

Annexure - 4 to Addendum no. 1

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)**

2024/Proj./GMRCL/AHMD/PH-II/SoD/30/76

New Delhi, dated 12.04.2024

Managing Director,
Gujarat Metro Rail Corporation (GMRC) Limited
1st Floor, BLOCK 1, KARMAYOGI BHAVAN, Sector 10A,
Gandhinagar, Gujarat - 382010

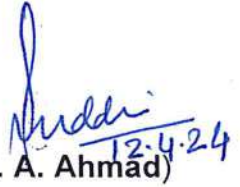
Sub: Approval of Schedule of Dimensions (SoDs) for Ahmedabad Metro Phase II (January 2024) of Gujarat Metro Rail Corporation Limited (GMRCL).

Ref: SoD uploaded on RDSO's online portal by GMRCL on 14.02.2024

The Schedule of Dimensions (SoDs) for Standard Gauge (1435 mm) for Surface, Elevated and Underground Sections (January, 2024) for Ahmedabad Metro Phase II of Gujarat Metro Rail Corporation Limited (GMRCL) have been examined in consultation with RDSO and approval of Railway Board is hereby conveyed for the same.

Accordingly, approved copy of SoDs is enclosed.

Encl: As above


(F. A. Ahmad) 12.4.24

Director/Gati Shakti (Civil)-IV
Railway Board

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Copy to:

1. **Executive Director/UTHS**, RDSO, Manak Nagar, Lucknow w.r.t letter No. UTHS/GMRC/AMRC2/P01/032021 dated 05.03.2024
2. **OSD/UT & Ex-Officio Joint Secretary**, Ministry of Housing & Urban Affairs (MoHUA), Nirman Bhavan, New Delhi-110011

**SCHEDULE OF DIMENSIONS
FOR
STANDARD GAUGE (1435 mm)
SURFACE, ELEVATED AND UNDERGROUND**

Examined and found in order



Director/UT/Civil/RDSO



January 2024

Gujarat Metro Rail Corporation (GMRC) Limited

(A SPV of Govt. of India and Govt. of Gujarat)

Block No. 01, First Floor, Karmayogi Bhavan,

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Gujarat, India



Sign

Location: Gandhinagar, India
Organization Unit: Gujarat Metro
Rail Corporation (GMRC) Limited
Date: 14-Feb-2024 (07:22 PM)



SCHEDULE OF DIMENSIONS FOR STANDARD GAUGE (1435 mm)

SURFACE, ELEVATED AND UNDERGROUND – January 2023

Sl. No.	Revision No	Date	Remarks
1			
2			
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PREAMBLE

Gujarat Metro Rail Corporation (GMRC) Limited has adopted Standard Gauge (SG) with Third Rail bottom current collection using 750V DC Traction system.

The Schedule of Dimensions (SOD) has been prepared based on the following guidelines:-

1. The SOD has been developed assuming certain coach dimensions and design characteristics as well as track and coach maintenance tolerances. Whenever a new stock is introduced the track and coach tolerances for maintenance tolerances should be laid down. The suitability of the Rolling stock for operation with these maintenance tolerances should be established and sanction obtained from the competent authority before the operation of the Rolling Stock.
2. The Kinematic Envelope has been developed for 2900 mm wide and 3980 mm high rolling stock and the max height of Kinematic Envelope is defined as 4053mm.
3. The clearances are based on the assumption that windows are sealed and doors are closed during movement/operation.
4. Track and Rolling Stock shall be maintained to the tolerances considered for calculation of Kinematic Envelope.
5. The Structure Gauge indicated in SOD shall not be violated under any circumstances except for platform coping, designated operational structures such as platform screen door/gate structures including structural support, hand railing in back of house, platform edge etc.
6. The vehicle Kinematic Envelope at wind speed of 70 kmph shall be applied for the platform area on At-Grade, Elevated stations and Nil wind speed for Underground stations within the confines of stations. At all other locations, the Kinematic Envelope corresponding to 100 kmph wind speed shall be used for determining the Structure Gauge for Elevated and At-Grade sections (outside the station area) and Nil wind speed for underground sections (outside the station area). The Kinematic envelope has been developed taking into account all track defects and rolling stock defects.
7. The maximum design speed through station platforms on At-Grade, Elevated and Underground shall be limited to 70 kmph & at all other locations the maximum design speed shall be limited to 90 kmph. Operating speed shall be 80 KMPH (except at stations). Operating speed at stations shall be 10% less than design speed (for which KE has been developed). Operating speed in depots shall be 25 KMPH. Maximum speed potential on diverging lines at turnouts having:
 - (i) Weldable CMS crossing (1 in 9) and thick web switch with 300 m radius of lead curve rail shall be 45 KMPH.
 - (ii) Weldable CMS crossing (1 in 9) and thick web switch with 190 m radius of lead curve rail shall be 35 KMPH.
 - (iii) Weldable CMS crossing (1 in 7) and thick web switch with 190 m radius of lead curve rail shall be 35 KMPH.
 - (iv) Weldable CMS crossing (1 in 7) and thick web switch with 140 m radius of lead curve rail shall be 25 KMPH.
8. The train operation will be stopped in affected section by central control if any of the train in UP or DN direction derails. The operation will remain suspended till the clearance given by Accident site manager from the site by exchange of private number with Central Control.

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9. The speed of trains at platform on Elevated or At Grade station shall be restricted to 40 KMPH when wind speed is more than 70 KMPH but less than 90 KMPH. Metro operation shall be stopped when wind speed reaches 90 KMPH or More. Continuous recording of wind speed shall be done at critical locations defined by the Metro administration.
10. The Kinematic envelope for stations and all other locations shall not be infringed under any circumstances.
11. No work/workmen/equipment are allowed between Vehicle and Structure gauge during operation of trains.
12. The train consists, not exceeding 6 coaches, will be operated on the system.
13. The type of emergency evacuation system for passengers is side evacuation.
14. All the Electrical Clearances should be measured from Kinematic Envelope of Rolling Stock.

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SCHEDULE OF DIMENSIONS

STANDARD GAUGE (1435 mm)

INTRODUCTION

1. The dimensions given in this SOD are to be observed in all works on 1435 mm Gauge (STANDARD GAUGE), unless prior sanction has been obtained from the Railway Board through the Commissioner of Metro Railway Safety to execute works which infringe this Schedule of Dimensions (SOD).
2. Any condonation in SOD parameters will require approval of Railway Board through the Chief Commissioner of Railway Safety (CCRS).
3. The dimensions given in this SOD are applicable to Elevated, At-Grade and Underground section of GMRC which is with 750 Volts D.C. Traction system with Third rail bottom current collection and track rail return current. The Rolling Stock shall be 2900 mm wide and 3980 mm high with sealed windows and sliding doors which shall remain closed when the train is in motion.
4. The Underground Section is with Circular Tunnel or Rectangular Box or Open Cut (at Ramps) of any suitable shape while Elevated Section is with over ground structure of elevated Viaduct, with sidewalks to be used as access for inspectors or maintainers during non – operation periods and a safe evacuation route for passengers in emergency evacuation. Both Underground and Elevated system shall have suitably designed Ballastless Track. Depot track may be Ballasted / Ballastless.
5. The Schedule of Dimensions (SOD) has been divided into five chapters as under:

Chapter-1	General
Chapter-2	Stations
Chapter-3	Rolling Stock
Chapter-4	Electric Traction
Chapter-5	Platform Screen Doors/Gates

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Chapter – I: GENERAL

1.1 SPACING OF TRACKS

Minimum distance, center to center of tracks without any structure between tracks for Tangent (Straight) track for:

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

Note: For minimum track centers on curves, refer to Appendix-1 at page 26

1.2 CURVES

1.2.1. Minimum radius of curvature (Horizontal):

i. On main running lines, other than stations:

a) Underground Sections	
Minimum Radius	200 m
b) Elevated and At-Grade Sections	
Minimum Radius (Without Check Rail)	>190 m
Minimum Radius (With Check Rail)	120 m

Note: Check Rail is to be provided on curves where radius is 190m or less including their transition curves.

ii. Depot, yard, and other non-passenger Lines

Minimum Radius	100 m
----------------	-------

Note: Provision of check rail is not mandatory in Depot, yard, and other non-passenger lines. However, if check rails are not provided, speed shall be restricted to 25 kmph or the safe speed, whichever is lower.

iii. At Station Passenger platforms

Minimum Radius	1000 m
----------------	--------

1.2.1.1 Minimum Transition length (Horizontal)

(a) On main running lines

(i) Underground sections	15 m
(ii) Elevated and At Grade sections	15 m
(b) At passenger platform	15 m

1.2.1.2 Minimum length of alignment elements (horizontal):

The Minimum length of alignment elements (circular curves and straights) between two transition curves should be 20 m except reverse curves. Speed restrictions will be there as per design calculation for the reverse curves.

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1.2.2 Check Rail / Restraining Rail:

- Check rails/ Restraining Rails should be provided on curves on main line where radius is 190m or less on Standard gauge. The clearance of check rail/ restraining rails shall be suitably decided after requisite studies. The detailed design calculations/ studies in this regard shall be furnished for record.
- Check rails/ Restraining Rails shall not be mandatory for curves in depots, yards and non-passenger lines where speed is not more than 25 kmph. However, decision in this regard may be taken by Metro themselves based on layout and maintenance requirement.

1.2.3 Cant & Cant Deficiency

- Maximum Cant Gradient 1 in 440
- Maximum desirable Cant on curves 110 m
Maximum permissible cant (C_a) 125 mm
- Maximum desirable Cant deficiency (C_d) 85 mm
Maximum permissible cant deficiency (C_d) 100 mm
- Desirable rate of change of Cant 40 mmm/sec.
- Desirable rate of change of cant deficiency 40 mm/sec.
- Maximum Lateral acceleration 0.55 m/sec²

1.2.4 Radius of Vertical Curve

- Minimum radius 1500 m
- Minimum Length of vertical curve 20 m

1.3 GRADIENTS

1.3.1. Maximum Permissible Gradient on Mid-Section

- Maximum Gradient (compensated) shall be 4%.

Note:

- There shall be no change of gradient in transition portion of horizontal curves.
- The gradient will be compensated for curvature at the rate of 0.04% per degree of curve.

1.3.2. Maximum permissible gradient on turnouts

- On Ballasted Track 0.25 %
- On Ballastless Track 3.0 %

Note:

- There shall be no change of gradient (i.e. vertical curve) on and within 15 meters (desirable)/3 meters (minimum) of any turnout on Ballastless track. In case of Ballasted track, there shall be no change of gradient on and within 30 meters of any turnout.
- There shall be no horizontal curve within 15 meters(desirable)/3 meters (Minimum) of any turnout on Ballastless Track and 30 meters of any Turnout on Ballasted Track.
- Turnout shall normally be installed on straight track. In exceptional situations, turnout may take off from curve provided that the radius of lead curve (main line as well as diverging line) is not less than 190m. The negotiability of rolling stocks on such turnout

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must be certified by rolling stock supplier and confirmed through oscillation trial and a suitable speed restriction should be imposed on main and/or diverging line based on track geometry and other considerations, if required. In case of turnout installed on curved track, the minimum distance for commencement of vertical curve or another horizontal curve shall be 15 meters for Ballastless track. Turnout shall not be laid on transition curve.

- (iv) The limit of turnout for above purposes shall be taken from Stock Rail Joint (SRJ) to end (i.e. heel) of crossing for Ballastless track. For Ballasted track, it shall be from SRJ to last common sleeper behind end of crossing.
- (v) The maximum permissible gradient on turnout and the location of turnout with respect to vertical/horizontal curves in vicinity shall be confirmed from rolling stock supplier for the negotiability of rolling stock.
- (vi) The above stipulations shall also be applicable for turnout to be laid outside the station limits, if any.

1.4

BUILDINGS AND STRUCTURES (OUTSIDE STATION AREA)

Minimum horizontal distance from center of track to any structure (Except Conductor Rail and platform Coping) for heights above Rail Level on tangent track on level/constant grade shall be as under:

(A) Underground Sections

1. Circular Tunnel

<u>Height from Rail Level</u>	<u>Horizontal Distance from C.L. of track</u>
i. From Rail Level to 88 mm	1730 mm
ii. At 88 mm	1730 mm increasing to 1768 mm
iii. 88 mm to 3197 mm	1768 mm
iv. 3197 mm to 3659 mm	1768 mm decreasing to 1428 mm
v. 3659 mm to 4153 mm	1428 mm decreasing to 628 mm
vi. At 4153 mm	628 mm decreasing to 0 mm

Refer Drawing no. MEGA/GEN/SOD/UND/01 at page 47

2. Rectangular Box Tunnel

<u>Height from Rail Level</u>	<u>Horizontal Distance from C.L. of track</u>
i. From Rail Level to 75 mm	1680 mm
ii. At 75 mm	1680 mm increasing to 1715mm
iii. 75 mm to 317 mm	1715 mm
iv. At 317 mm	1715 mm decreasing to 1593 mm
v. 317 mm to 883 mm	1593 mm increasing to 1676 mm
vi. 883 mm to 1771 mm	1676 mm increasing to 1678 mm
vii. 1771 mm to 3121 mm	1678 mm decreasing to 1604 mm
viii. 3121 mm to 3659 mm	1604 mm decreasing to 1428 mm

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|------------------------|------------------------------|
| ix. 3659 mm to 4153 mm | 1428 mm decreasing to 628 mm |
| x. 4153 mm | 628 mm decreasing to 0 mm |

Refer Drawing no. MEGA/GEN/SOD/UND/03 at page 48

(B) Elevated and Surface (At-Grade) Sections (Ballastless Track)

<u>Height from Rail Level</u>	<u>Horizontal Distance from C.L. of track</u>
i. From Rail Level to 367 mm	1765 mm
ii. At 367 mm	1765 mm decreasing to 1653 mm
iii. 367 mm to 875 mm	1653 mm increasing to 1736 mm
iv. 875 mm to 1769 mm	1736 mm increasing to 1758 mm
v. 1769 mm to 3122 mm	1758 mm decreasing to 1702 mm
vi. 3122 mm to 3463 mm	1702 mm decreasing to 1624 mm
vii. 3463 mm to 3820 mm	1624 mm decreasing to 1308 mm
viii. 3820 mm to 4203 mm	1308 mm decreasing to 640 mm
ix. At 4203 mm	640 mm decreasing to 0 mm

Refer Drawing no. MEGA/GEN/SOD/ELE-02 at page 46

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

<u>Height from Rail Level</u>	<u>Horizontal Distance from C.L. of track</u>
i. From Rail Level to 87 mm	1805 mm
ii. At 87 mm	1805 mm increasing to 1895 mm
iii. 87 mm to 3202 mm	1895 mm
iv. 3202 mm to 3672 mm	1895 mm decreasing to 1587 mm
v. 3672 mm to 4203 mm	1587 mm decreasing to 639 mm
vi. At 4203 mm	639 mm decreasing to 0 mm

Refer to drawing no. MEGA/GEN/SOD/ATG/02 at page 49

Notes for (A), (B) and (C):

- Extra clearance shall be provided for curves as laid down at para 1.7.
- The term 'structure' covers any item including light ones like ladders, isolated posts, cables etc. erected alongside the track.
- For At-Grade and Elevated Sections, a clearance of minimum 150 mm has been made over the Kinematic Envelope on the lateral dimensions to arrive at the Structure Gauge. For Underground Sections this clearance is 100 mm.

