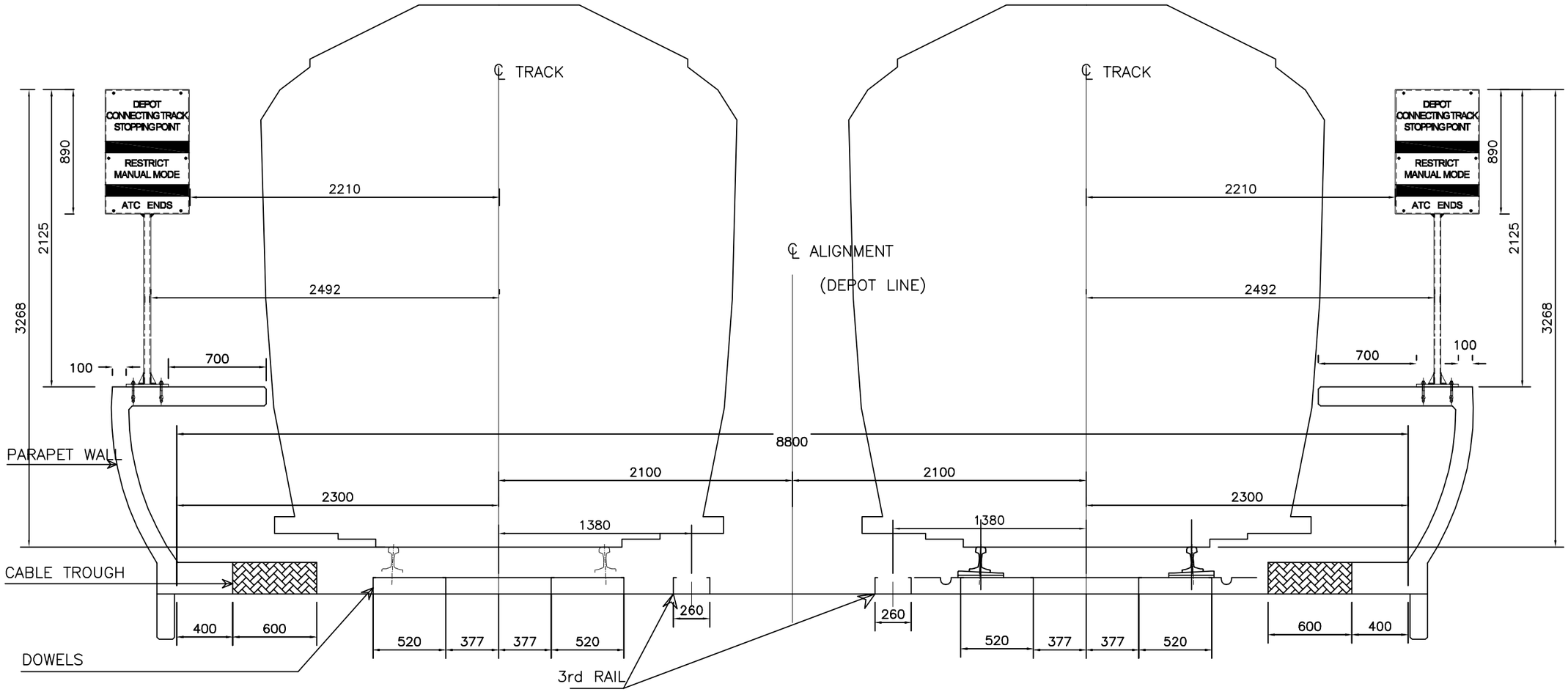
AnsaldoSTS
A Finmeccanica Company

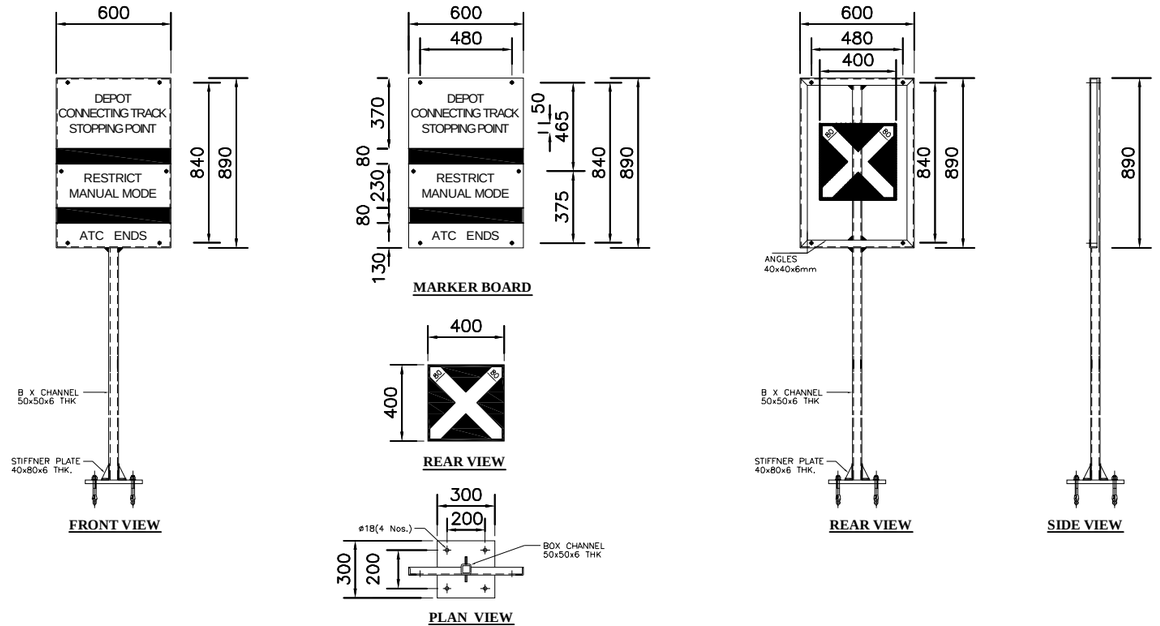
TITLE:

TYPICAL ARRANGEMENT FOR FIXING OF ATC BEGINS MARKER BOARD

TYPICAL WAYSIDE INSTALLATION DRAWING

CAD FILE:KMRC-2B303-02-WI70.DWG





NOTE:

1. **ALL DIMENSIONS ARE IN MM.**
2. **THE DETAILS PROVIDED ARE PRELIMINARY.**

IMPORTANT NOTES:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	INSCRIPTION	BLACK COLOUR
2.	BACK GROUND	WHITE COLOUR
3.	BAND	RED COLOUR

MATERIAL SPECIFICATIONS:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	MARKER BOARD	2 mm THK SHEET ALUMINIUM.
2.	INSCRIPTION & BACKGROUND	HARD PRESSED RETRO REFLECTIVE SHEET DIAMOND GRADE VIP
3.	SUPPORT & ACCESSORIES	HOT DIP GALVANISED.
4.	REAR VIEW CROSS	BLACK OPAQUE FILM.
5.	LETTERS	SCREEN PRINTED.