KINEMATIC ENVELOPE

- For Kinematic Envelope for level/constant grade (tangent track) outside platform area, refer to:
 Drawing no. MEGA/GEN/SOD/ELE/01, at page 42
 Drawing no. MEGA/GEN/SOD/UND/02, at page 43
 Drawing no. MEGA/GEN/SOD/ATG/01, at page 44

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- b) For Kinematic Envelope for level/constant grade (tangent track) in platform area, refer to: Drawing no. MEGA/GEN/SOD/ELE & UND-70 Kmph at page 45

1.6 STRUCTURE GAUGE (Except for Passenger platforms)

1.6.1. Underground sections

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

- a) For Structure Gauge for Underground Sections (Circular Tunnel) with Ballastless Track for level/constant grade (tangent track) Refer drawing no. MEGA/GEN/SOD/UND/01 at page 47.
- b) For Structure Gauge for Underground Sections (Rectangular Box Tunnel) with Ballastless Track for level/constant grade (tangent track) Refer drawing no. MEGA/GEN/SOD/UND/03 at page 48.

Note: Extra clearances shall be provided for curves as laid down at Para 1.7

1.6.2. Elevated Sections and Surface (At-Grade) sections with Ballastless Track

The Structure Gauge (Fixed Structure Line) has been arrived at by allowing minimum clearance of 150 mm to Kinematic Envelope. This includes 50 mm additional clearance for Elevated Sections.

- a) For Structure Gauge on Elevated Sections and At-Grade sections outside station with Ballastless Track for level/constant grade (tangent track) refer to drawing no. MEGA/GEN/SOD/ELE/02 at page 46 (outside station) with Ballastless Track for level/constant grade (tangent track).

Note: Extra clearances shall be provided for curves as laid down at Para 1.7

1.6.3. Surface (At-Grade) Sections with Ballasted Track

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

- a) For Structure Gauge on Surface sections (outside stations) with Ballasted Track for level/constant grade (tangent track) Refer to drawing no. MEGA/GEN/SOD/ATG/02 at page 49.

Note: Extra clearance shall be provided for curves as laid down at Para 1.7

1.7 EXTRA CLEARANCES ON CURVES

Following are the extra clearances considered for curves.

1.7.1. INSIDE OF CURVE

(A) Curvature effect

- a) Mid throw at the center of the vehicle = V (in mm) = $125 C^2/R$
- b) Lateral shift due to gauge widening on curves, is 9 mm for curves sharper than 500m radius and 5 mm for curves of radius 500m up to 1000 m.

Examined and found in order c) Lateral shift for nosing is 37 mm for ballasted track and 34 mm for Ballastless track.

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For values of curvature effect,

- i) For At-Grade (Surface) Sections — Ballasted Track refer Appendix — 2A at page 27 and Appendix — 2B at page 28
- ii) For Tunnel, Elevated and At-Grade (Surface) Sections — Ballastless Track refer Appendix — 2C at page 29 and Appendix — 2D at page 30

Notes:

- i) Underground, Elevated and At-Grade Ballastless sections.

Lateral shift of 34 mm due to nosing is included in 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 clearance worked out as at Para 1.7.1(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).

- ii) At-Grade (Surface) Ballasted Sections

Lateral shift of 37 mm due to nosing is included in Kinematic Envelope for At-Grade (Surface) Sections with Ballasted Track for tangent track (and as a result, also included in Structure Gauge) which shall be subtracted from the total extra clearance worked out as at Para 1.7.1(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) Clearance 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:

$L = C_a \times h/g$ (all in mm), where $g = 1435 + c$ mm, c being the rail head width, and C_a being the cant.

Values of Cant effect on Structure Gauge for inside of a curve with only the cant effect, as shown in drawing no. MEGA/GEN/SOD/GEN/01 at page 39, is as under:

- (i) For At-Grade (Surface) Sections — Ballasted Track refer Appendix — 3A at page 31
- (ii) For Elevated and At-Grade (Surface) Sections—Ballastless Track refer Appendix— 3B at page 32
- (iii) For Box Structures of Underground Sections—Ballastless Track refer Appendix — 3C at page 33

- b) Circular Tunnels

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



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For values of horizontal and vertical shifts of center of Circular Tunnel for different values of cant, refer to Appendix – 4 at page 37 and Drawing no. MEGA/GEN/SOD/UND/04 at page 50.

(C) Clearance for Vertical curve (Vertical Throw)

- a) Vertical Throw V1 and V2 (in mm) for vertical curve shall be calculated as under:
V1 (with vehicle center in sag or vehicle end on summit) = $125 \times C^2/R$
V2 (with vehicle center in summit or vehicle end in sag) = $[125 \times C_1^2/R] - [125 \times C^2/R]$
- b) Values of Vertical Throw V1 and V2 due to vertical curves of different radii are shown in Drawing no. MEGA/GEN/SOD/GEN/02 at page 40.

1.7.2.

OUTSIDE OF CURVE

(A) Curvature effect

- a) End throw at the end of vehicle = V_o (in mm) = $[125 \times C_1^2/R] - [125 \times C^2/R]$
- b) Clearance due to gauge widening on curves, is 9 mm for curves sharper than 500m radius and 5 mm for curves of radius 500m upto 1000m.
- c) Additional nosing due to gauge widening on curves, for curves sharper than 1000 m radius.

For values of curvature effect, refer to:

- i) For At-Grade (Surface) Sections — Ballasted Track refer Appendix – 2A at page 27 and Appendix — 2B at page 28.
- ii) For Underground, Elevated and At-Grade (Surface) Sections — Ballastless Track refer Appendix – 2C at page 29 and Appendix — 2D at page 30.

(B) Clearance for Cant

- a) Underground (Box Structure), Elevated and At-Grade (Surface) Sections
The lean 'L' due to Cant at any point at height 'h' above Rail Level is given by:

$$L = (-) C_a \times h/g \text{ (all in mm), where } g = 1435 + c, c \text{ being the rail head width}$$

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

Values of cant effect on Structure Gauge on inside and outside of curve with only the cant effect as shown in drawing no. MEGA/GEN/SOD/GEN-01 at Page 39:

- (i) For Ballasted Track sections refer Appendix — 3A at page 31
- (ii) For Elevated and At-Grade(surface) sections (Ballastless Track) refer Appendix — 3B at page 32
- (iii) For Box structures of Underground sections (Ballastless Track) refer Appendix—3C at page 33

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Circular Tunnels

In the case of Circular Tunnel, the cant is provided by raising the outer rail and suitably shifting the center of the Circular Tunnel towards inside of curve and upwards. This has





same effect as assuming rotation of the Circular Tunnel about mid-point of top of inner rail resulting in shift of Tunnel center laterally towards inside of curve and also vertically upwards.

For values of horizontal and vertical shifts of center of Circular Tunnel for different Values of cant, refer to Appendix – 4 at page 37 and Drawing no. MEGA/GEN/SOD/UND/04 at page 50.

(C) Clearance for Vertical curve (Vertical Throw)

The provision at Para 1.7.1. (C) above shall be applicable in this case also.

Vertical Throw V1 and V2 (in mm) for vertical curve shall be calculated as under:

V1 (with vehicle center in sag or vehicle end on summit) = $125 \times C^2/R$

V2 (with vehicle center in summit or vehicle end in sag) = $[125 \times C_1^2/R] - [125 \times C^2/R]$

Values of vertical throw V1 and V2 due to vertical curves of different radii are shown in drawing no. MEGA/GEN/SOD/GEN/02 at page 40.

Abbreviations used in para 1.7 above:

C is the distance between centers of bogies in meters

C₁ is the coach length in meters

R is the radius of curve in meters

C_a is the cant provided in mm

h is the height from Rail Level in mm, and

g is the distance between centers of rails in mm

1.8 MINIMUM TRACK SPACING ON CURVES

Underground, Elevated and At-Grade (Surface) Sections

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

1.8.1. Without any structure between tracks

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

a) (E + F),

Where,

E is the horizontal distance from vertical axis of center line of canted track to canted Kinematic Envelope on inside of curve at a height 'h' (from Rail Level) for a given cant,

F is the horizontal distance from vertical axis of center line of canted track to canted Kinematic Envelope on outside of curve at a height 'h' (from Rail Level) for a given cant,

Refer Drawing no. MEGA/GEN/SOD/GEN/03) at page 41.

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- b) T1 (Extra lateral clearance due to curvature on inside of curve)
- c) T2 (Extra lateral clearance due to curvature on outside of curve)

Minimum clearance between adjacent Kinematic Envelopes is stipulated as under:

- i) 300 mm for Underground Sections
- ii) 300 mm for Elevated Sections
- iii) 300 mm for Surface (At-Grade) Sections

Notes:

- i) The value of 'F', calculated from the formula at drawing no. MEGA/GEN/SOD/GEN/03 at Page no. 41 includes full relief due to Cant.
- ii) 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.

For values of E, F, T1 and T2, refer to the Appendices as shown below:

SECTIONS	FOR E & F	For T1 & T2
1 Elevated, Underground & At-Grade (Ballastless)	Appendix 3E at page 35 & Page 36	Appendix 2C at page 29 Appendix 2D at page 30
2 Surface (At-Grade) Ballasted Section	Appendix 3D at page 34	Appendix 2A at page 27 Appendix 2B at page 28

1.8.2. With a structure between adjacent tracks

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

- a) (E1 + T1) Minimum clearance to the structure from center line of track on inside of curve (for outer track)
- b) (F1 + T2) Minimum clearance to the structure from center line of track on outside of curve (for inner track)
- c) Width of structure between adjacent tracks (measured across the tracks)

Where,

E1 is the horizontal distance from vertical axis of center line of canted track to canted Structure Gauge on inside of curve for a given cant,

F1 is the horizontal distance from vertical axis of center line of canted track to canted Structure Gauge on outside of curve for a given cant,

T1 is extra lateral clearance due to curvature on inside of curve and

T2 is extra lateral clearance due to curvature on outside of curve

Notes:

Examined and found in order The values of E1 and F1 for a given cant C_a , shall each be the maximum of values at different heights of structure from Rail Level. In case the cant provided is greater than



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50 mm on inner track, the value of F1 shall be for the cant of (C_a-50) mm. In case the cant provided is 50 mm or less on inner track, the value of F1 shall be for ZERO cant.

- ii) Minimum track spacing, so worked out with a structure between the adjacent tracks shall not be less than that calculated as per Para 1.8.1 for tracks without any structure between adjacent tracks.

For values of E1, F1, T1 and T2, refer to the Appendices as shown in Table below:

SECTIONS	FOR E1 & F1	FOR T1 & T2
1 Underground Rectangular Box Tunnels (Ballastless)	Appendix 3C at page 33	Appendix 2C at page 29 Appendix 2D at page 30
2 Elevated & At-Grade (Ballastless)	Appendix 3B at page 32	Appendix 2C at page 29 Appendix 2D at page 30
3 Surface (At-Grade) Ballasted Section	Appendix 3A at page 31	Appendix 2A at page 27 Appendix 2B at page 28

1.9

WALKWAYS

Minimum Width of Walkway	610 mm
Minimum Height of Walkway	1000 mm
Maximum Height of Walkway	1200 mm

Note: Extra clearance to walkway shall be provided for curves, as laid down at Para 1.7

- i) Minimum clearance to walkway at the nearest edge from the Kinematic Envelope shall be 100 mm for Underground sections and 150mm for Elevated and Surface (At-Grade) sections.
- ii) Walkway should be used by Metro inspection and maintenance staff only during non-operation hours.
- iii) The maximum and minimum heights of walkway on curves are above inner rail.
- iv) No structure, other than signaling and minor signaling, telecom equipment posts, shall be permitted within the minimum width of walkway.
- v) At locations having combined effect of curves and grades and approaches to such location, based on technical considerations duly approved by Metro, the minimum height of walkway can be reduced up to 900 mm with stipulation that such location will be suitably notified and other evacuation measures as published by MOUD, shall be ensured and width of walkway shall not be less than 940 mm (800 mm on inside of curve) for sharp curves of radius 200 m or less at such locations.

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If tunnel provided with walkway on the same side of the platform is connecting two stations, one station having island platform and another station having a side platform, track crossing at Rail Level is to be provided to allow access from either of the stations

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to the walkway and vice versa. The track crossing shall not infringe the structure gauge and shall be put to use only after train operation is stopped and traction power is switched off.

1.10 DERAILMENT GUARDS

1.10.1. The derailment guard should be provided inside/outside of running rail on viaduct as well as in tunnel having multiple tracks and At-Grade section locations specified by the Metro Railway. For single track tunnel, location for providing derailment guard is given in note. In tunnels, the derailment guard should preferably be provided inside the track, so that it permits less sway of coach towards tunnel wall in case of derailment.

Note:

Location for providing Derailment Guard in single track tunnel

- i) Entry of tunnel: 200 m from tunnel portal outside the tunnel to 50 m inside the tunnel.
- ii) Exit of tunnel: 50 m from inside of tunnel portal to 200 m outside the tunnel.
- iii) In curved track having radius 500 m or less including transition portion but excluding locations where check rail is provided.
- iv) Covering locations of all important installations e.g. Location of any sub-station or hazardous structures inside the tunnel, etc. damage to which in the assessment of metro rail administration can result into serious loss of life or/and infrastructure as a result of derailment in tunnel.

The above is subject to the condition that Metro Railway shall carry out the risk assessment analysis for derailment in tunnels and ensure that the maintenance practices in the maintenance manual are as per the risk assessment mitigation plan.

1.10.2. The lateral clearance between the running rail and the derailment guard shall be 210 ± 30 mm. It shall not be higher than 25 mm above the top of the running rail and should be clear of the rail fastenings to permit installation, replacement and maintenance.

Note:

In case of Double Resilient Base Plate Assembly fastening system as approved by MoR, the lateral clearance between running rail and the derailment guard shall be 250 ± 20 mm. This fastening system, if used in tunnel having multiple tracks, KE of adjacent tracks is not to be infringed so long as the wheels of any derailed vehicles are within the main rail and derailment guard.

1.10.3. Derailment guard shall be designed such that in case of derailment:

- i) The wheels of a derailed vehicle under crush load, moving at maximum speed are retained on the viaduct or tunnel.
- ii) Damage to track and supporting structures is minimum.

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Chapter – II: STATIONS

2.1 SPACING OF TRACKS AT STATIONS

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 (Ballasted Track)	3800 mm
d.	At-Grade Section (Ballastless Track)	3750 mm

2.2 PLATFORMS

2.2.1. Maximum horizontal distance from center of track to face of passenger platform coping (Ballastless Track)

a.	Underground Station	1525 mm	} (A)
b.	Elevated Station	1535 mm	
c.	At-Grade Station	1535 mm	

2.2.2. Minimum horizontal distance from center of track to face of passenger platform coping (Ballastless Track)

a.	Underground Station	1515 mm	} (B)
b.	Elevated Station	1530 mm	
c.	At-Grade Station	1530 mm	

Notes:

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

- 1575 +/-5 for Underground and Elevated Stations
- 1590 +/-5 for Surface (At-Grade) Stations

- (ii) For additional clearance for platforms on curves, refer to Para 2.7.

- (iii) Maximum and Minimum distances specified at Para 2.2.1 and 2.2.2 are for 2900 mm wide Rolling Stock. The distance (A) and (B) shall be adjusted with the variation in width of Rolling Stock.

2.2.3. Height Above Rail Level for Passenger Platform on Ballastless Track

a.	Maximum height above Rail Level for Passenger platform	1095 mm
b.	Minimum height above Rail Level for Passenger platform	1085 mm

Note: No Station is proposed to be located on Ballasted Track

- 2.2.4.
- | | | |
|----|---|---------|
| a. | Minimum horizontal distance of any isolated structure on a passenger platform from the edge of coping with/without platform screen door/gate. | 2500 mm |
| b. | Minimum horizontal distance of any continuous Structure on a passenger platform from the edge of coping with/without platform screen door/gate. | 3000 mm |

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Note:

- a) The Platform Gates (PG) may be installed at platform as per design of Original Equipment Manufacturer (OEM) of PG but shall have a minimum clearance of 10 mm from Kinematic Envelope.
- b) 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 a continuous structure except platform screen doors.
- c) The clocks/mirrors/CCTV/LED/LCD Screens/PIDS (passenger Information Display System) etc. shall not be considered structures and shall be located at a minimum horizontal distance of 1000 mm from platform edge/coping with minimum height of 2500 mm from platform surface.