ASTS RECORD		
DESIGNED	AG	25-04-2013
DRAWN	PM	25-04-2013
CHECKED	AN/AH	25-04-2013
APPROVED	PKB	25-04-2013

REV	DATE	DESIGNED	CHECKED	APPROVED	MODIFICATION
02	25-04-2013				PRELIMINARY DESIGN
01	26-10-2012				PRELIMINARY DESIGN

C.A.No :- KMRCL/CE/S&T/01/2011, Dated. 10.10.2011

DRAWING NO.: KMRC-2B303-02-WI71

AUTOCAD SCALE - NTS

CONT'D ON KMRC-2B303-02-WI72

EMPLOYER

KMRC

KOLKATA METRO RAIL CORPORATION LIMITED

CONTRACTOR

Ansaldo STS Consortium

No. 35, SLV Complex, AVS Compound, 4th Block
80 Feet Road, Koramangala, Bangalore 560 034, India

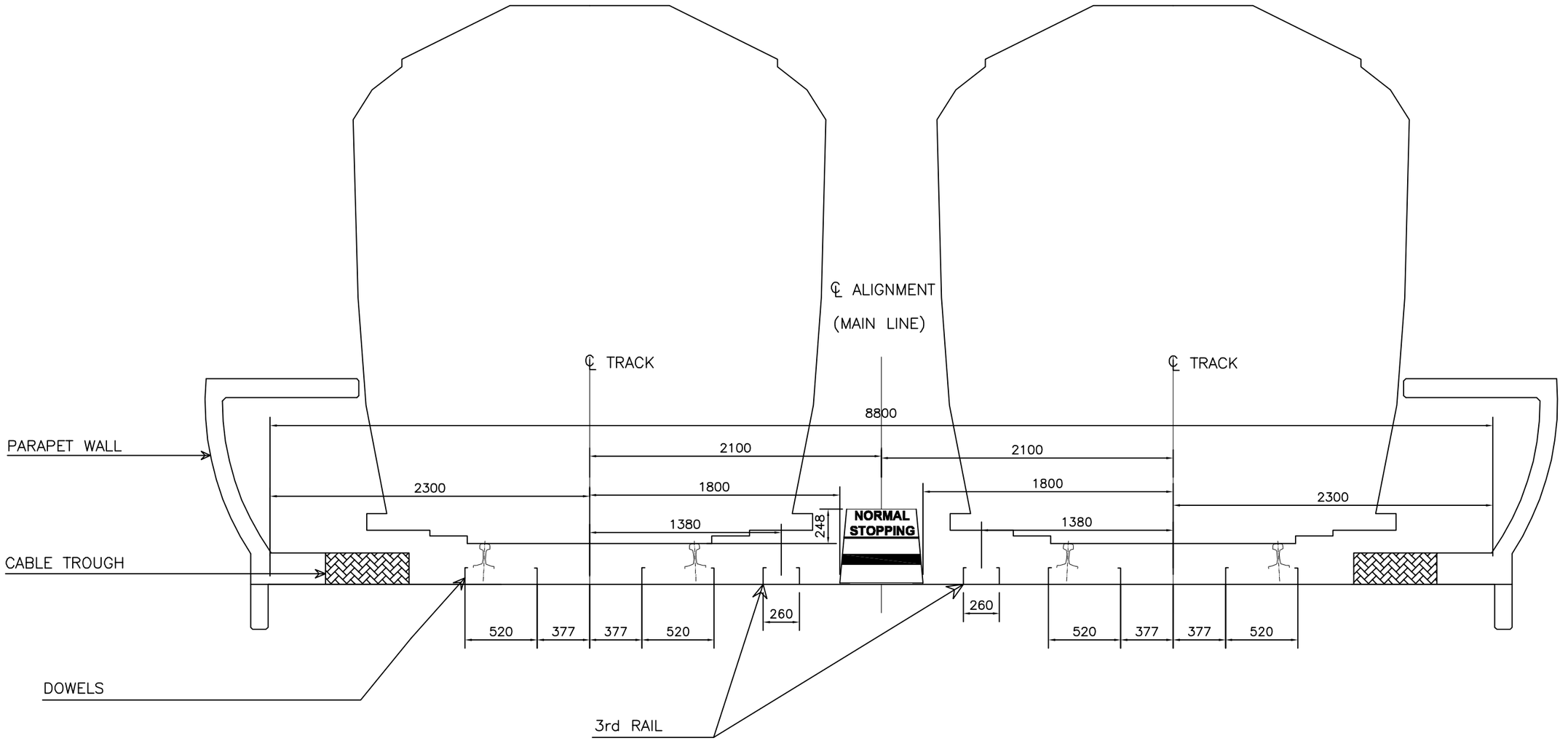
AnsaldoSTS
A Finmeccanica Company

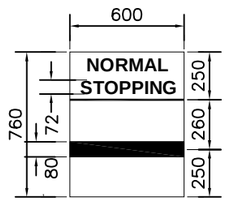
TITLE:

TYPICAL ARRANGEMENT FOR FIXING OF DEPOT CONNECTING TRACK STOPPING POINT, RESTRICT MANUAL MODE & ATC ENDS MARKER BOARD

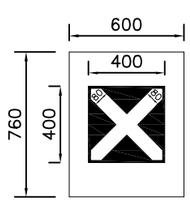
TYPICAL WAYSIDE INSTALLATION DRAWING

CAD FILE:KMRC-2B303-02-WI71.DWG

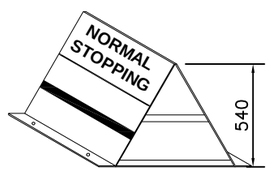




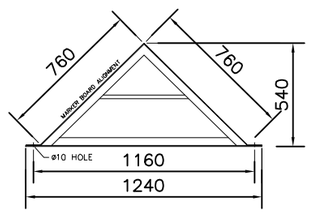
NORMAL STOPPING MARKER BOARD



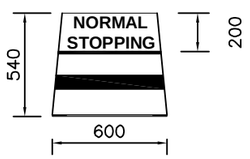
REAR VIEW



NORMAL STOPPING MARKER BOARD ISOMETRIC VIEW



SIDE VIEW



FRONT VIEW

NOTE:

1. **ALL DIMENSIONS ARE IN MM.**
2. **THE DETAILS PROVIDED ARE PRELIMINARY.**

IMPORTANT NOTES:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	INSCRIPTION	BLACK COLOUR
2.	BACK GROUND	WHITE COLOUR
3.	BAND	RED COLOUR

MATERIAL SPECIFICATIONS:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	MARKER BOARD	2 mm THK SHEET ALUMINIUM.
2.	INSCRIPTION & BACK GROUND	HARD PRESSED RETRO REFLECTIVE SHEET DIAMOND GRADE VIP
3.	SUPPORT & ACCESSORIES	HOT DIP GALVANISED.
4.	REAR VIEW CROSS	BLACK OPAQUE FILM.
5.	LETTERS	SCREEN PRINTED.