Note: Anything like above, hung from the Roof of Station shall be adequately secured and a safety loop is to be provided for taking care of incidences of failure of hanging arrangement.

- d) For platform structure setting-out dimensions at stations, refer to figure no. MEGA/GEN/SOD/PSD -1&2. No fixed structures should infringe the Structure Gauge except for designated railway operational platform gates, hand railing in back-of-house platform edge, Track Access Gates. Such designated railway operational structures should not infringe the Kinematic Envelope under any circumstances.

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

- a. For Elevated and At-Grade Stations Drawing No. MEGA/ GEN/SOD/ELE-03 at page 51 (Side platform) with/without platform screen gate
- b. For elevated and At-Grade Stations Drawing No. MEGA/ GEN/SOD/ELE-04 at page 52 (Island platform) with/without platform screen gate.
- c. For Underground Stations (Island platform) with/without platform screen door Drawing No. MEGA/ GEN/SOD/UND-05 at page 53

2.2.6. For Kinematic Envelope on platform at station, Drawing No. MEGA/ GEN/SOD/ELE &UND- 70 Kmph refer to: at page 45

2.3 TRACK GRADIENTS IN PLATFORM

2.3.1. Track gradient in platform

1. Desirable Grade (recommended): Level
2. Maximum Grade: 1 in 1200
3. Exceptional Grade: 1 in 400

Note:

- (a) There shall be no change of grade within station platform track.
- (b) Any gradient steeper than 1 in 1200 and up to an exceptional gradient of 1 in 400 shall be proposed by Civil engineering Head and approved by Managing Director in consultation with Head of safety nominated by Metro Authority.

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2.4 INTERLOCKING AND SIGNAL GEAR

Maximum height above Rail Level of any part of interlocking or signal gear on either side of center of track falling within the structure gauge limits shall be as under, subject to the restrictions as per Note below:

- | | |
|---|--------|
| a) <u>In Underground Stations</u> | |
| From center of track to 1610 mm | 0 mm |
| Beyond 1610 mm from center of track up to 1705 mm | 250 mm |
| b) <u>In Elevated Stations</u> | |
| From center of track up to 1610 mm | 0 mm |
| Beyond 1610 mm from center of track up to 1755 mm | 250 mm |
| c) <u>In Surface Stations</u> | |
| From center of track up to 1610 mm | 0 mm |
| Beyond 1610 mm from center of track up to 1880 mm | 250 mm |

Note:

Except for check rails of ordinary and diamond crossings, upstands or wing rails and point rails of crossings leading to snag dead ends, or such parts of signaling gear as are required to be actuated by the wheels, no gear or track fittings shall project above Rail Level for a distance of 1150 mm on either side of center of the track.

2.5 POINTS & CROSSING

- | | | |
|--------|--|--------|
| 2.5.1. | Maximum clearance of check rail opposite nose of crossing: | 42 mm |
| 2.5.2. | Minimum clearance of check rail opposite nose of crossings: | 37 mm |
| 2.5.3. | Maximum clearance of wing rail at nose of crossing: | 43 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: | 160 mm |
| 2.5.6. | Minimum radius of lead curve for slip points, turnouts and crossover roads | |
| | 1 in 9 turnouts – Minimum: 190 m | |
| | 1 in 7 turnouts – Minimum: 140 m | |

The design of the turnout shall be as per approved track structure

- | | | |
|--------|---|--------|
| 2.5.7. | Minimum angle of crossing (ordinary) | |
| a) | For passenger running lines | 1 in 7 |
| b) | For depots, yards and other non-running lines | 1 in 7 |
| 2.5.8. | Diamond crossings not to be flatter than | 1 in 6 |

Notes:

- The above restrictions shall not apply to moveable diamond crossings
- There must be no change of superelevation (of outer rail over inner rail) between a point 18 meters outside toe of switch rail and heel of crossing, 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 | 10,000 mm |
|--------|-------------------------------|-----------|

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

2.6.1. Main Line:

Subject to the permissible run through speed based on the standard of interlocking, the equilibrium superelevation, calculated for the speed of the fastest train may be reduced by a maximum amount of Cant Deficiency permitted without reducing speed on the main line.

2.6.2. Turnouts:

a) Curves of contrary flexure:

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

Where, c= Rail head width, R = radius of turnout in meters and V is speed on turnout in kmph.

The permissible negative superelevation on the turnout (which is also the actual superelevation of the main line) may then be = (Can't Deficiency permitted – s) mm

b) Curves of Similar flexure:

The question of reduction or otherwise of superelevation on the main line in order to keep the cant deficiency on turnout track within limits for the speed permitted on turnout track must be determined by the administration concerned. In the case of a reverse curve close behind the crossing of a turnout, the superelevation 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:

On inside of curve:

Mid throw

On outside of curve:

End throw

The additional clearance for platforms on curves is shown in Appendix- 5 at page no. 38.

No superelevation and gauge widening shall be provided on passenger platform lines.

Platforms located in curve shall be fitted with gap filler/or suitable arrangement wherever necessary to maintain the Maximum stepping distance (between platform and car body floor) at platform as 75 mm in Horizontal direction and 50 mm in Vertical direction. The gap filler shall be of elastic nature and flexible to allow train contact without any adverse effect on passenger safety and stability of trains.

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CHAPTER — III: ROLLING STOCK

3.1 PASSENGER ELECTRIC MULTIPLE UNITS

- 3.1.1. a) Maximum Length of Coach body (including end fairings) 21965 mm
- b) Maximum width of the vehicle 2900 mm
- c) Maximum Height of Coach Body 3980 mm
- 3.1.2. Distance between Bogie centers 14800 ± 200 mm
- 3.1.3. a) Kinematic Envelope for level tangent track except for passenger platform
- For Underground Ballastless track, refer drawing MEGA/GEN/SOD/UND-02 at page 43 no:
 - For At-Grade & elevated sections, Ballastless MEGA/GEN/SOD/ELE- 01 at page 42 track, refer drawing no:
- b) Kinematic Envelope for level tangent track at passenger platform (for Underground, At-Grade and Elevated MEGA/GEN/SOD/ELE & UND- 70 Kmph at page 45 sections) refer drawing no:
- 3.1.4. Net Minimum Clearance above Rail Level under dynamic condition of fully loaded vehicle under worst condition 50 mm *#
- ** for bogie and axle mounted equipment excluding Current Collection Device (CCD) and Obstacle Deflection Device after considering upto 25mm projection of Check rails, wing rails and upstand above Rail Level.
- Note:**
- *The Current Collection Device in worst condition (with the deflection of primary springs and with maximum tread wear) in retracted position shall have a net minimum clearance of 25mm above Rail Level.
- # The Obstacle Deflection Device working height shall be 125mm above Rail Level and in worst condition (with the deflection of primary springs and with maximum tread wear) shall have a minimum clearance of 25mm above Rail Level.
- 3.1.5. Minimum Clearance above Rail Level under dynamic condition of fully loaded vehicle under worst condition 102 mm
- *** for body mounted equipment
- ** The "worst condition" means that it is with deflection of Primary suspension with Maximum tread wear.
- *** The "worst condition" means that it is with deflection of Primary suspension, deflated air spring and maximum tread wear.
- 3.1.6. Wheel
- a) Maximum wheel gauge back-to-back distance 1360 mm



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	b) Minimum wheel gauge back to back distance	1358 mm
3.1.7.	a) Maximum diameter on the tread measured at 70mm from the wheel gauge face	860 mm
	b) Minimum diameter on the tread measured at 70mm from the wheel gauge face	780 mm
3.1.8.	a) Minimum projection for flange of new wheel measured from tread at 70mm from the wheel gauge face	28 mm
	b) Maximum projection for flange of worn wheel measured from tread at 70mm from the wheel gauge face	36 mm
3.1.9.	a) Maximum thickness of flange of wheel measured from wheel gauge face at 18mm from outer edge of flange	32.5 mm
	b) Minimum thickness of flange of wheel measured from wheel gauge face at 18mm from outer edge of flange	22 mm
3.1.10.	Width of wheel	135 ± 1 mm
3.1.11.	Incline of tread/ Wheel Profile	1 in 20/As per EN13715 wheel Profile: S1002/h28/e32.5/6.7%
3.1.12.	Floor Height	
	a) Maximum Height of floor above Rail Level, for an unloaded vehicle	1130 mm
	b) Minimum Height of floor above Rail Level, for a fully loaded normal vehicle	1100 mm
3.1.13.	a) Maximum height of center of coupler above Rail Level for unloaded vehicle.	815 mm
	b) Minimum height of center of coupler above Rail Level for fully loaded vehicle	740 mm
3.1.14.	Maximum length over couplers	22600 mm
3.1.15.	1. Length of rigid wheelbase for single bogie	2200 to 2400 mm
	2. Maximum distance between any two adjacent axles	12800 mm

3.2 LOCOMOTIVES AND ENGINEERING SERVICE VEHICLES

Other items of rolling stock, viz. shunting locomotives, inspection cars, emergency re-railing van, track machines, etc., used on Ahmedabad Metro System (Standard Gauge) will conform with the Kinematic Envelope of the Passenger Electric Multiple Units as shown in:

3.2.1. For Underground refer Drawing no. MEGA/GEN/SOD/UND/02, at page 43

For At-Grade & Elevated sections refer Drawing no. MEGA/GEN/SOD/ELE/01, at page 42

For Surface (At-Grade) Sections for ballasted track refer Drawing no. MEGA/GEN/SOD/ATG/01 at page 44.

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CHAPTER — IV: ELECTRIC TRACTION

- 4.1 ELECTRIC TRACTION – 750V DC, THIRD RAIL WITH BOTTOM CURRENT COLLECTION
- 4.1.1. a) Minimum height from Rail Level to current collecting Surface of the conductor rail 148 mm
- b) Maximum height from Rail Level to current collecting Surface of the conductor rail including worn-out condition 164 mm
- 4.1.2. a) Distance of centre line of the conductor rail from the track centre 1480 mm
- b) Tolerance of (a) above - 5 mm, + 5 mm
- 4.1.3. Minimum clearance between the bottom of the shroud and the bottom of the conductor rail 19 mm
- 4.1.4. Maximum distance between the centre line of the conductor Rail and the outer edge of the shroud structure 91 mm
- 4.1.5. a) Minimum clearance between live parts of third rail and the earthed structure in static and dynamic conditions as per IEC 62497-1 25 mm
- b) Minimum clearance between live parts of conductor rail and Kinematic Envelope of Rolling stock as per IEC 62497-1 25 mm
- 4.2 All the clearances for Power Line Crossings and its fixed structures, in Territory of 750 VDC Traction Power Supply System of Gujarat Metro Rail Corporation (GMRC) Limited, must be ensured as per IRSOD-2022 and IR-ACTM with latest A&C Slips issued by Railway Board.

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CHAPTER — V: PLATFORM SCREEN DOORS/GATES

5.1 PLATFORM SCREEN DOOR SETTING OUT

5.1.1.	Minimum Platform Screen Door/Gate width	2000 mm
5.1.2.	Minimum Platform Screen Door height from Platform level	2150 mm
5.1.3.	Minimum Platform Screen Gate height from Platform level	1500 mm
5.1.4.	a) Minimum Platform Screen Door/ Gate panel offset from track center Line — Tangent track.	1600 mm
	b) Minimum Platform Screen Door/ Gate threshold offset from track center Line — Tangent track.	
	i. Underground Station	1555 mm
	ii. Elevated Station	1570 mm
5.1.5.	Station platform (Finished Floor Level) height from Rail Level	
	a) Ballastless Track	1090 ± 5 mm
5.1.6.	Station platform Edge offset from centerline of track (Minimum)	
	a) Underground Station	1515 mm
	b) Elevated Station	1530 mm
	c) At-Grade Station (Ballastless Track)	1530 mm
5.1.7.	Station platform Edge offset from centerline of track (Maximum)	
	a) Underground Station	1525 mm
	b) Elevated Station	1535 mm
	c) At-Grade Station (Ballastless Track)	1535 mm

Notes:

- Assumed ± 250 mm stopping accuracy of the train on the platforms.
 - Extra Clearance on station situated on curved track shall be as per Appendix 5 at Page no 38
 - Platform Screen Doors/Platform Screen Gates are designated as railway operational structures which are allowed to infringe the structure gauge but are clear of Kinematic Envelope at stations.
 - The deflector attached to the bottom of the sliding door shall be designed in order not to protrude beyond the door threshold.
 - Platform located in curves and straight alignment shall be fitted with gap filler to maintain the maximum stepping distance as per KE.
- 5.1.8. For static and Kinematic Envelope for stations in UG with Platform Screen Door, see Drawing No. MEGA/GEN/SOD/PSD-1 at page 54
- 5.1.9. For Static and Kinematic Envelope for Elevated/At-Grade (Stations with Platform Gate, see Drawing No. MEGA/GEN/SOD/PSD-2 at page 55

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**PERMISSIBLE SPEED, CANT AND MINIMUM TRACK SPACING ON CURVES
BALLASTLESS TRACK ON UNDERGROUND (TUNNELS) & ELEVATED SECTIONS
AND BALLASTED TRACK ON AT- GRADE (SURFACE) SECTIONS**

RADIUS OF CURVE	CANT	MAXIMUM PERMISSIBLE SPEED	MINIMUM DISTANCE BETWEEN ADJACENT TRACKS		
			BALLASTLESS		BALLASTED
			UNDERGROUND	ELEVATED & AT-GRADE	AT-GRADE
Metres	mm	kmph	mm	mm	mm
≥ 3000	15	80	3650	3750	3800
2800	15	80	3650	3750	3800
2600	15	80	3650	3750	3800
2400	20	80	3650	3750	3800
2200	20	80	3650	3750	3850
2000	20	80	3650	3750	3850
1900	20	80	3650	3750	3850
1800	25	80	3650	3750	3850
1700	25	80	3650	3750	3850
1600	25	80	3650	3750	3850
1500	30	80	3700	3800	3850
1400	30	80	3700	3800	3850
1300	35	80	3700	3800	3850
1200	35	80	3700	3800	3850
1100	40	80	3700	3800	3850
1000	40	80	3700	3800	3850
950	45	80	3700	3800	3850
900	45	80	3700	3800	3850
850	50	80	3700	3800	3850
800	50	80	3700	3800	3850
750	60	80	3700	3800	3850
700	60	80	3700	3800	3850
650	60	80	3700	3800	3850
600	70	80	3700	3800	3850
550	75	80	3750	3850	3900
500	85	80	3750	3850	3900
450	110	80	3750	3850	3900
400	110	75	3800	3900	3950
350	110	70	3800	3900	3950
300	110	65	3850	3950	4000
250	110	60	3900	4000	4050
200	115	55	3950	4050	4100
190	110	55	NA	4050	4100
175	110	50	NA	4100	4150
150	110	45	NA	4150	4200
120	110	40	NA	4250	4300
100	110	40	NA	NA	4400

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

(ii) The table above is not applicable to Platform Tracks.

(iii) Figure for any intermediate radius of curvature may be obtained by adopting the value for sharper curve.



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APPENDIX-2A

EXTRA HORIZONTAL CLEARANCE ON CURVES (CURVATURE EFFECT) –
AT GRADE (SURFACE) SECTIONS (BALLASTED TRACK)
INSIDE OF CURVE
(REFERENCE PARAs 1.7.1 A., 1.8.1 AND 1.8.2)

RADIUS (METERS) R	MID THROW (28125/R) (mm) (V)	NOSING INCLUDED IN K. E./STRUCTURE GAUGE FOR TANGENT TRACK (mm) (N)	GAUGE WIDENING ON CURVES (mm) (G)	EXTRA HORIZONTAL CLEARANCE ON CURVE (mm) (T1)	REMARKS
100	281.3	37	9	253	GAUGE WIDENING ON CURVES = 9 mm; FOR CURVES SHARPER THAN 500 m RADIUS; 5mm FOR CURVES OF 500m RADIUS & ABOVE, BUT LESS THAN 1000m RADIUS AND 0 mm FOR CURVES WITH RADIUS OF 1000 m AND ABOVE
120	234.4	37	9	206	
150	187.5	37	9	160	
175	160.7	37	9	133	
190	148.0	37	9	120	
200	140.6	37	9	113	
250	112.5	37	9	85	
300	93.8	37	9	66	
350	80.4	37	9	52	
400	70.3	37	9	42	
450	62.5	37	9	35	
500	56.3	37	5	24	
550	51.1	37	5	19	
600	46.9	37	5	15	
650	43.3	37	5	11	
700	40.2	37	5	8	
750	37.5	37	5	6	
800	35.2	37	5	5	
850	33.1	37	5	5	
900	31.3	37	5	5	
950	29.6	37	5	5	
1000	28.1	37	0	0	T1 = V-N+G FOR V EQUAL TO OR GREATER THAN (N) AND T1 = G FOR V < (N)
1100	25.6	37	0	0	
1200	23.4	37	0	0	
1300	21.6	37	0	0	
1400	20.1	37	0	0	
1500	18.8	37	0	0	
1600	17.6	37	0	0	
1700	16.5	37	0	0	
1800	15.6	37	0	0	
1900	14.8	37	0	0	
2000	14.1	37	0	0	
2200	12.8	37	0	0	
2400	11.7	37	0	0	
2600	10.8	37	0	0	
2800	10.0	37	0	0	
3000	9.4	37	0	0	



Mid throw (In mm) $V = (125 \times C^2)/R = 28125 / R$

Where 'C' is the distance between bogie centres = 14.800+0.200 = 15.000 m OR 14.800-0.200 = 14.600 m
The worst case will be with C = 15.000 m
R is the radius of curve in metres.

Examined and found in order

(Handwritten signature)



APPENDIX-2B EXTRA HORIZONTAL CLEARANCE ON CURVES (CURVATURE EFFECT) – AT GRADE (SURFACE) SECTIONS (BALLASTED TRACK) OUTSIDE OF CURVE (REFERENCE PARAs 1.7.2 A., 1.8.1 AND 1.8.2)					
RADIUS (METRES) R	END THROW (34020/R) (mm) (V _o)	GAUGE WIDENING ON CURVES (mm) (G)	NOSING DUE TO GAUGE WIDENING (mm) (EN) = G x 0.219723183	EXTRA HORIZONTAL CLEARANCE ON CURVE (mm)	REMARKS
100	340.2	9	2.0	351	GAUGE WIDENING ON CURVES = 9 mm; FOR CURVES SHARPER THAN 500 m RADIUS; 5mm FOR CURVES OF 500m RADIUS & ABOVE, BUT LESS THAN 1000m RADIUS AND 0 mm FOR CURVES WITH RADIUS OF 1000 m AND ABOVE T2 = Vo+G+EN
120	283.5	9	2.0	295	
150	226.8	9	2.0	238	
175	194.4	9	2.0	205	
190	179.1	9	2.0	190	
200	170.1	9	2.0	181	
250	136.1	9	2.0	147	
300	113.4	9	2.0	124	
350	97.2	9	2.0	108	
400	85.1	9	2.0	96	
450	75.6	9	2.0	87	
500	68.0	5	1.1	74	
550	61.9	5	1.1	68	
600	56.7	5	1.1	63	
650	52.3	5	1.1	58	
700	48.6	5	1.1	55	
750	45.4	5	1.1	51	
800	42.5	5	1.1	49	
850	40.0	5	1.1	46	
900	37.8	5	1.1	44	
950	35.8	5	1.1	42	
1000	34.0	0	0.0	34	
1100	30.9	0	0.0	31	
1200	28.4	0	0.0	28	
1300	26.2	0	0.0	26	
1400	24.3	0	0.0	24	
1500	22.7	0	0.0	23	
1600	21.3	0	0.0	21	
1700	20.0	0	0.0	20	
1800	18.9	0	0.0	19	
1900	17.9	0	0.0	18	
2000	17.0	0	0.0	17	
2200	15.5	0	0.0	15	
2400	14.2	0	0.0	14	
2600	13.1	0	0.0	13	
2800	12.2	0	0.0	12	
3000	11.3	0	0.0	11	

End throw (in mm) $V = (125 \times C_1^2)/R - (125 \times C^2)/R = 34020 / R$
 Where 'C' is the distance between bogie centres = 14.800+0.200 = 15.000 m OR 14.800-0.200 = 14.600 m
 The worst case will be with C = 14.600 m
 'C1' is the length of coach in metres = 22.030 m and R is the radius of curve in metres

COACH LENGTH = 21900 mm
 FOR DMC IT CAN INCREASE TO 21965 mm
 DIFFERENCE IN LENGTH 65 mm

HALF LENGTH FROM CENTRE OF 2 BOGIES 11015 mm. = ((21900)/2)+65
 LENGTH FOR CALCULATIONS OF END THROW = 22030 mm
 2 x HALF LENGTH FROM CENTRE OF 2 BOGIES

Examined and found in order

(THIS INCREASE WILL BE ON ONE SIDE FOR DRIVING CAB)

12/4/2024
 Approved on
 Director/UT/Civil/RDSO

APPENDIX-2C

RADIUS (METRES) R	MID THROW (28125/R) (mm) (V)	NOSING INCLUDED IN K. E./STRUCTURE GAUGE FOR TANGENT TRACK (mm) (N)	EXTRA GAUGE WIDENING ON CURVES (mm) (G)	EXTRA HORIZONTAL CLEARANCE ON CURVE (mm) (T1)	REMARKS
120	234.4	34	9	209	GAUGE WIDENING ON CURVES = 9 mm ; FOR CURVES SHARPER THAN 500 m RADIUS; 5mm FOR CURVES OF 500m RADIUS & ABOVE, BUT LESS THAN 1000m RADIUS AND 0 mm FOR CURVES WITH RADIUS OF 1000 m AND ABOVE
150	187.5	34	9	163	
175	160.7	34	9	136	
190	148.0	34	9	123	
200	140.6	34	9	116	
250	112.5	34	9	88	
300	93.8	34	9	69	
350	80.4	34	9	55	
400	70.3	34	9	45	
450	62.5	34	9	38	
500	56.3	34	5	27	
550	51.1	34	5	22	
600	46.9	34	5	18	
650	43.3	34	5	14	
700	40.2	34	5	11	
750	37.5	34	5	9	
800	35.2	34	5	6	
850	33.1	34	5	5	
900	31.3	34	5	5	
950	29.6	34	5	5	
1000	28.1	34	0	0	T1 = V-N+G FOR V EQUAL TO OR GREATER THAN (N) AND T1 = G FOR V < (N)
1100	25.6	34	0	0	
1200	23.4	34	0	0	
1300	21.6	34	0	0	
1400	20.1	34	0	0	
1500	18.8	34	0	0	
1600	17.6	34	0	0	
1700	16.5	34	0	0	
1800	15.6	34	0	0	
1900	14.8	34	0	0	
2000	14.1	34	0	0	
2200	12.8	34	0	0	
2400	11.7	34	0	0	
2600	10.8	34	0	0	
2800	10.0	34	0	0	
3000	9.4	34	0	0	

Mid throw (in mm) $V = (125 \times C^2)/R =$	28125 /R
Where 'C' is the distance between bogie centres=14.800+0.200 = 15.000 m OR 14.800-0.200=14.600 m	
The worst case will be with C =	15.000 m
R is the radius of curve in metres	

Examined and found in order

Director/UT/Civil/RDSO



(REFERENCE PARAs 1.7.2 A., 1.8.1 AND 1.8.2)

12/4/2024

Approved on
Railway Board



Director/UT/Civil/RDSO

End throw (in mm) $V = (125 \times C_1^2)/R - (125 \times C^2)/R =$ 34020 / R

Where 'C' is the distance between bogie centres = $14.800 + 0.200 = 15.000$ m OR $14.800 - 0.200 = 14.600$ m

The worst case will be with $C = 14.600 \text{ m}$

'C₁' is the length of coach in metres =

22.03 m and R is the radius of curve in metres

COACH LENGTH =	21900 mm
FOR DMC IT CAN INCREASE TO	21965 mm
DIFFERENCE IN LENGTH	65 mm.

HALF LENGTH FROM CENTRE OF 2 BOGIES	11015 mm. = ((21900)/2)+65)
LENGTH FOR CALCULATIONS OF END THROW =	22030 mm
2 x HALF LENGTH FROM CENTRE OF 2 BOGIES	

(THIS INCREASE WILL
BE ON ONE SIDE FOR
DRIVING CAB)

$T = [ab \cdot \sin \alpha \tan \alpha] / x \cos \alpha$
 $H1 = (Ca/2) + (h/\cos \alpha) + [Ab \cdot h \times \tan \alpha] \times \sin \alpha$
 $H2 = (Ca/2) + (h/\cos \alpha) - [ab \cdot h \times \tan \alpha] \times \sin \alpha$
 $bB = Ab =$ Distance from inclined centre line of
 $cC =$ Distance from vertical centre line of canal
 $h =$ Depth of canal
 $\alpha =$ Lateral increment due to canal



/2024 11:32 am

Director/UT/Civil/RDSO

12/4/2024

$$\begin{aligned} E I &= [A b + (h \times \tan \alpha)] \times \cos \alpha \\ F I &= [A b - (h \times \tan \alpha)] \times \cos \alpha \\ H I &= (C a / 2) + (h / \cos \alpha) + (A b - h \times \tan \alpha) \times \sin \alpha \\ H H &= (C a / 2) + (h / \cos \alpha) - (A b + h \times \tan \alpha) \times \sin \alpha \\ a b &= A b = D \text{ distance from inclined centre line} \\ D &= \text{Distance from vertical centre line of canal} \\ h \times \tan \alpha &= \text{Lateral increment due to canal} \end{aligned}$$


11:32 am

Director/UT/Civil/RDSO



APPENDIX-3C

CANT EFFECT ON STRUCTURE GAUGE

UNDERGROUND SECTION (RECTANGULAR BOX TUNNELS) – BALLASTLESS TRACK

REFERENCE DRAWING NO. MEGA/GEN/SOD/UND/03, MEGA/GEN/SOD/GEN/01 AND PARAS 1.7.1 B., 1.7.2 B. and 1.8.2.)

Object	Height above rail level measured perpendicular to plane of track										Distance from centre line of track to perpendicular Gauge for tangent track																						
	h _a					h _b					h _c					h _d																	
	E1	F1	H1	H2	h _a	E1	F1	H1	H2	h _b	E1	F1	H1	H2	h _c	E1	F1	H1	H2	h _d													
Cant	Angle α	tan α																															
	125	4.764	0.083	0.997	0.083	1613.8	1561.2	510.7	246.1	1743.5	1596.9	1081.7	803.2	1519.3	1525.1	1966.7	1688	1857.7	1339.2	3195.9	3039.5	1727	1119.2	3827.5	3590.3	970.8	280.9	4253.3	4149	344.9	-344.9	4201.2	4201.2
	120	4.573	0.080	0.997	0.080	1613.2	1562.7	503	249	1741.1	1600.3	1073.8	806.6	1513.9	1531.4	1959.2	1691.6	1847.7	1350	3299	3043.2	1715.2	1131.7	3821.2	3593.5	957.1	294.9	4249.9	4149.7	331.1	-331.1	4199.8	4199.8
	115	4.382	0.076	0.997	0.077	1612.6	1564.1	495.3	251.8	1738.6	1603.6	1066	809.9	1508.4	1537.8	1951.5	1695.1	1837.8	1360.8	3291.9	3046.8	1703.4	1144.2	3814.9	3596.7	943.5	308.8	4246.3	4150.4	317.3	-317.3	4198.4	4198.4
	110	4.191	0.073	0.997	0.073	1611.9	1565.6	487.6	254.7	1736.1	1607	1058.1	813.1	1803	1544.1	1943.9	1698.6	1827.8	1371.6	3284.9	3050.4	1691.6	1156.7	3808.6	3599.8	929.9	322.8	4242.8	4151	303.5	-303.5	4196.9	4196.9
	105	4.001	0.070	0.998	0.070	1611.2	1567	479.9	257.6	1733.5	1610.3	1050.3	816.4	1797.5	1550.4	1936.3	1702.1	1817.8	1382.3	3277.8	3054	1679.8	1169.2	3802.2	3603	916.2	336.7	4239.2	4151.6	289.7	-289.7	4195.4	4195.4
	100	3.810	0.066	0.998	0.067	1610.5	1568.4	472.1	260.5	1731	1613.6	1042.4	819.7	1792	1556.6	1928.6	1705.6	1807.8	1393.1	3270.7	3057.5	1668	1181.7	3795.8	3606	902.6	350.7	4235.5	4152.1	275.9	-275.9	4193.8	4193.8
	95	3.619	0.063	0.998	0.063	1609.8	1569.8	464.4	263.3	1728.4	1616.9	1034.5	822.9	1786.4	1562.9	1920.9	1709	1797.8	1403.8	3263.5	3061	1656.1	1194.2	3789.3	3609.1	888.9	364.6	4231.9	4152.6	262.1	-262.1	4192.2	4192.2
	90	3.428	0.060	0.998	0.060	1609.1	1571.2	456.7	266.2	1725.8	1620.2	1026.6	826.2	1780.9	1569.1	1913.2	1712.5	1787.8	1414.5	3256.3	3064.5	1644.3	1206.6	3782.8	3612.1	875.2	378.5	4228.1	4153	248.4	-248.4	4190.6	4190.6
	85	3.238	0.056	0.998	0.057	1608.4	1572.6	449	269	1723.2	1623.5	1018.7	829.4	1775.3	1575.3	1905.4	1715.9	1777.7	1425.2	3249.1	3067.9	1632.4	1219.1	3776.3	3615	861.6	392.4	4224.3	4153.4	234.6	-234.6	4188.9	4188.9
80	3.047	0.053	0.999	0.053	1607.6	1573.9	441.2	271.9	1720.6	1626.7	1010.8	832.7	1769.8	1581.5	1897.7	1719.3	1767.6	1435.8	3241.9	3071.3	1620.5	1231.5	3769.7	3617.9	847.9	406.4	4220.5	4153.7	220.8	-220.8	4187.1	4187.1	
75	2.856	0.050	0.999	0.050	1606.8	1575.2	433.5	274.7	1717.9	1629.9	1002.9	835.9	1764.2	1587.7	1889.9	1722.7	1757.5	1446.5	3234.6	3074.7	1608.6	1243.9	3763.1	3620.8	834.2	420.3	4216.6	4154	207	-207	4185.3	4185.3	
70	2.666	0.047	0.999	0.047	1606	1576.5	425.7	277.6	1715.3	1633.1	995	839.1	1758.6	1593.8	1882.1	1726	1747.4	1457.1	3227.2	3078	1596.6	1256.3	3756.5	3623.6	820.5	434.2	4212.7	4154.3	193.2	-193.2	4183.5	4183.5	
65	2.475	0.043	0.999	0.043	1605.2	1577.8	418	280.4	1712.6	1636.3	987.1	842.3	1752.9	1599.9	1874.3	1729.4	1732.3	1467.7	3219.9	3081.3	1584.7	1268.6	3749.8	3626.4	806.8	448	4208.7	4154.5	179.4	-179.4	4181.6	4181.6	
60	2.285	0.040	0.999	0.040	1604.4	1579.1	410.3	283.2	1709.9	1639.5	979.1	845.5	1747.3	1606.1	1866.5	1732.7	1727.2	1478.3	3212.5	3084.6	1572.7	1281	3743	3629.2	793.1	461.9	4204.7	4154.7	165.6	-165.6	4179.7	4179.7	
55	2.094	0.037	0.999	0.037	1603.5	1580.4	402.5	286.1	1707.1	1642.6	971.2	848.7	1741.6	1612.2	1858.6	1736	1717	1488.9	3205	3087.8	1560.8	1293.3	3736.2	3631.9	779.4	475.8	4200.7	4154.8	151.8	-151.8	4177.7	4177.7	
50	1.904	0.033	0.999	0.033	1602.7	1581.6	394.7	288.9	1704.4	1645.7	963.2	851.8	1735.9	1618.2	1850.8	1739.3	1706.8	1499.4	3197.6	3091	1548.8	1305.7	3729.4	3634.5	765.6	489.7	4196.6	4154.8	138	-138	4175.7	4175.7	
45	1.713	0.030	1.000	0.030	1601.8	1582.8	387	291.7	1701.7	1648.8	955.2	855	1730.2	1624.3	1842.9	1742.5	1696.6	1510	3190.1	3094.1	1536.8	1318	3722.6	3637.2	751.9	503.5	4192.4	4154.9	124.2	-124.2	4173.6	4173.6	
40	1.523	0.027	1.000	0.027	1600.9	1584	379.2	294.5	1698.9	1651.9	947.2	858.1	1724.5	1630.3	1835	1745.8	1886.4	1520.5	3182.5	3097.3	1524.7	1310.2	3715.7	3639.8	738.2	517.4	4188.2	4154.8	110.4	-110.4	4171.5	4171.5	
35	1.333	0.023	1.000	0.023	1599.9	1585.2	371.5	297.4	1696.1	1655.1	939.2	861.3	1718.7	1636.4	1827	1749	1676.1	1531	3175	3100.4	1512.7	1342.5	3708.7	3642.3	724.4	531.2	4184	4154.8	96.6	-96.6	4169.4	4169.4	
30	1.142	0.020	1.000	0.020	1599	1586.4	363.7	300.2	1693.3	1658.1	931.2	864.4	1713	1642.4	1819.1	1752.2	1665.9	1541.5	3167.4	3103.4	1500.7	1354.8	3701.7	3644.8	710.7	545.1	4179.7	4154.7	82.8	-82.8	4167.2	4167.2	
25	0.952	0.017	1.000	0.017	1598	1587.5	355.9	303	1690.4	1661.1	921.2	867.5	1707.2	1648.3	1811.1	1755.4	1655.6	1551.9	3159.7	3106.4	1488.6	1367	3694.7	3647.3	696.9	558.9	4175.4	4154.5	69	-69	4164.9	4164.9	
20	0.761	0.013	1.000	0.013	1597.1	1588.6	348.1	305.8	1687.6	1664.1	915.2	870.6	1701.4	1654.3	1803.1	1758.5	1645.3	1562.4	3152	3109.4	1476.5	1379.2	3687.7	3649.7	683.1	572.8	4171	4154.3	55.2	-55.2	4162.6	4162.6	
15	0.571	0.010	1.000	0.010	1596.1	1589.8	340.4	308.6	1684.7	1667.1	907.2	873.8	1695.6	1660.3	1795.1	1761.7	1635	1572.8	3144.3	3112.4	1464.4	1391.5	3680.6	3652.1	669.4	586.6	4166.6	4154	41.4	-41.4	4160.3	4160.3	
10	0.381	0.007	1.000	0.007	1595.1	1590.9	332.6	311.4	1681.8	1670.1	899.1	876.8	1689.7	1666.2	1787.1	1764.8	1624.7	1581.2	3136.6	3115.3	1452.3	1403.7	3673.4	3654.4	655.6	600.4	4162.1	4153.7	27.6	-27.6	4157.9	4157.9	
5	0.190	0.003	1.000	0.003	1594	1591.9	324.8	314.2	1678.9	1673.1	891.1	879.9	1683.9	1672.1	1779.1	1767.9	1614.4	1593.6	3128.8	3118.2	1440.1	1415.8	3666.2	3656.7	641.8	614.2	4157.6	4153.4	13.8	-13.8	4155.5	4155.5	
0	0.000	0.000	1.000	0.000	1593	1593	317	317	1676	1676	883	883	1678	1678	1771	1771	1604	1604	3121	3121	1428	1428	3659	3659	628	628	4153	4153	0	0	4153	4153	