ASTS RECORD		
DESIGNED	AG	25-04-2013
DRAWN	PM	25-04-2013
CHECKED	AN/AH	25-04-2013
APPROVED	PKB	25-04-2013

REV	DATE	DESIGNED	CHECKED	APPROVED	MODIFICATION
02	25-04-2013				PRELIMINARY DESIGN
01	26-10-2012				PRELIMINARY DESIGN

C.A.No :- KMRCL/CE/S&T/01/2011, Dated. 10.10.2011

DRAWING NO.: KMRC-2B303-02-WI72

AUTOCAD SCALE - NTS

CONT'D ON KMRC-2B303-02-WI73

EMPLOYER

KMRC

KOLKATA METRO RAIL CORPORATION LIMITED

CONTRACTOR

Ansaldo STS Consortium

No. 35, SLV Complex, AVS Compound, 4th Block
80 Feet Road, Koramangala, Bangalore 560 034, India

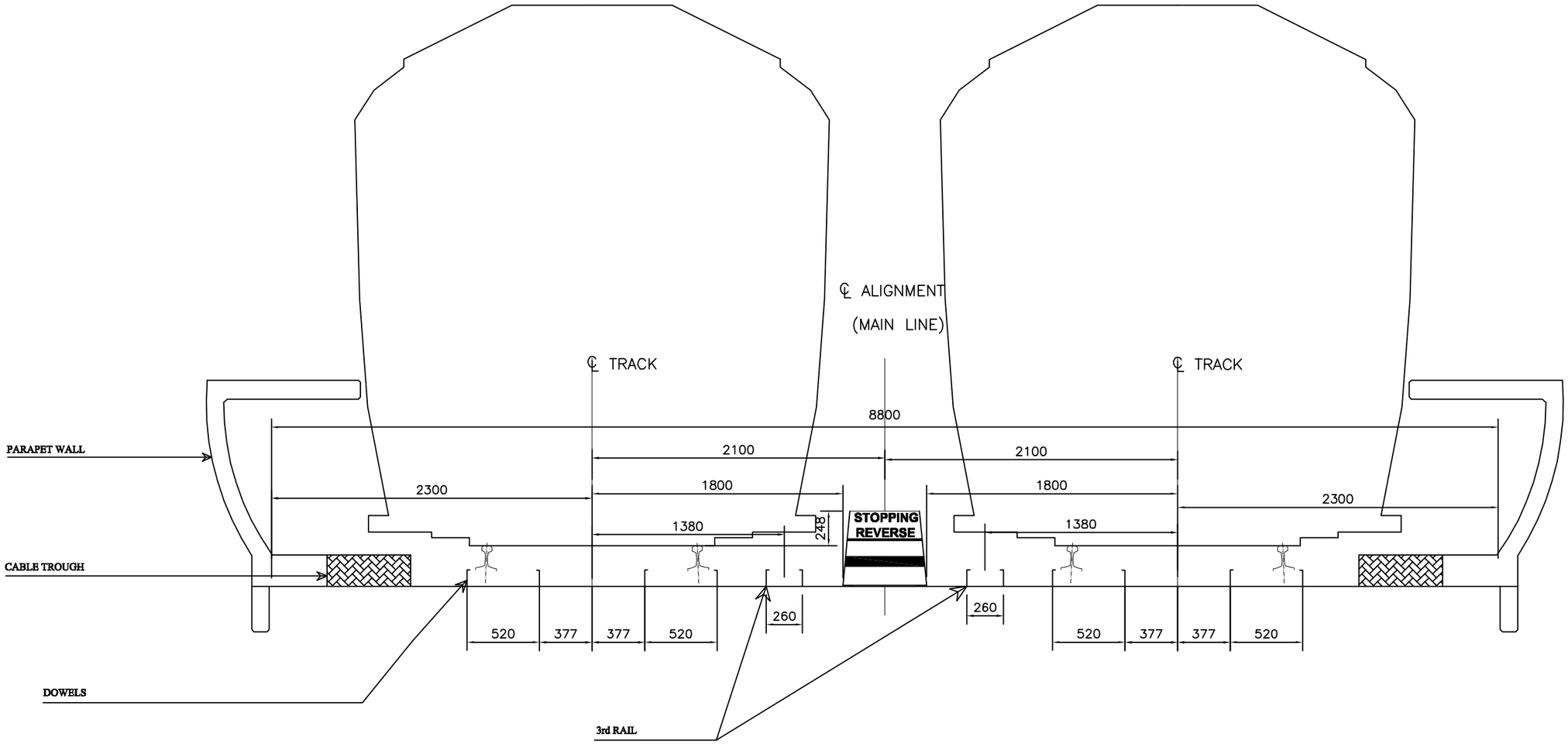
AnsaldoSTS
A Finmeccanica Company

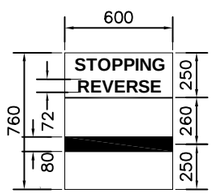
TITLE:

TYPICAL ARRANGEMENT FOR FIXING OF NORMAL STOPPING MARKER BOARD

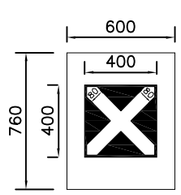
TYPICAL
WAYSIDE INSTALLATION
DRAWING

CAD FILE:KMRC-2B303-02-WI72.DWG

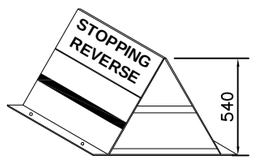




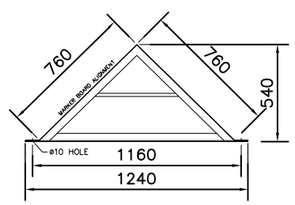
STOPPING REVERSE MARKER BOARD



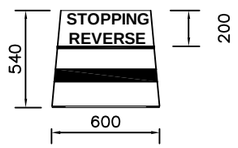
REAR VIEW



STOPPING REVERSE MARKER BOARD ISOMETRIC VIEW



SIDE VIEW



FRONT VIEW

NOTE:

1. ALL DIMENSIONS ARE IN MM.
2. THE DETAILS PROVIDED ARE **PRELIMINARY**.

IMPORTANT NOTES:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	INSCRIPTION	BLACK COLOUR
2.	BACK GROUND	WHITE COLOUR
3.	BAND	RED COLOUR

MATERIAL SPECIFICATIONS:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	MARKER BOARD	2 mm THK SHEET ALUMINIUM.
2.	INSCRIPTION & BACK GROUND	HARD PRESSED RETRO REFLECTIVE SHEET DIAMOND GRADE VIP
3.	SUPPORT & ACCESSORIES	HOT DIP GALVANISED.
4.	REAR VIEW CROSS	BLACK OPAQUE FILM.
5.	LETTERS	SCREEN PRINTED.

ASTS RECORD		
DESIGNED	AG	25-04-2013
DRAWN	PM	25-04-2013
CHECKED	AN/AH	25-04-2013
APPROVED	PKB	25-04-2013

REV	DATE	DESIGNED	CHECKED	APPROVED	MODIFICATION
02	25-04-2013				PRELIMINARY DESIGN
01	26-10-2012				PRELIMINARY DESIGN

C.A.No :- KMRCL/CE/S&T/01/2011, Dated. 10.10.2011

DRAWING NO.: KMRC-2B303-02-WI73

AUTOCAD SCALE : NTS

CONT'D ON KMRC-2B303-02-WI74

EMPLOYER

KMRC

KOLKATA METRO RAIL CORPORATION LIMITED

CONTRACTOR

Ansaldo STS Consortium

No. 35, SLV Complex, AVS Compound, 4th Block
80 Feet Road, Koramangala, Bangalore 560 034, India

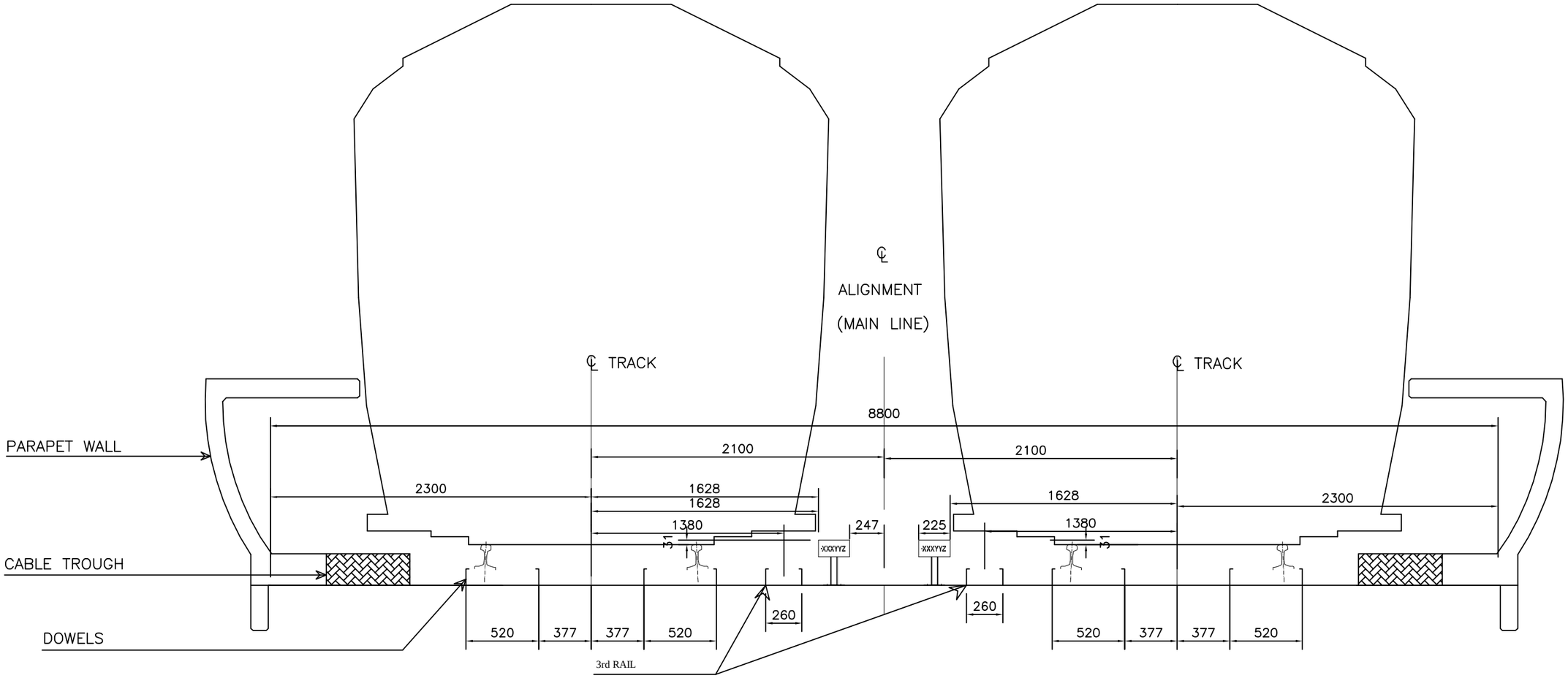
AnsaldoSTS
A Finmeccanica Company

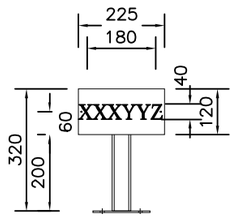
TITLE:

TYPICAL ARRANGEMENT FOR FIXING OF STOPPING REVERSE MARKER BOARD

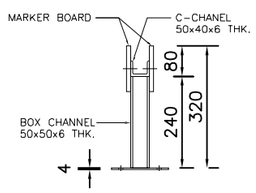
TYPICAL WAYSIDE INSTALLATION DRAWING

CAD FILE:KMRC-2B303-02-WI73.DWG

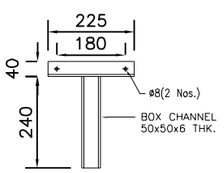




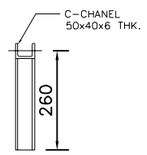
FRONT VIEW



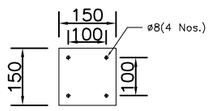
SIDE VIEW



FRONT VIEW



SIDE VIEW



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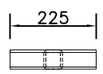


PLAN VIEW

POINT MACHINE MARKER BOARD

SUPPORT FRAME OF POINT MACHINE MARKER BOARD

SCALE 1:2

NOTE:

1. ALL DIMENSIONS ARE IN MM.
2. THE DETAILS PROVIDED ARE TENTATIVE.

MARKER BOARD SPECIFICATION:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	XXX	INTERLOCKING AREA CODE
2.	YY	SWITCH MACHINE NUMBER
3.	Z	END POINT

IMPORTANT NOTES:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	INSCRIPTION	BLACK COLOUR
2.	BACKGROUND	WHITE COLOUR
3.	BAND	RED COLOUR

MATERIAL SPECIFICATION:

SL. NO	MARKER DETAILS	DESCRIPTION
1.	MARKER BOARD	2 mm THK SHEET ALUMINIUM.
2.	INSCRIPTION & BACKGROUND	HARD PRESSED RETRO REFLECTIVE SHEET DIAMOND GRADE VIP
3.	SUPPORT & ACCESSORIES	HOT DIP GALVANISED.
4.	LETTERS	SCREEN PRINTED.

ASTS RECORD		
DESIGNED	AG	25-04-2013
DRAWN	PM	25-04-2013
CHECKED	AN/AH	25-04-2013
APPROVED	PKB	25-04-2013

REV	DATE	DESIGNED	CHECKED	APPROVED	MODIFICATION
02	25-04-2013				PRELIMINARY DESIGN
01	26-10-2012				PRELIMINARY DESIGN

C.A.No :- KMRCL/CE/S&T/01/2011, Dated. 10.10.2011

DRAWING NO.: KMRC-2B303-02-WI75

AUTOCAD SCALE - NTS

CONT'D ON -

EMPLOYER

KMRC

KOLKATA METRO RAIL CORPORATION LIMITED

CONTRACTOR

Ansaldo STS Consortium

No. 35, SLV Complex, AVS Compound, 4th Block
80 Feet Road, Koramangala, Bangalore 560 034, India