REFER TO DRAWING NO. MEGA/GEN/SOD/UND/03 at page no 47 & MEGA/GEN/SOD/GEN/01 at page no 38

$$E1 = [A \cdot b + (h \times \tan \alpha)] \times \cos \alpha$$
$$E1 = [AB + (11 \times \tan \alpha)] \times \cos \alpha$$
$$H1 = (Ca/2) + (h/\cos \alpha) + (Ab-h \times \tan \alpha) \times \sin \alpha$$
$$H1 = (Ca/Z) + (h/\cos \alpha) + (AD-h) \times \tan \alpha / \times \sin \alpha$$
$$H_2 = (C \sin \alpha) / (H \cos \alpha) - (AB + H \times \tan \alpha) \times \sin \alpha$$
$$d_{ab} = \text{distance from vertical control line of camera } a \text{ to distance from vertical control line of camera } b$$
$$\Delta \text{ac} = \text{Distance from vertical centre line of car}$$
$$bc = h \times \tan \alpha = \text{Lateral increment due to cam}$$

Director/UT/Civil/RDSO

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Organization Unit: Gujarat Metro
Rail Corporation (GMRC) Limited
Date: 14-Feb-2024 (07:22 PM)

Sign

$HZ = \frac{(C+Z)^2}{2} \left(\frac{\pi}{180} \cos \phi \right) \left(\frac{1}{R} + \tan^2 \phi \right) \sin \alpha$
 $ab = A = B =$ Distance from Inclined centre line of vehicle to Structure Gauge for tangent track at height 'h' from rail level in the direction parallel to the line joining the top of rails.
 $ac = C = D =$ Distance from vertical centre line of cant track to Structure Gauge for tangent track at height 'h' from rail level in the direction parallel to the line joining the top of rails.
 $bb = h \times \tan \alpha =$ Lateral increment due to cant (measured along the line parallel to line joining the top of rails).

Examined and found in order

Director/UT/Civil/RDSO

Sign

Signed by: ANAND SINGH BISHT
Location: Gandhinagar, India
Organization Unit: Gujarat Metro
Rail Corporation (GMRCL) Limited
Date: 14-Feb-2024 (07:22 PM)



REFER TO DRAWING NO. MEGA/GEN/SOD/ATG/01 at page no 43 & MEGA/GEN/SOD/GEN/03 at page no 40
 $E = (Ab + h \times \tan \alpha) \times \cos \alpha$
 $F = (Ab - h \times \tan \alpha) \times \cos \alpha$
 $H1 = (Ca/2) + (h \times \cos \alpha) \times (Ab - h \times \tan \alpha) \times \sin \alpha$
 $H2 = (Ca/2) + (h \times \cos \alpha) \times (Ab + h \times \tan \alpha) \times \sin \alpha$
 $ab = Ab =$ Distance from inclined centre line of vehicle to Kinematic Envelope for tangent track at height 'h' from rail level in the direction parallel to the line joining the top of rails.
 $ac =$ Distance from vertical centre line of canted track to Kinematic Envelope for tangent track at height 'h' from rail level in the direction parallel to the line joining the top of rails.
 $bc = h \times \tan \alpha =$ Lateral Increment due to cant (measured along the line parallel to line joining the top of rails).

APPENDIX-3D CANT EFFECT ON KINEMATIC ENVELOPE-HORIZONTAL AT-GRADE (SURFACE) SECTION (BALLASTED TRACK) (REFERENCE DRAWING NO. MEGA/GEN/SOD/ATG/01 & MEGA/GEN/SOD/GEN/03 AND PARA 1.8.1)																			
above rail level measured perpendicular to plane of track	h=	B95	h=	1768	h=	3102	h=	3392	h=	3587	h=	3750	h=	4053	h=	4053	h=	4053	h=
to from centre line of track to structure gauge for tangent track	ab=	12508	ab=	16230	ab=	15465	ab=	14916	ab=	13226	ab=	11441	ab=	6000	ab=	0	ab=	0	ab=
Angle α in $^{\circ}$	sin α	F	sin α	F	sin α	F	sin α	F	sin α	F	sin α	F	sin α	F	sin α	F	sin α	F	sin α
4.764	0.0833	0.997	0.0833	1666.8	1518.1	1687.1	0.1117	1761.2	1487.6	1609.8	1817.2	1302	2181.8	3023.8	1774.6	1211.1	3587.2	3128.4	1619.3
4.773	0.080	0.997	0.080	1644.3	1521.6	1679.6	0.104	1755.8	1475.9	1595.1	1807.4	1312.7	3276.9	3027.3	1763.7	1222.8	3540.4	3321.8	1607.8
4.782	0.076	0.997	0.076	1661.7	1524.9	1672.8	0.107	1748.4	1480.2	1594.1	1809.5	1324.4	3270	3030.8	1752.8	1234.6	3554	3325.1	1596.2
4.791	0.072	0.997	0.072	1609.1	1528.3	1654.8	0.108	1744.9	1486.4	1590.7	1809.5	1341.1	3281.3	3034.8	1741.9	1246.1	3547.4	3328.4	1584.6
4.801	0.070	0.998	0.070	1656.5	1531.7	1656.8	0.113	1739.8	1492.7	1592.2	1803.2	1377.6	3344.8	3037.5	1731	1257.7	3533.7	3351.2	1573
4.810	0.068	0.998	0.068	1603.9	1535	1648.2	0.116	1731.9	1498.9	1591.7	1806.5	1394.1	3324.1	3041.2	1720.1	1269.3	3534	3335	1561.4
4.819	0.065	0.998	0.065	1601.3	1538.3	1641.6	0.119	1724.8	1505.2	1594.2	1809.7	1394.1	3342.1	3044.5	1709.1	1280.9	3537.1	3338.2	1549.8
4.828	0.060	0.998	0.060	1648.7	1541.6	1642.8	0.124	1722.8	1511.4	1596.7	1813	1392.7	3376.7	3047.9	1698.2	1292.5	3541.3	1538.1	1529.1
4.837	0.056	0.998	0.056	1646	1544.9	1624.3	0.125	1712.3	1517.6	1599.2	1816.2	1387.3	3327.9	3051.2	1687.2	1304	3543.7	1534.5	1516.8
4.846	0.053	0.998	0.053	1601.3	1548.2	1618.7	0.128	1709.8	1523.7	1591.6	1818.4	1397.5	3308.8	3054.4	1674.2	1315.6	3546.8	1531.4	1504.8
4.855	0.050	0.999	0.050	1601.6	1551.4	1611	0.131	1704.1	1528.9	1584	1821.6	1407.5	3311.6	3060.9	1654.1	1326.1	3549	1530.6	1492.9
4.864	0.047	0.999	0.047	1601.9	1554.6	1603.4	0.134	1700.5	1536	1576.4	1825.7	1419	3206.4	3062.9	1634.1	1336.6	3549	1528.1	1480.9
4.873	0.040	0.999	0.040	1602.4	1561.4	1601	0.138	1696.6	1542.1	1568.8	1828.9	1429.6	3199.2	3064	1613.1	1350.1	3546	1526.1	1469.1
4.882	0.037	0.999	0.037	1602.9	1564.2	1598.3	0.141	1692.1	1548.2	1561.2	1832.7	1440.1	3211.9	3067.1	1602	1361.6	3549	1523.6	1458.1
4.891	0.033	0.999	0.033	1603.6	1567.4	1595.7	0.144	1687.8	1556.4	1553.5	1837.1	1450.6	3218.6	3070.2	1581	1373	3547	1520.2	1446.4
4.900	0.030	1.000	0.030	1624	1570.5	1594.9	0.148	1683.1	1562.1	1548.8	1841.3	1461.1	3217.3	3073.3	1569.4	1384.5	3545.4	1518.4	1434.4
4.909	0.027	1.000	0.027	1601.2	1573.6	1592.2	0.151	1678.1	1568.4	1545.1	1845.5	1471.5	3218.1	3076.3	1558.8	1395.9	3543.7	1516.2	1422.2
4.918	0.024	1.000	0.024	1601.7	1576.9	1589.7	0.154	1673.6	1574.8	1542.5	1849.7	1481.8	3219.2	3079.3	1548.6	1407.3	3541.6	1514.1	1410.1
4.927	0.021	1.000	0.021	1602.2	1580.2	1587.2	0.157	1669.1	1581.1	1539.4	1853.9	1492.1	3220.3	3082.3	1538.3	1418.7	3539.1	1511.9	1400.1
4.936	0.018	1.000	0.018	1602.7	1583.5	1584.7	0.160	1664.6	1587.2	1536.6	1858.1	1502.4	3221.4	3085.3	1528.3	1427.3	3537.1	1509.1	1388.1
4.945	0.015	1.000	0.015	1603.2	1586.8	1581.9	0.163	1660.1	1592.7	1533.9	1862.3	1512.6	3222.5	3088.3	1518.3	1436.3	3535.1	1507.1	1376.1
4.954	0.012	1.000	0.012	1603.7	1590.1	1579.2	0.166	1655.6	1598.2	1531.4	1866.5	1522.8	3223.6	3091.3	1508.3	1445.3	3533.1	1505.1	1364.1
4.963	0.010	1.000	0.010	1604.2	1593.4	1576.5	0.169	1651.1	1603.7	1529.9	1870.7	1532.9	3224.7	3094.3	1498.3	1454.3	3531.1	1503.1	1352.1
4.972	0.007	1.000	0.007	1604.7	1596.7	1573.8	0.172	1646.6	1609.2	1528.4	1874.9	1534.0	3225.8	3097.3	1488.3	1463.3	3529.1	1501.1	1340.1
4.981	0.004	1.000	0.004	1605.2	1599.9	1571.1	0.175	1642.1	1614.3	1526.9	1879.1	1535.1	3226.9	3100.3	1478.3	1472.3	3527.1	1499.1	1328.1
4.990	0.001	1.000	0.001	1605.7	1603.2	1568.4	0.178	1637.6	1619.4	1525.4	1883.3	1536.2	3228.0	3103.3	1468.3	1481.3	3525.1	1497.1	1316.1
5.000	0.000	1.000	0.000	1606.2	1606.5	1565.7	0.181	1633.1	1624.5	1524.9	1887.5	1537.3	3229.1	3106.3	1458.3	1490.3	3523.1	1495.1	1304.1
5.009	0.000	1.000	0.000	1606.7	1609.8	1563.0	0.184	1628.6	1629.6	1524.4	1891.7	1538.4	3230.2	3109.3	1448.3	1499.3	3521.1	1493.1	1292.1
5.018	0.000	1.000	0.000	1607.2	1613.1	1560.3	0.187	1624.1	1634.7	1523.9	1895.9	1539.5	3231.3	3112.3	1438.3	1508.3	3519.1	1491.1	1280.1
5.027	0.000	1.000	0.000	1607.7	1616.4	1557.6	0.190	1619.6	1640.8	1523.4	1900.1	1540.6	3232.4	3115.3	1428.3	1517.3	3517.1	1489.1	1268.1
5.036	0.000	1.000	0.000	1608.2	1619.7	1554.9	0.193	1615.1	1646.9	1522.9	1904.3	1541.7	3233.5	3118.3	1418.3	1526.3	3515.1	1487.1	1256.1
5.045	0.000	1.000	0.000	1608.7	1623.0	1552.2	0.196	1610.6	1653.0	1522.4	1908.5	1542.8	3234.6	3121.3	1408.3	1535.3	3513.1	1485.1	1244.1
5.054	0.000	1.000	0.000	1609.2	1626.3	1549.5	0.199	1606.1	1659.1	1521.9	1912.7	1543.9	3235.7	3124.3	1398.3	1544.3	3511.1	1483.1	1232.1
5.063	0.000	1.000	0.000	1609.7	1629.6	1546.8	0.202	1601.6	1665.2	1521.4	1916.9	1545.0	3236.8	3127.3	1388.3	1553.3	3509.1	1481.1	1220.1
5.072	0.000	1.000	0.000	1610.2	1632.9	1544.1	0.205	1597.1	1671.3	1520.9	1921.1	1546.1	3237.9	3130.3	1378.3	1562.3	3507.1	1479.1	1208.1
5.081	0.000	1.000	0.000	1610.7	1636.2	1541.4	0.208	1592.6	1677.4	1520.4	1925.3	1547.2	3239.0	3133.3	1368.3	1571.3	3505.1	1477.1	1196.1
5.090	0.000	1.000	0.000	1611.2	1639.5	1538.7	0.211	1588.1	1683.5	1519.9	1929.5	1548.3	3240.1	3136.3	1358.3	1580.3	3503.1	1475.1	1184.1
5.099	0.000	1.000	0.000	1611.7	1642.8	1536.0	0.214	1583.6	1689.6	1519.4	1933.7	1549.4	3241.2	3139.3	1348.3	1589.3	3501.1	1473.1	1172.1
5.108	0.000	1.000	0.000	1612.2	1646.1	1533.3	0.217	1579.1	1695.7	1518.9	1937.9	1550.5	3242.3	3142.3	1338.3	1598.3	3499.1	1471.1	1160.1
5.117	0.000	1.000	0.000	1612.7	1649.4	1530.6	0.220	1574.6	1701.8	1518.4	1942.1	1551.6	3243.4	3145.3	1328.3	1607.3	3497.1	1469.1	1148.1
5.126	0.000	1.000	0.000	1613.2	1652.7	1527.9	0.223	1570.1	1707.9	1517.9	1946.3	1552.7	3244.5	3148.3	1318.3	1616.3	3495.1	1467.1	1136.1
5.135	0.000	1.000	0.000	1613.7	1656.0	1525.2	0.226	1565.6	1714.0	1517.4	1950.5	1553.8	3245.6	3151.3	1308.3	1625.3	3493.1	1465.1	1124.1
5.144	0.000	1.000	0.000	1614.2	1659.3	1522.5	0.229	1561.1	1720.1	1516.9	1954.7	1554.9	3246.7	3154.3	1298.3	1634.3	3491.1	1463.1	1112.1
5.153	0.000	1.000	0.000	1614.7	1662.6	1519.8	0.232	1556.6	1726.2	1516.4	1958.9	1556.0	3247.8	3157.3	1288.3	1643.3	3489.1	1461.1	1100.1
5.162	0.000	1.000	0.000	1615.2	1665.9	1517.1	0.235	1552.1	1732.3	1515.9	1963.1	1557.1	3248.9	3160.3	1278.3	1652.3	3487.1	1459.1	1088.1
5.171	0.000	1.000	0.000	1615.7	1669.2	1514.4	0.238	1547.6	1738.4	1515.4	1967.3	1558.2	3250.0	3163.3	1268.3	1661.3	3485.1	1457.1	1076.1
5.180	0.000	1.000	0.000	1616.2	1672.5	1511.7	0.241	1543.1	1744.5	1514.9	1971.5	1559.3	3251.1	3166.3	1258.3	1670.3	3483.1	1455.1	1064.1
5.189	0.000	1.000	0.000	1616.7	1675.8	1509.0	0.244	1538.6	1750.6	1514.4	1975.7	1560.4	3252.2	3169.3	1248.3	1679.3	3481.1	1453.1	1052.1
5.198	0.000	1.000	0.000	1617.2	1679.1	1506.3	0.247	1534.1	1756.7	1513.9	1979.9	1561.5	3253.3	3172.3	1238.3	1688.3	3479.1	1451.1	