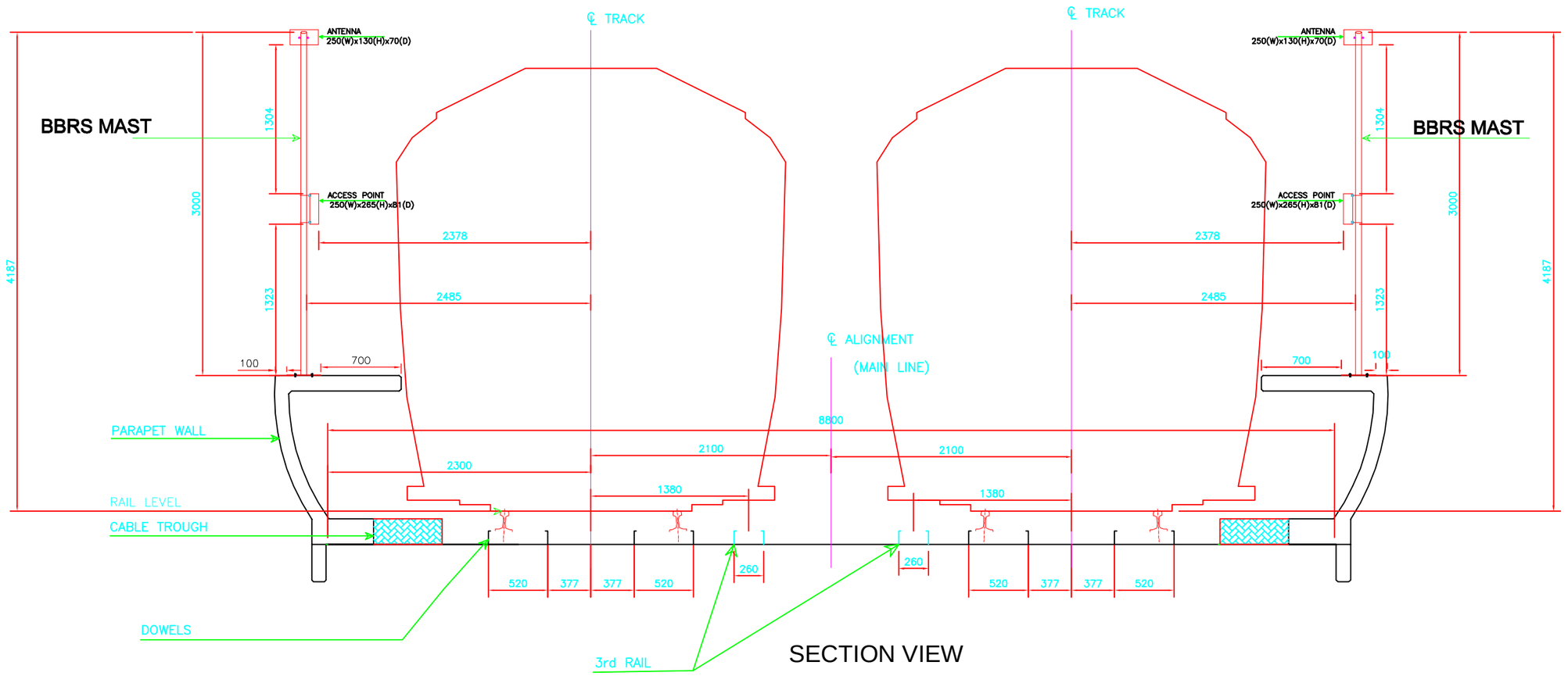
Ansaldo STS
A Finmeccanica Company

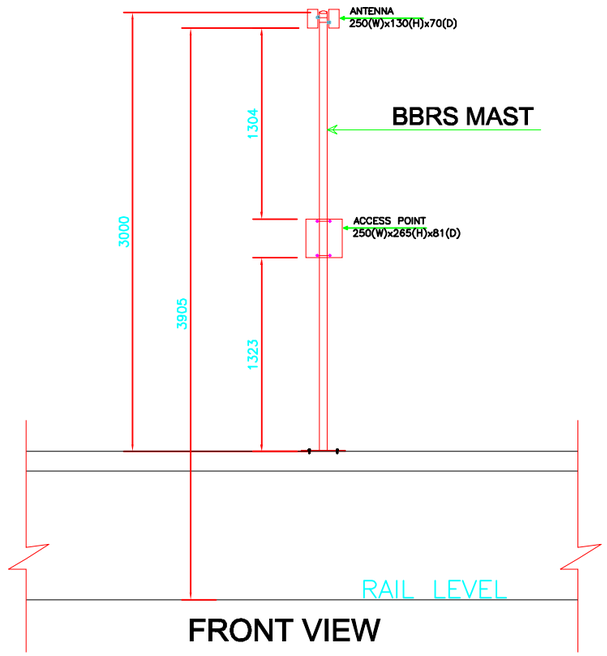
TITLE:

TYPICAL ARRANGEMENT FOR FIXING OF POINT NUMBER MARKER BOARD

TYPICAL
WAYSIDE INSTALLATION
DRAWING

CAD FILE:KMRC-2B303-02-WI75.DWG





NOTE:

1. ALL DIMENSIONS ARE IN MM.
2. THE DETAILS PROVIDED ARE TENTATIVE & SUBJECT TO OEM APPROVAL.
3. THE PLACEMENT OF BBRS MAST MAY BE ON BOTH SIDES OR EITHER SIDE DEPENDING ON THE DETAILED DESIGN.

ASTS RECORD		
DESIGNED	VKG	25–04–2013
DRAWN	PM	25–04–2013
CHECKED	VSB	25–04–2013
APPROVED	PKB	25–04–2013

REV	DATE	DESIGNED	CHECKED	APPROVED	MODIFICATION
01	25–04–2013				PRELIMINARY DESIGN

C.A.No :– KMRCL/CE/S&T/01/2011, Dated. 10.10.2011

DRAWING NO.: KMRC-02000-01-TP100

AUTOCAD SCALE : NTS

CONT'D ON KMRC-2B303-01-WI47

EMPLOYER

KMRC

KOLKATA METRO RAIL CORPORATION LIMITED

CONTRACTOR

Ansaldo STS Consortium

No. 35, SLV Complex, AVS Compound, 4th Block
80 Feet Road, Koramangala, Bangalore 560 034, India

Ansaldo STS
A Finmeccanica Company

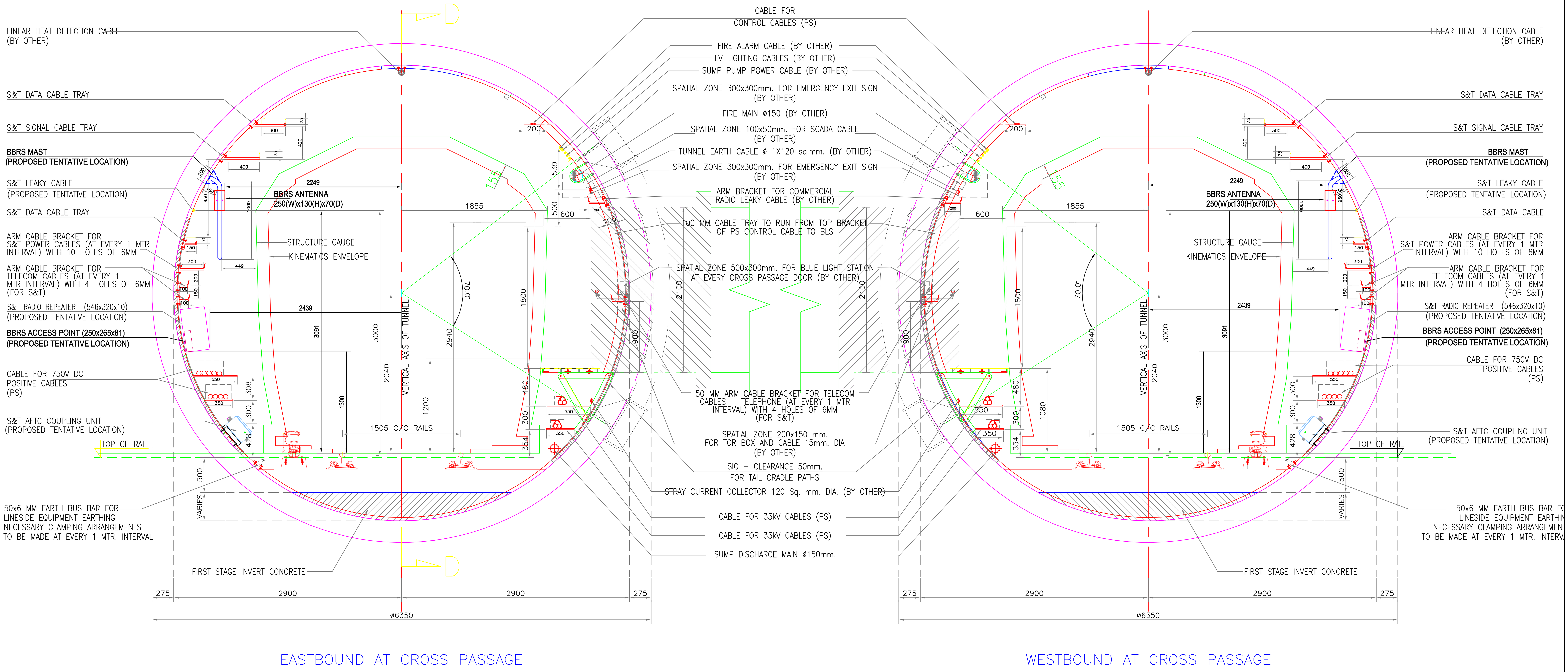
TITLE:

TYPICAL WAYSIDE INSTALLATION DRAWING INDICATING BBRS FIXING ARRANGEMENT

TYPICAL
WAYSIDE INSTALLATION
DRAWING-TELECOM

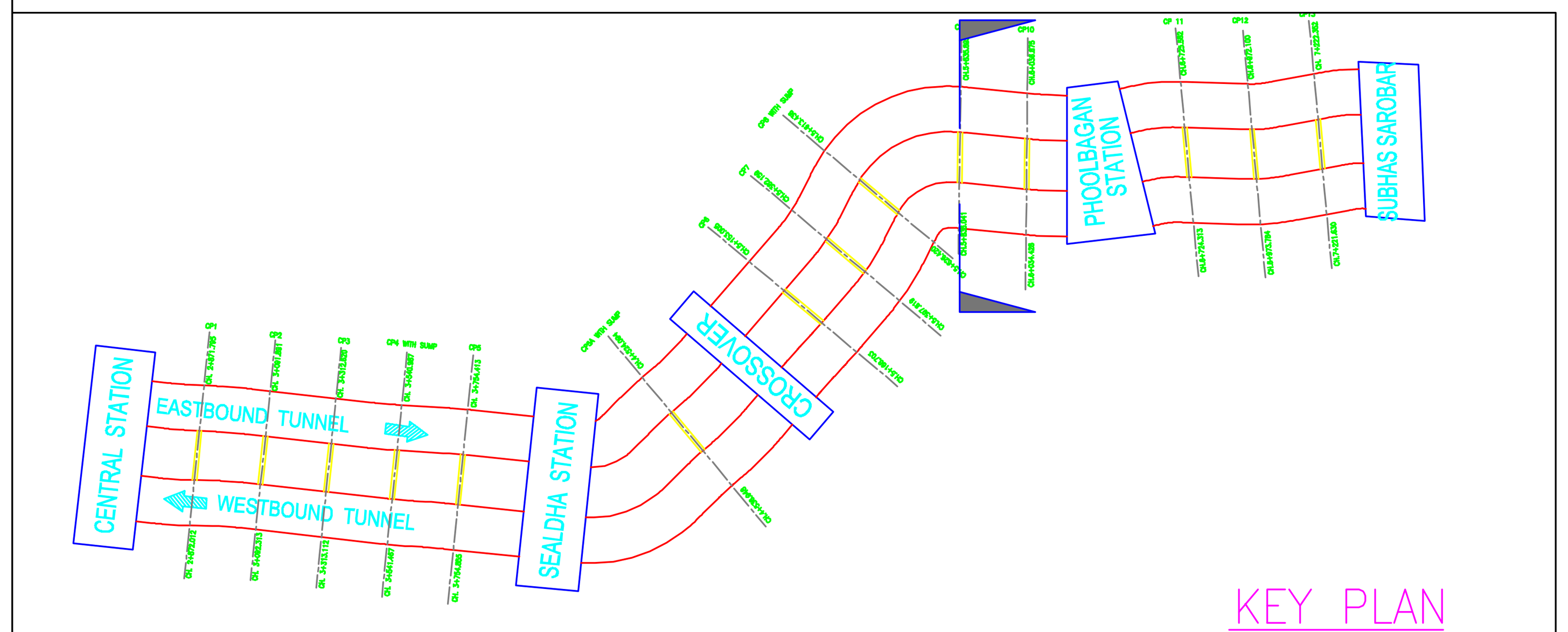
CAD FILE: KMRC-02000-01-TP100.DWG

ORIGINAL DRAWING SIZE : A1



TUNNEL SECTION

SCALE = 1:25



KEY PLAN

NOTE:

*** ALL BRACKETS & CABLE TRAY WITH FIXING ARRANGEMENTS TO BE PROVIDED BY OTHERS.

*** SPACING BETWEEN TWO SUCCESSIVE BRACKETS IS 1 METER LONGITUDINALLY.

*** THE SUMP DISCHARGE MAIN 150MM DIA PIPE SHOWN IN BOTH THE TUNNELS AS THE ABOVE DRAWINGS ARE CONSIDERED AS DEFINITIVE TYPICAL SECTIONS OF THE TUNNELS. HOWEVER THERE IS ONLY ONE SUMP DISCHARGE PIPE RUN FROM SUMP AT CROSS PASSAGE THROUGH ANY ONE OF THE TUNNEL. ACTUAL LOCATION TO BE REFLECTED IN AS BUILT DRAWING.

*** ALL THE ABOVE REQUIRED S&T CABLE TRAY, BRACKETS & EARTH BUS BAR ALONG WITH FIXING ARRANGEMENTS CONTINUOUSLY ALL ALONG THE TUNNEL WALL (BOTH FOR EAST & WEST BOUND TUNNEL) NEED TO BE DESIGNED IN ACCORDANCE WITH THE NOS. OF CABLES PER TRAY AND CABLE LOAD PER METER (PROVIDED BY ASTS EARLIER VIDE DWG. NO: KMRC-02000-02-TP70) & SUPPLIED BY THE UNDERGROUND E&M CONTRACTOR.

*** LEAKY CABLE FOR COMMERCIAL RADIO IS NOT IN THE SCOPE OF ASTS.

ASTS NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. REFER THIS DRAWING ONLY FOR BBRS WAYSIDE EQUIPMENTS-TELECOM.
3. THE DETAILS PROVIDED ARE TENTATIVE & SUBJECT TO OEM APPROVAL.
4. THE PLACEMENT OF BBRS MAST MAY BE ON BOTH SIDES OR EITHER SIDE DEPENDING ON THE DETAILED DESIGN.

General Consultants :

MYCEL Kolkata Metro East West Line : General Consultant

KMRC Building, Level 1, Munshi Premchand Sarani, Hastings, Kolkata 700 021

MAUNSELL | AECOM yec egis Rail LHPA

Certified that this document has been designed and checked in accordance with DDC Quality Assurance Plan.

(Name and Designation) Authorised Signatory for DDC.