APPENDIX-3E

CART EFFECT ON KINEMATIC ENVELOPE

ELEVATED AND AT-GRADE (SURFACE) - BALLASTLESS TRACK

(REFERENCE DRAWING NO. MEGA/GEN/SOD/LE/01 & MEGA/GEN/SOD/GEN/03 AND PARA 1.8.1)

Case		Angle α	tan α	cos α	sin α	h ₁	h ₂	h ₃	h ₄	h ₅	h ₆	h ₇	h ₈	h ₉	h ₁₀	h ₁₁	h ₁₂	h ₁₃	h ₁₄	h ₁₅	h ₁₆	h ₁₇	h ₁₈	h ₁₉	h ₂₀	h ₂₁	h ₂₂	h ₂₃	h ₂₄	h ₂₅	h ₂₆	h ₂₇	h ₂₈	h ₂₉	h ₃₀	h ₃₁	h ₃₂	h ₃₃	h ₃₄	h ₃₅	h ₃₆	h ₃₇	h ₃₈	h ₃₉	h ₄₀	h ₄₁	h ₄₂	h ₄₃	h ₄₄	h ₄₅	h ₄₆	h ₄₇	h ₄₈	h ₄₉	h ₅₀	h ₅₁	h ₅₂	h ₅₃	h ₅₄	h ₅₅	h ₅₆	h ₅₇	h ₅₈	h ₅₉	h ₆₀	h ₆₁	h ₆₂	h ₆₃	h ₆₄	h ₆₅	h ₆₆	h ₆₇	h ₆₈	h ₆₉	h ₇₀	h ₇₁	h ₇₂	h ₇₃	h ₇₄	h ₇₅	h ₇₆	h ₇₇	h ₇₈	h ₇₉	h ₈₀	h ₈₁	h ₈₂	h ₈₃	h ₈₄	h ₈₅	h ₈₆	h ₈₇	h ₈₈	h ₈₉	h ₉₀	h ₉₁	h ₉₂	h ₉₃	h ₉₄	h ₉₅	h ₉₆	h ₉₇	h ₉₈	h ₉₉	h ₁₀₀	h ₁₀₁	h ₁₀₂	h ₁₀₃	h ₁₀₄	h ₁₀₅	h ₁₀₆	h ₁₀₇	h ₁₀₈	h ₁₀₉	h ₁₁₀	h ₁₁₁	h ₁₁₂	h ₁₁₃	h ₁₁₄	h ₁₁₅	h ₁₁₆	h ₁₁₇	h ₁₁₈	h ₁₁₉	h ₁₂₀	h ₁₂₁	h ₁₂₂	h ₁₂₃	h ₁₂₄	h ₁₂₅	h ₁₂₆	h ₁₂₇	h ₁₂₈	h ₁₂₉	h ₁₃₀	h ₁₃₁	h ₁₃₂	h ₁₃₃	h ₁₃₄	h ₁₃₅	h ₁₃₆	h ₁₃₇	h ₁₃₈	h ₁₃₉	h ₁₄₀	h ₁₄₁	h ₁₄₂	h ₁₄₃	h ₁₄₄	h ₁₄₅	h ₁₄₆	h ₁₄₇	h ₁₄₈	h ₁₄₉	h ₁₅₀	h ₁₅₁	h ₁₅₂	h ₁₅₃	h ₁₅₄	h ₁₅₅	h ₁₅₆	h ₁₅₇	h ₁₅₈	h ₁₅₉	h ₁₆₀	h ₁₆₁	h ₁₆₂	h ₁₆₃	h ₁₆₄	h ₁₆₅	h ₁₆₆	h ₁₆₇	h ₁₆₈	h ₁₆₉	h ₁₇₀	h ₁₇₁	h ₁₇₂	h ₁₇₃	h ₁₇₄	h ₁₇₅	h ₁₇₆	h ₁₇₇	h ₁₇₈	h ₁₇₉	h ₁₈₀	h ₁₈₁	h ₁₈₂	h ₁₈₃	h ₁₈₄	h ₁₈₅	h ₁₈₆	h ₁₈₇	h ₁₈₈	h ₁₈₉	h ₁₉₀	h ₁₉₁	h ₁₉₂	h ₁₉₃	h ₁₉₄	h ₁₉₅	h ₁₉₆	h ₁₉₇	h ₁₉₈	h ₁₉₉	h ₂₀₀	h ₂₀₁	h ₂₀₂	h ₂₀₃	h ₂₀₄	h ₂₀₅	h ₂₀₆	h ₂₀₇	h ₂₀₈	h ₂₀₉	h ₂₁₀	h ₂₁₁	h ₂₁₂	h ₂₁₃	h ₂₁₄	h ₂₁₅	h ₂₁₆	h ₂₁₇	h ₂₁₈	h ₂₁₉	h ₂₂₀	h ₂₂₁	h ₂₂₂	h ₂₂₃	h ₂₂₄	h ₂₂₅	h ₂₂₆	h ₂₂₇	h ₂₂₈	h ₂₂₉	h ₂₃₀	h ₂₃₁	h ₂₃₂	h ₂₃₃	h ₂₃₄	h ₂₃₅	h ₂₃₆	h ₂₃₇	h ₂₃₈	h ₂₃₉	h ₂₄₀	h ₂₄₁	h ₂₄₂	h ₂₄₃	h ₂₄₄	h ₂₄₅	h ₂₄₆	h ₂₄₇	h ₂₄₈	h ₂₄₉	h ₂₅₀	h ₂₅₁	h ₂₅₂	h ₂₅₃	h ₂₅₄	h ₂₅₅	h ₂₅₆	h ₂₅₇	h ₂₅₈	h ₂₅₉	h ₂₆₀	h ₂₆₁	h ₂₆₂	h ₂₆₃	h ₂₆₄	h ₂₆₅	h ₂₆₆	h ₂₆₇	h ₂₆₈	h ₂₆₉	h ₂₇₀	h ₂₇₁	h ₂₇₂	h ₂₇₃	h ₂₇₄	h ₂₇₅	h ₂₇₆	h ₂₇₇	h ₂₇₈	h ₂₇₉	h ₂₈₀	h ₂₈₁	h ₂₈₂	h ₂₈₃	h ₂₈₄	h ₂₈₅	h ₂₈₆	h ₂₈₇	h ₂₈₈	h ₂₈₉	h ₂₉₀	h ₂₉₁	h ₂₉₂	h ₂₉₃	h ₂₉₄	h ₂₉₅	h ₂₉₆	h ₂₉₇	h ₂₉₈	h ₂₉₉	h ₃₀₀	h ₃₀₁	h ₃₀₂	h ₃₀₃	h ₃₀₄	h ₃₀₅	h ₃₀₆	h ₃₀₇	h ₃₀₈	h ₃₀₉	h ₃₁₀	h ₃₁₁	h ₃₁₂	h ₃₁₃	h ₃₁₄	h ₃₁₅	h ₃₁₆	h ₃₁₇	h ₃₁₈	h ₃₁₉	h ₃₂₀	h ₃₂₁	h ₃₂₂	h ₃₂₃	h ₃₂₄	h ₃₂₅	h ₃₂₆	h ₃₂₇	h ₃₂₈	h ₃₂₉	h ₃₃₀	h ₃₃₁	h ₃₃₂	h ₃₃₃	h ₃₃₄	h ₃₃₅	h ₃₃₆	h ₃₃₇	h ₃₃₈	h ₃₃₉	h ₃₄₀	h ₃₄₁	h ₃₄₂	h ₃₄₃	h ₃₄₄	h ₃₄₅	h ₃₄₆	h ₃₄₇	h ₃₄₈	h ₃₄₉	h ₃₅₀	h ₃₅₁	h ₃₅₂	h ₃₅₃	h ₃₅₄	h ₃₅₅	h ₃₅₆	h ₃₅₇	h ₃₅₈	h ₃₅₉	h ₃₆₀	h ₃₆₁	h ₃₆₂	h ₃₆₃	h ₃₆₄	h ₃₆₅	h ₃₆₆	h ₃₆₇	h ₃₆₈	h ₃₆₉	h ₃₇₀	h ₃₇₁	h ₃₇₂	h ₃₇₃	h ₃₇₄	h ₃₇₅	h ₃₇₆	h ₃₇₇	h ₃₇₈	h ₃₇₉	h ₃₈₀	h ₃₈₁	h ₃₈₂	h ₃₈₃	h ₃₈₄	h ₃₈₅	h ₃₈₆	h ₃₈₇	h ₃₈₈	h ₃₈₉	h ₃₉₀	h ₃₉₁	h ₃₉₂	h ₃₉₃	h ₃₉₄	h ₃₉₅	h ₃₉₆	h ₃₉₇	h ₃₉₈	h ₃₉₉	h ₄₀₀	h ₄₀₁	h ₄₀₂	h ₄₀₃	h ₄₀₄	h ₄₀₅	h ₄₀₆	h ₄₀₇	h ₄₀₈	h ₄₀₉	h ₄₁₀	h ₄₁₁	h ₄₁₂	h ₄₁₃	h ₄₁₄	h ₄₁₅	h ₄₁₆	h ₄₁₇	h ₄₁₈	h ₄₁₉	h ₄₂₀	h ₄₂₁	h ₄₂₂	h ₄₂₃	h ₄₂₄	h ₄₂₅	h ₄₂₆	h ₄₂₇	h ₄₂₈	h ₄₂₉	h ₄₃₀	h ₄₃₁	h ₄₃₂	h ₄₃₃	h ₄₃₄	h ₄₃₅	h ₄₃₆	h ₄₃₇	h ₄₃₈	h ₄₃₉	h ₄₄₀	h ₄₄₁	h ₄₄₂	h ₄₄₃	h ₄₄₄	h ₄₄₅	h ₄₄₆	h ₄₄₇	h ₄₄₈	h ₄₄₉	h ₄₅₀	h ₄₅₁	h ₄₅₂	h ₄₅₃	h ₄₅₄	h ₄₅₅	h ₄₅₆	h ₄₅₇	h ₄₅₈	h ₄₅₉	h ₄₆₀	h ₄₆₁	h ₄₆₂	h ₄₆₃	h ₄₆₄	h ₄₆₅	h ₄₆₆	h ₄₆₇	h ₄₆₈	h ₄₆₉	h ₄₇₀	h ₄₇₁	h ₄₇₂	h ₄₇₃	h ₄₇₄	h ₄₇₅	h ₄₇₆	h ₄₇₇	h ₄₇₈	h ₄₇₉	h ₄₈₀	h ₄₈₁	h ₄₈₂	h ₄₈₃	h ₄₈₄	h ₄₈₅	h ₄₈₆	h ₄₈₇	h ₄₈₈	h ₄₈₉	h ₄₉₀	h ₄₉₁	h ₄₉₂	h ₄₉₃	h ₄₉₄	h ₄₉₅	h ₄₉₆	h ₄₉₇	h ₄₉₈	h ₄₉₉	h ₅₀₀	h ₅₀₁	h ₅₀₂	h ₅₀₃	h ₅₀₄	h ₅₀₅	h ₅₀₆	h ₅₀₇	h ₅₀₈	h ₅₀₉	h ₅₁₀	h ₅₁₁	h ₅₁₂	h ₅₁₃	h ₅₁₄	h ₅₁₅	h ₅₁₆	h ₅₁₇	h ₅₁₈	h ₅₁₉	h ₅₂₀	h ₅₂₁	h ₅₂₂	h ₅₂₃	h ₅₂₄	h ₅₂₅	h ₅₂₆	h ₅₂₇	h ₅₂₈	h ₅₂₉	h ₅₃₀	h ₅₃₁	h ₅₃₂	h ₅₃₃	h ₅₃₄	h ₅₃₅	h ₅₃₆	h ₅₃₇	h ₅₃₈	h ₅₃₉	h ₅₄₀	h ₅₄₁	h ₅₄₂	h ₅₄₃	h ₅₄₄	h ₅₄₅	h ₅₄₆	h ₅₄₇	h ₅₄₈	h ₅₄₉	h ₅₅₀	h ₅₅₁	h ₅₅₂	h ₅₅₃	h ₅₅₄	h ₅₅₅	h ₅₅₆	h ₅₅₇	h ₅₅₈	h ₅₅₉	h ₅₆₀	h ₅₆₁	h ₅₆₂	h ₅₆₃	h ₅₆₄	h ₅₆₅	h ₅₆₆	h ₅₆₇	h ₅₆₈	h ₅₆₉	h ₅₇₀	h ₅₇₁	h ₅₇₂	h ₅₇₃	h ₅₇₄	h ₅₇₅	h ₅₇₆	h ₅₇₇	h ₅₇₈	h ₅₇₉	h ₅₈₀	h ₅₈₁	h ₅₈₂	h ₅₈₃	h ₅₈₄	h ₅₈₅	h ₅₈₆	h ₅₈₇	h ₅₈₈	h ₅₈₉	h ₅₉₀	h ₅₉₁	h ₅₉₂	h ₅₉₃	h ₅₉₄	h ₅₉₅	h ₅₉₆	h ₅₉₇	h ₅₉₈	h ₅₉₉	h ₆₀₀	h ₆₀₁	h ₆₀₂	h ₆₀₃	h ₆₀₄	h ₆₀₅	h ₆₀₆	h ₆₀₇	h ₆₀₈	h ₆₀₉	h ₆₁₀	h ₆₁₁	h ₆₁₂	h ₆₁₃	h ₆₁₄	h ₆₁₅	h ₆₁₆	h ₆₁₇	h ₆₁₈	h ₆₁₉	h ₆₂₀	h ₆₂₁	h ₆₂₂	h ₆₂₃	h ₆₂₄	h ₆₂₅	h ₆₂₆	h ₆₂₇	h ₆₂₈	h ₆₂₉	h ₆₃₀	h ₆₃₁	h ₆₃₂	h ₆₃₃	h ₆₃₄	h ₆₃₅	h ₆₃₆	h ₆₃₇	h ₆₃₈	h ₆₃₉	h ₆₄₀	h ₆₄₁	h ₆₄₂	h ₆₄₃	h ₆₄₄	h ₆₄₅	h ₆₄₆	h ₆₄₇	h ₆₄₈	h ₆₄₉	h ₆₅₀	h ₆₅₁	h ₆₅₂	h ₆₅₃	h ₆₅₄	h ₆₅₅	h ₆₅₆	h ₆₅₇	h ₆₅₈	h ₆₅₉	h ₆₆₀	h ₆₆₁	h ₆₆₂	h ₆₆₃	h ₆₆₄	h ₆₆₅	h ₆₆₆	h ₆₆₇	h ₆₆₈	h ₆₆₉	h ₆₇₀	h ₆₇₁	h ₆₇₂	h ₆₇₃	h ₆₇₄	h ₆₇₅	h ₆₇₆	h ₆₇₇	h ₆₇₈	h ₆₇₉	h ₆₈₀	h ₆₈₁	h ₆₈₂	h ₆₈₃	h ₆₈₄	h ₆₈₅	h ₆₈₆	h ₆₈₇	h ₆₈₈	h ₆₈₉	h ₆₉₀	h ₆₉₁	h ₆₉₂	h ₆₉₃	h ₆₉₄	h ₆₉₅	h ₆₉₆	h ₆₉₇	h ₆₉₈	h ₆₉₉	h ₇₀₀	h ₇₀₁	h ₇₀₂	h ₇₀₃	h ₇₀₄	h ₇₀₅	h ₇₀₆	h ₇₀₇	h ₇₀₈	h ₇₀₉	h ₇₁₀	h ₇₁₁	h ₇₁₂	h ₇₁₃	h ₇₁₄	h ₇₁₅	h ₇₁₆	h ₇₁₇	h ₇₁₈	h ₇₁₉	h ₇₂₀	h ₇₂₁	h ₇₂₂	h ₇₂₃	h ₇₂₄	h ₇₂₅	h ₇₂₆	h ₇₂₇	h ₇₂₈	h ₇₂₉	h ₇₃₀	h ₇₃₁	h ₇₃₂	h ₇₃₃	h ₇₃₄	h ₇₃₅	h ₇₃₆	h ₇₃₇	h ₇₃₈	h ₇₃₉	h ₇₄₀	h ₇₄₁	h ₇₄₂	h ₇₄₃	h ₇₄₄	h ₇₄₅	h ₇₄₆	h ₇₄₇	h ₇₄₈	h ₇₄₉	h ₇₅₀	h ₇₅₁	h ₇₅₂	h ₇₅₃	h ₇₅₄	h ₇₅₅	h ₇₅₆	h ₇₅₇	h ₇₅₈	h ₇₅₉	h ₇₆₀	h ₇₆₁	h ₇₆₂	h ₇₆₃	h ₇₆₄	h ₇₆₅	h ₇₆₆	h ₇₆₇	h ₇₆₈	h ₇₆₉	h ₇₇₀	h ₇₇₁	h ₇₇₂	h ₇₇₃	h ₇₇₄	h ₇₇₅	h ₇₇₆	h ₇₇₇	h ₇₇₈
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APPENDIX-3E
ON KINEMATIC ENVELOPE