(Project Leader ITD-ITD CEM Joint venture)

OFFICE OF ORIGIN: ITD - ITD CEM JOINT VENTURE

DESIGNATION	SIGNATURE	DATE	DESIGNATION	SIGNATURE	DATE
CE1 / KMRCL			PROJECT DIRECTOR/ ITD–ITD CEM JV.		
CE S&T / KMRCL			DESIGN MANAGER/ ITD–ITD CEM JV.		
CE E / KMRCL			PROJECT MANAGER/ DDC		
PROJECT MANAGER MYCEL					

REFERENCE DRAWINGS

Drg. No.	Description

REV.	PARTICULARS	DRN.	CHD.	VER.	DATE
3	REPOSITIONING OF SPETIAL ZONE, COUPLING UNIT, CABLE TRAY, BBRS ANTENA & LICKY CABLE SHOWN.	TD	AC	PJ	12/01/2013
2	SUMP DRAINAGE PIPE REPOSITIONING	TD	AC	PJ	21/12/2012
1	REPOSITIONING OF CABLE TRAY	TD	AC	PJ	18/12/2012
0	FIRST ISSUE	TD	AC	PJ	18/12/2012

ITD - ITD CEM JOINT VENTURE

AMBERG & TTI ENGINEERING — Amberg &TTI Engineering Pte. Ltd., 2 International Business Park, #11-01 The Strategy, Singapore 609930, Tel: +65 6344 6666, Fax: +65 6344 4556

JURONG Consultants Pte Ltd — [A member of JURONG International] 8 Jurong Town Hall Road, #08-00 The JTC Summit, Singapore 609434

STUP Consultants Pvt. Ltd. — P-11, Darga Road, Park Circus, Kolkata 700 017, India. Tel: 033-40109797, 22807430/31, E-Mail: kolkata@stupmail.com

DRAWN BY: TD
CHECKED BY: AC
VERIFIED BY: PJ
DATE OF ISSUE: 21/11/2012

KOLKATA METRO RAIL CORPORATION LTD.

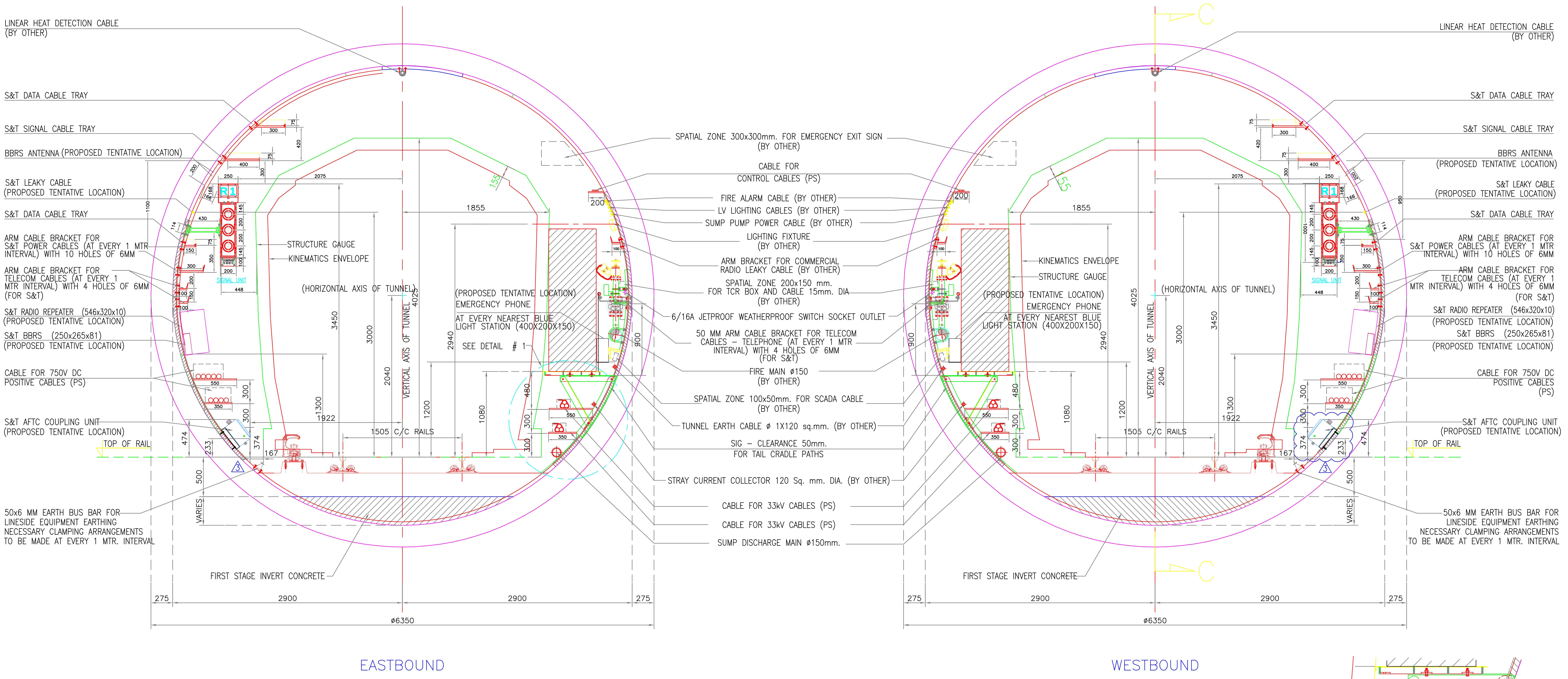
CONTRACT UG2 : DESIGN AND CONSTRUCTION OF UNDERGROUND SECTION FROM CENTRAL STATION TO SUBHAS SAROBAR

DRAWING TITLE: BORED TUNNEL COMBINED SERVICES SECTIONS AT CROSS PASSGE

DRG. NO. UG2-D-BT-CSD-6204 | REV. 3 | SCALE: AS SHOWN | STATUS: DEFINITIVE DESIGN DRAWING

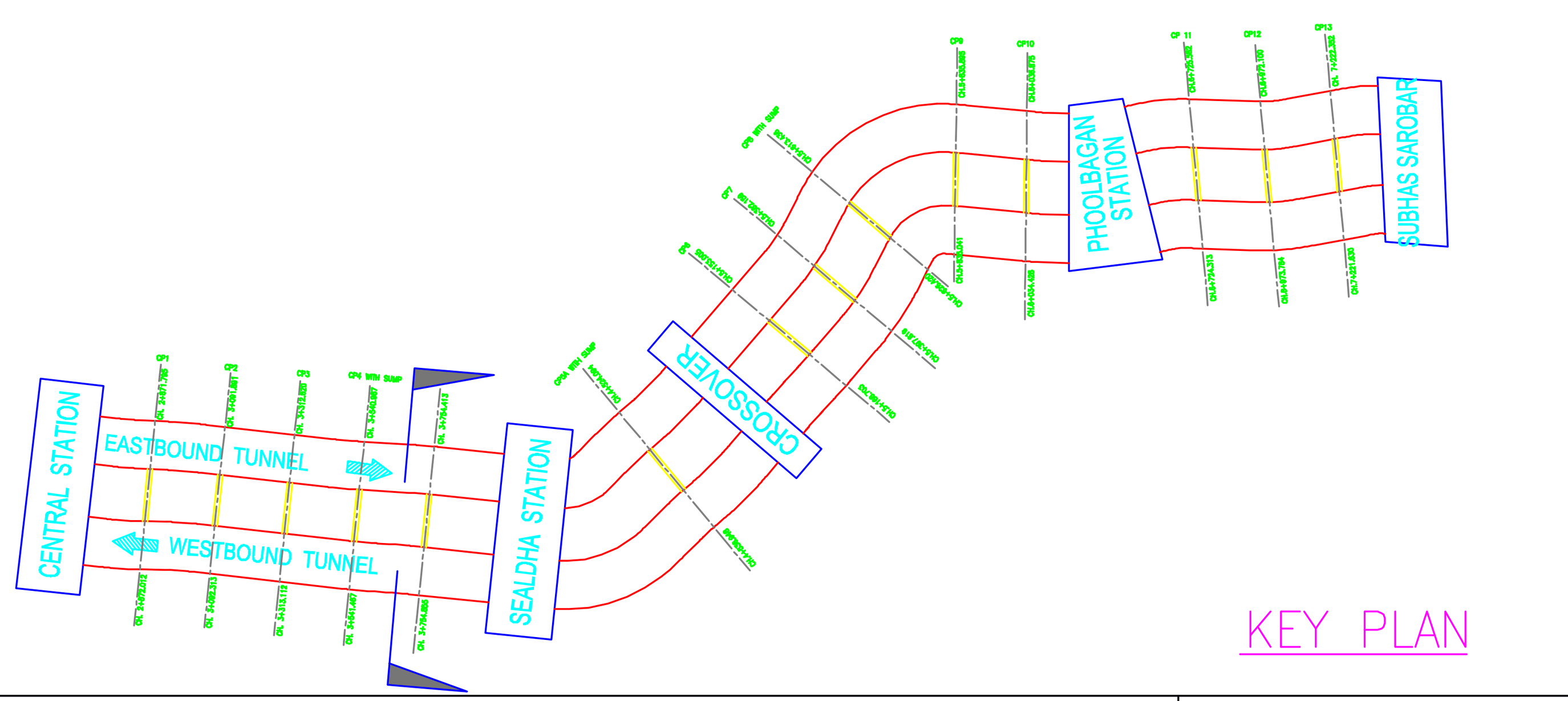
COMBINED SERVICE DRAWING

ORIGINAL DRAWING SIZE : A1



TUNNEL SECTION

SCALE = 1:25



KEY PLAN

NOTE:

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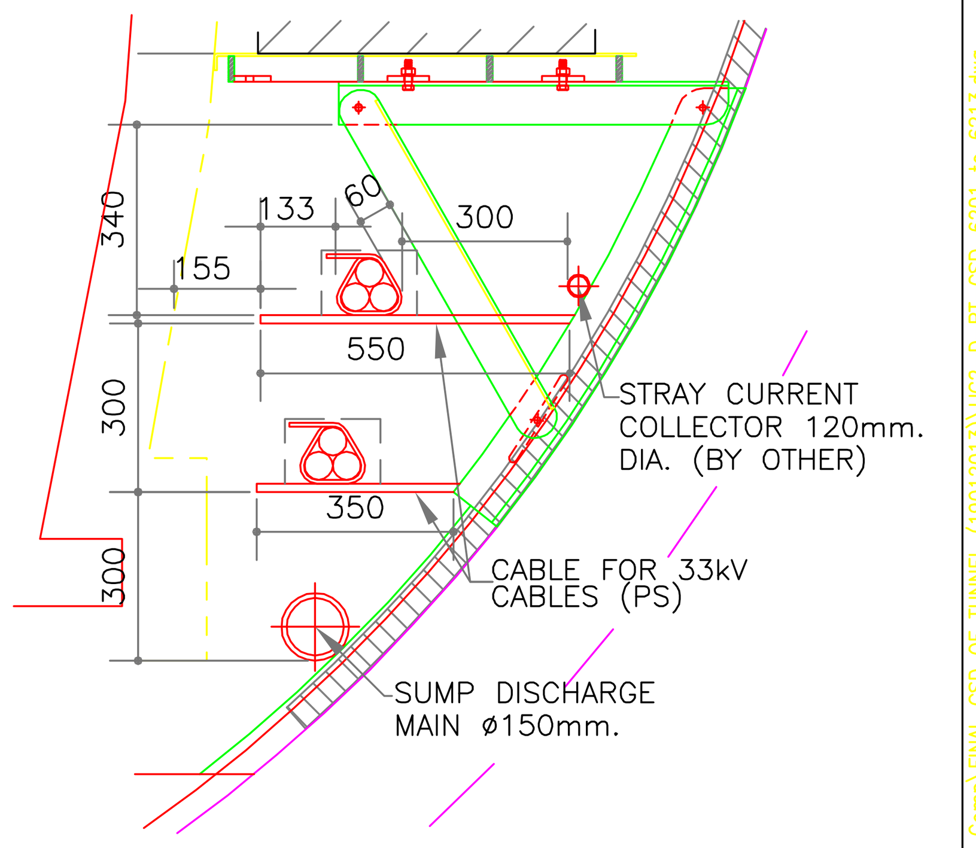
*** LEAKY CABLE FOR COMMERCIAL RADIO IS NOT IN THE SCOPE OF ASTS.



DETAIL # 1

General Consultants :

MYCEL Kolkata Metro East West Line : General Consultant

KMRC Building, Level 1, Munshi Premchand Sarani, Hastings Kolkata 700 021

MAUNSELL | AECOM, yec, egis Rail, LHPA

Certified that this document has been designed and checked in accordance with DDC Quality Assurance Plan.

(Name and Designation) Authorised Signatory for DDC.

(Project Leader ITD-ITD CEM Joint venture)

ITD - ITD CEM JOINT VENTURE

REV.	PARTICULARS	DRN.	CHD.	VER.	DATE
3	REPOSITIONING OF SPETIAL ZONE, COUPLING UNIT, CABLE TRAY, BBRS ANTENA & LICKY CABLE .	TD	AC	PJ	12/01/2013
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1	REPOSITIONING OF CABLE TRAY	TD	AC	PJ	18/12/2012
0	FIRST ISSUE	TD	AC	PJ	18/12/2012

REFERENCE DRAWINGS

Drg. No.	Description

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2 International Business Park
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JURONG Consultants Pte Ltd
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STUP Consultants Pvt. Ltd.
P-11, Darga Road, Park Circus, Kolkata-700 017, India.
Tel: 033-40109797, 22807430/31
E-Mail : kolkata@stupmail.com

OFFICE OF ORIGIN: ITD - ITD CEM JOINT VENTURE

DRAWN BY: TD

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VERIFIED BY: PJ

DATE OF ISSUE: 21/11/2012

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CE E / KMRCL			PROJECT MANAGER/ DDC		
PROJECT MANAGER MYCEL					

KOLKATA METRO RAIL CORPORATION LTD.

CONTRACT UG2 : DESIGN AND CONSTRUCTION OF UNDERGROUND SECTION FROM CENTRAL STATION TO SUBHAS SAROBAR

DRAWING TITLE: BORED TUNNEL COMBINED SERVICES SECTIONS AT TANGENT TRACK

DRG. NO.: UG2-D-BT-CSD-6201 | REV.: 3 | SCALE: AS SHOWN | STATUS: DEFINITIVE DESIGN DRAWING

COMBINED SERVICE DRAWING