APPENDIX 2 ON KINEMATIC ENVELOPE

UNDERGROUND -- BALLSTESS TRACK

REFERENCE DRAWING NO. MEGA/GEN/SOD/UND/02 & MEGA/GEN/SOD/GEN/03 AND PARA 1.8.11

Height above rail level measured perpendicular to plane of track	Distance from centre line of track to structure centre for tangent track	1576		1578		1580		1582		1584		1586		1588		1590		1592		1594		1596		1600		1602		1604		1606		1608		1610		1612		1614		1616		1618		1620		1622		1624		1626		1628		1630		1632		1634		1636		1638		1640		1642		1644		1646		1648		1650		1652		1654		1656		1658		1660		1662		1664		1666		1668		1670		1672		1674		1676		1678		1680		1682		1684		1686		1688		1690		1692		1694		1696		1698		1700		1702		1704		1706		1708		1710		1712		1714		1716		1718		1720		1722		1724		1726		1728		1730		1732		1734		1736		1738		1740		1742		1744		1746		1748		1750		1752		1754		1756		1758		1760		1762		1764		1766		1768		1770		1772		1774		1776		1778		1780		1782		1784		1786		1788		1790		1792		1794		1796		1798		1800		1802		1804		1806		1808		1810		1812		1814		1816		1818		1820		1822		1824		1826		1828		1830		1832		1834		1836		1838		1840		1842		1844		1846		1848		1850		1852		1854		1856		1858		1860		1862		1864		1866		1868		1870		1872		1874		1876		1878		1880		1882		1884		1886		1888		1890		1892		1894		1896		1898		1900		1902		1904		1906		1908		1910		1912		1914		1916		1918		1920		1922		1924		1926		1928		1930		1932		1934		1936		1938		1940		1942		1944		1946		1948		1950		1952		1954		1956		1958		1960		1962		1964		1966		1968		1970		1972		1974		1976		1978		1980		1982		1984		1986		1988		1990		1992		1994		1996		1998		2000		2002		2004		2006		2008		2010		2012		2014		2016		2018		2020		2022		2024		2026		2028		2030		2032		2034		2036		2038		2040		2042		2044		2046		2048		2050		2052		2054		2056		2058		2060		2062		2064		2066		2068		2070		2072		2074		2076		2078		2080		2082		2084		2086		2088		2090		2092		2094		2096		2098		2100		2102		2104		2106		2108		2110		2112		2114		2116		2118		2120		2122		2124		2126		2128		2130		2132		2134		2136		2138		2140		2142		2144		2146		2148		2150		2152		2154		2156		2158		2160		2162		2164		2166		2168		2170		2172		2174		2176		2178		2180		2182		2184		2186		2188		2190		2192		2194		2196		2198		2200		2202		2204		2206		2208		2210		2212		2214		2216		2218		2220		2222		2224		2226		2228		2230		2232		2234		2236		2238		2240		2242		2244		2246		2248		2250																		
		h _a	h _b	h _c	h _d	h _e	h _f	h _g	h _h	h _i	h _j	h _k	h _l	h _m	h _n	h _o	h _p	h _q	h _r	h _s	h _t	h _u	h _v	h _w	h _x	h _y	h _z	h _{aa}	h _{ab}	h _{ac}	h _{ad}	h _{ae}	h _{af}	h _{ag}	h _{ah}	h _{ai}	h _{aj}	h _{ak}	h _{al}	h _{am}	h _{an}	h _{ao}	h _{ap}	h _{aq}	h _{ar}	h _{as}	h _{at}	h _{au}	h _{av}	h _{aw}	h _{ax}	h _{ay}	h _{az}	h _{ba}	h _{bb}	h _{bc}	h _{bd}	h _{be}	h _{bf}	h _{bg}	h _{bh}	h _{bi}	h _{bj}	h _{bk}	h _{bl}	h _{bm}	h _{bn}	h _{bo}	h _{bp}	h _{bq}	h _{br}	h _{bs}	h _{bt}	h _{bu}	h _{bv}	h _{bw}	h _{bx}	h _{by}	h _{bz}	h _{ca}	h _{cb}	h _{cc}	h _{cd}	h _{ce}	h _{cf}	h _{cg}	h _{ch}	h _{ci}	h _{cj}	h _{ck}	h _{cl}	h _{cm}	h _{cn}	h _{co}	h _{cp}	h _{cq}	h _{cr}	h _{cs}	h _{ct}	h _{cu}	h _{cv}	h _{cw}	h _{cx}	h _{cy}	h _{cz}	h _{da}	h _{db}	h _{dc}	h _{dd}	h _{de}	h _{df}	h _{dg}	h _{dh}	h _{di}	h _{dj}	h _{dk}	h _{dl}	h _{dm}	h _{dn}	h _{do}	h _{dp}	h _{dq}	h _{dr}	h _{ds}	h _{dt}	h _{du}	h _{dv}	h _{dw}	h _{dx}	h _{dy}	h _{dz}	h _{ea}	h _{eb}	h _{ec}	h _{ed}	h _{ee}	h _{ef}	h _{eg}	h _{eh}	h _{ei}	h _{ej}	h _{ek}	h _{el}	h _{em}	h _{en}	h _{eo}	h _{ep}	h _{eq}	h _{er}	h _{es}	h _{et}	h _{eu}	h _{ev}	h _{ew}	h _{ex}	h _{ey}	h _{ez}	h _{fa}	h _{fb}	h _{fc}	h _{fd}	h _{fe}	h _{ff}	h _{fg}	h _{fh}	h _{fi}	h _{fj}	h _{fk}	h _{fl}	h _{fm}	h _{fn}	h _{fo}	h _{fp}	h _{fq}	h _{fr}	h _{fs}	h _{ft}	h _{fu}	h _{fv}	h _{fw}	h _{fx}	h _{fy}	h _{fz}	h _{ga}	h _{gb}	h _{gc}	h _{gd}	h _{ge}	h _{gf}	h _{gg}	h _{gh}	h _{gi}	h _{gj}	h _{gk}	h _{gl}	h _{gm}	h _{gn}	h _{go}	h _{gp}	h _{gq}	h _{gr}	h _{gs}	h _{gt}	h _{gu}	h _{gv}	h _{gw}	h _{gx}	h _{gy}	h _{gz}	h _{ha}	h _{hb}	h _{hc}	h _{hd}	h _{he}	h _{hf}	h _{hg}	h _{hh}	h _{hi}	h _{hj}	h _{hk}	h _{hl}	h _{hm}	h _{hn}	h _{ho}	h _{hp}	h _{hq}	h _{hr}	h _{hs}	h _{ht}	h _{hu}	h _{hv}	h _{hw}	h _{hx}	h _{hy}	h _{hz}	h _{ia}	h _{ib}	h _{ic}	h _{id}	h _{ie}	h _{if}	h _{ig}	h _{ih}	h _{ii}	h _{ij}	h _{ik}	h _{il}	h _{im}	h _{in}	h _{io}	h _{ip}	h _{iq}	h _{ir}	h _{is}	h _{it}	h _{iu}	h _{iv}	h _{iw}	h _{ix}	h _{iy}	h _{iz}	h _{ja}	h _{jb}	h _{jc}	h _{jd}	h _{je}	h _{jf}	h _{jj}	h _{jh}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}	h _{jp}	h _{jq}	h _{jr}	h _{js}	h _{jt}	h _{ju}	h _{jv}	h _{jw}	h _{jx}	h _{ji}	h _{jj}	h _{jk}	h _{jl}	h _{jm}	h _{jn}	h _{jo}

DEED TO DRAWING NO. MEGA/GEN/SOD/IND02 at page no 43 & MEGA/GEN/SOD/GEN03 at page no 41

$$E = (A \sin a + (h \times \tan a)) \times \cos a$$

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

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

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

ab=Ab= Distance from Inclined centre line of vehicle to tangent track at height "h" from rail level in the direction parallel to the line joining the top of rails.

ac=Distance from vertical centre line of canted track to Kinematic Envelope for tangent track at height h from

$bc = h \times \tan \alpha =$ Lateral increment due to cant (measured along the line parallel to line joining the top of rails).

eSign

Signed by: ANAND SINGH BISHT
Location: Gandhinagar, India
Organization Unit: Gujarat Metro
Rail Corporation (GMRC) Limited
Date: 14-Feb-2024 (07:22 PM)

Examined and found in order

Director/UT/Civil/RDSO



Sign



APPENDIX-4

**LATERAL AND VERTICAL SHIFT OF CENTRE OF CIRCULAR TUNNEL
FOR DIFFERENT CANT VALUES**

(REFERENCE Drawing No. MEGA/GEN/SOD/UND/04 AND PARAs 1.7.1 B. b) AND 1.7.2 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	4.757937	172	55	(a) THE CANT IS PROVIDED BY ROTATING THE TUNNEL ABOUT THE MID POINT OF TOP OF INNER RAIL THIS WILL RESULT IN LATERAL AND VERTICAL SHIFT OF THE CENTRE OF THE CIRCULAR TUNNEL.
120	4.567207	165	54	
115	4.376527	158	52	
110	4.185896	151	50	
105	3.995312	144	48	(b) LATERAL SHIFT OF THE CENTRE OF TUNNEL (TOWARDS INSIDE OF CURVE)
100	3.804772	137	46	$X = \{ [2 \times (r-D_1) \sin \theta] \times \sin \alpha/2 \} \times \cos (90 - \theta - \alpha/2)$
95	3.614274	130	43	(c) VERTICAL SHIFT OF THE CENTRE OF TUNNEL (UPWARDS)
90	3.423816	123	41	$Y = \{ [2 \times (r-D_1) \sin \theta] \times \sin \alpha/2 \} \times \sin (90 - \theta - \alpha/2)$
85	3.233396	116	39	Where 'r' is internal radius of the circular tunnel=2800 mm
80	3.043011	109	37	D_1 = depth from rail level to invert of circular tunnel=760 mm
75	2.852660	102	35	α = angle of rotation= $\sin^{-1} (\text{Cant}/g)$ and
70	2.662341	96	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	2.472051	89	31	$= \tan^{-1} \{ (r-D_1) / (g/2) \}$ in degrees =
60	2.281789	82	28	69.72764836
55	2.091551	75	26	g = Centre to centre of rails = 1507 mm
50	1.901337	68	24	Note: Please see Drawing no. MEGA/GEN/SOD/UND-04 at page 50 for details
45	1.711144	61	22	
40	1.520969	54	19	
35	1.330811	48	17	
30	1.140668	41	15	
25	0.950538	34	12	
20	0.760418	27	10	
15	0.570306	20	7	
10	0.380200	14	5	
5	0.190099	7	2	
0	0.000000	0	0	

Examined and found in order

Director/UT/Civil/RDSO





APPENDIX-5 ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES UNDER GROUND, ELEVATED AND SURFACE SECTIONS (REFERENCE PARA 2.7)				
RADIUS (meters)	CANT C_a (mm)	EXTRA CLEARANCE (mm) FOR PASSENGER PLATFORM		REMARKS
		INSIDE OF CURVE	OUTSIDE OF CURVE	
3000	0	10	10	Extra CLEARANCE for curves (a) Inside of curve = Midthrow = 28125/R (b) Outside of curve = Endthrow = 34020/R Please see Appendix 2A, 2B, 2C & 2D. Additional sway (nosing Effect) has been neglected in the calculation as a measure of additional safety to passengers.
2800	0	10	10	
2600	0	15	15	
2400	0	15	15	
2200	0	15	15	
2000	0	15	15	
1800	0	20	20	
1700	0	20	20	
1600	0	20	20	
1500	0	20	25	
1400	0	20	25	
1300	0	25	25	
1200	0	25	30	
1100	0	30	30	
1000	0	30	35	

Examined and found in order

Director/UT/Civil/RDSO





For values of E1, F1, H1 AND H2, refer to
Appendix 3A, 3B & 3C



Director/UT/Civil/RDSO

LEGEND:

STRUCTURE GAUGE

DRAWING NO : MEGA/GEN/SOD/GEN-01	REFERENCE PARA NO.: 1.7.18, 1.7.2B & 1.8.2
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DRAWING NO.: MEGA/GEN/SOD/GEN-01

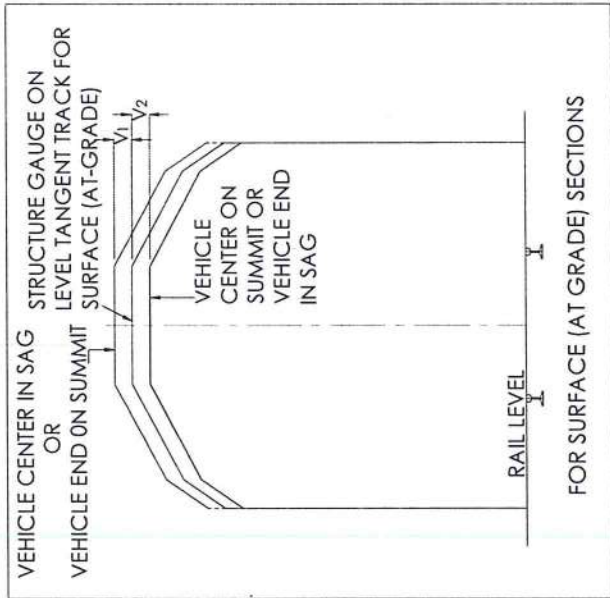
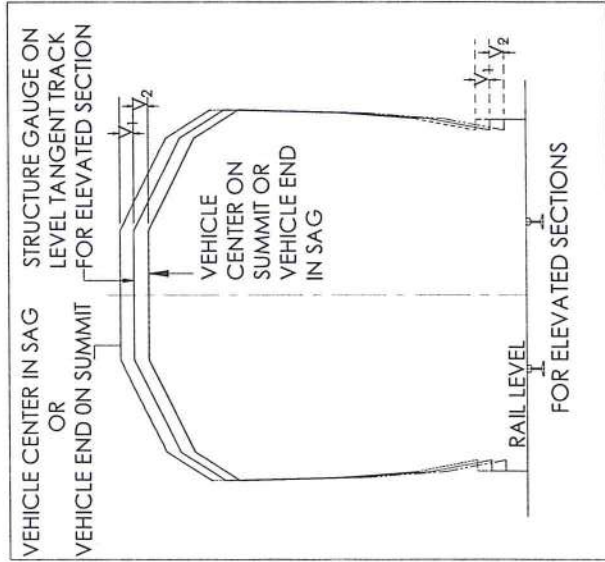
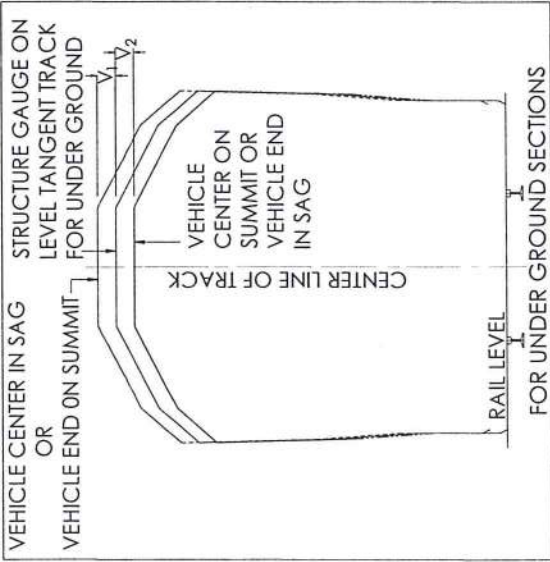
 Gujarat Metro Rail Corporation (GMRC) Limited

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

EFFECT OF CANT ON STRUCTURE GAUGE
(TYPICAL)

Page no : 39

[illegible]



Examined and found in order

[Signature]

Director/UT/Civil/RDSO

Note:

1. THE VALUES OF V_1 AND V_2 ARE APPROXIMATELY EQUAL AND APPLICABLE TO UNDERGROUND, ELEVATED AND SURFACE SECTIONS

VERTICAL THROW

RADIUS OF VERTICAL CURVE (M)	V_1 mm	V_2 mm
1500	19	21
1600	18	20
1700	17	19
1800	16	18
1900	15	17
2000	14	16
2100	13	15
2200	13	15
2300	12	14
2400	12	13
2500	11	13
2600	11	12
2700	10	12
2800	10	11
2900	10	11
3000	9	11

$$V_1 = 125 \times \frac{C^2}{R}$$

$$V_2 = (125 \times C_1^2/R) - (125 \times C^2/R)$$

C = BOGIE CENTER DISTANCE

C_1 = COACH LENGTH



Annexure - 4 to Addendum no. 1

DRAWING NO. : MEGA/GEN/SOD/GEN-02	REFERENCE PARA NO.: 1.7.1C & 1.7.2C
Gujarat Metro Rail Corporation (GMRC) Limited	
STANDARD GAUGE (1435) - 750 VOLT D.C. TRACTION	

CONSULTANTS:

DATE: JANUARY -2024

SCALE: Not to Scale

EFFECT OF VERTICAL CURVE ON STRUCTURE GAUGE

$$\sin \alpha = C_d/g$$

$g = 1507 \text{ mm}$

 $C_g = \text{Cant applied}$

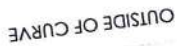
$$E = [ab + (h \times \tan \alpha)] \times \cos \alpha$$

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

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

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

For values of E, F, H1 AND H2, refer to Appendix - 3D and 3E



Director/UT/Civil/RDSO

LEGEND:

KINEMATIC ENVELOPE OF COACH

DRAWING NO.: MEGA/GEN/SOD/GEN-03

REFERENCE PARA NO.: 1.8.1



Gujarat Metro Rail Corporation (GMRC) Limited

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

EFFECT OF CANT ON KINEMATIC ENVELOPE (TYPICAL)

Page no : 41

JANUARY -2024

Not to Scale

CONSULTANTS:

DETAILS OF REVISION

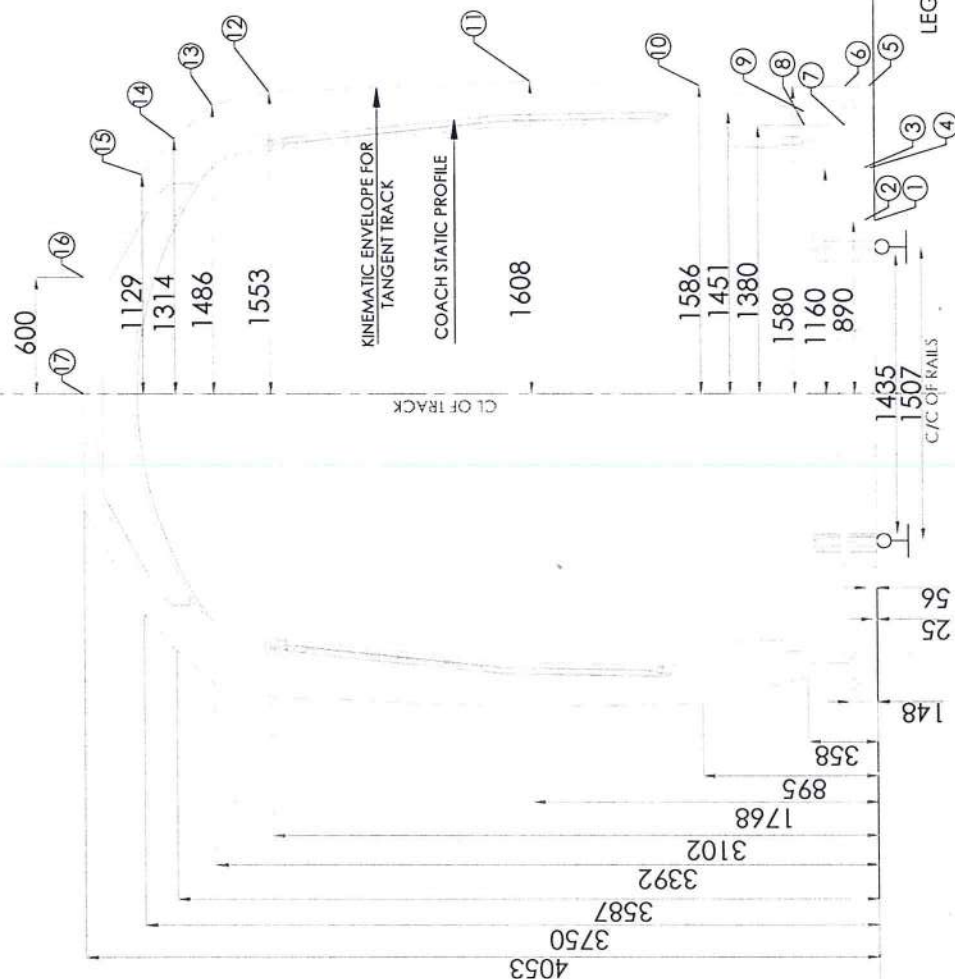
MARK	DATE
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5496

Note:

1. ALL DIMENSIONS ARE IN MM.
2. HORIZONTAL AND VERTICAL CLEARANCES 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.
4. COACH SIZE W-2900, H-3980.
5. THE KINEMATIC ENVELOPE IS FOR DESIGN SPEED OF 90KM/PH WITH MAXIMUM PERMISSIBLE TOLERANCE FOR TRACK & ROLLING STOCK. THE KINEMATIC ENVELOPE AND STRUCTURE GAUGE WILL BE ALSO VALID FOR NEW ROLLING STOCK HAVING SIMILAR SUSPENSION SYSTEM AND DIMENSIONS.
6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 100KM/PH.

POINT	X	Y
1	890	0
2	890	56
3	1160	56
4	1160	25
5	1580	25
6	1580	148
7	1380	148
8	1380	358
9	1451	358
10	1586	895
11	1608	1768
12	1553	3102
13	1486	3392
14	1314	3587
15	1129	3750
16	600	4053
17	0	4053



Annexure - 4 to Addendum no. 1

Examined and found in order

Director/UT/Civil/RDSO

REFERENCE PARA NO.: 1.5

DRAWING NO. : MEGA/GEN/SOD/ELE-01

 Gujarat Metro Rail Corporation (GMRC) Limited

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

KINEMATIC ENVELOPE FOR AT-GRADE & ELEVATED SECTION
WITH BALLASTLESS TRACK ON LEVEL/CONSTANT GRADE
(TANGENT TRACK) OUTSIDE STATION

DATE: _____

JANUARY -2024

CONSULTANTS:

Not to Scale

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6/10/21

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Journal of Internal Medicine 255: 115–122

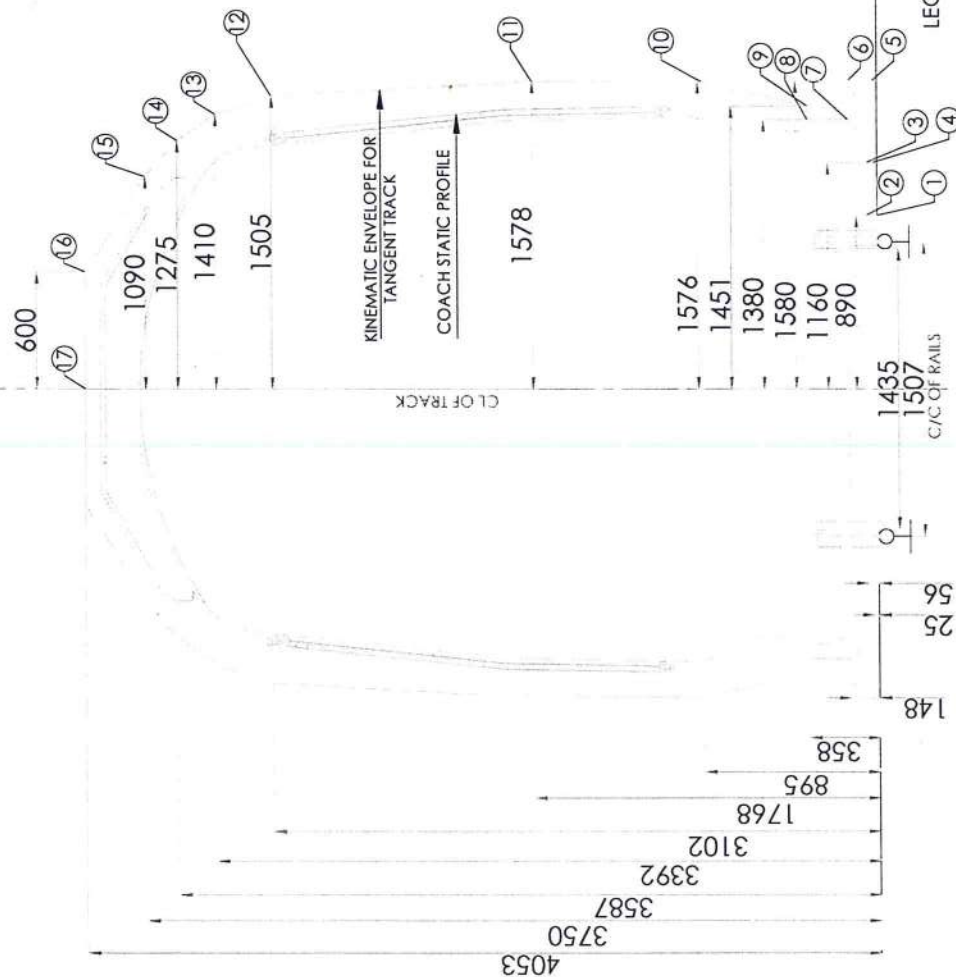
POINT	X	Y
1	890	0
2	890	56
3	1160	56
4	1160	25
5	1580	25
6	1580	148
7	1380	148
8	1380	358
9	1451	358
10	1576	895
11	1578	1768
12	1505	3102
13	1410	3392
14	1275	3587
15	1090	3750
16	600	4053
17	0	4053

1. ALL DIMENSIONS ARE IN mm.
2. HORIZONTAL AND VERTICAL CLEARANCES 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.
4. COACH SIZE W-2900, H-3980.
5. THE KINEMATIC ENVELOPE IS FOR DESIGN SPEED OF 90 KM/H WITH MAXIMUM PERMISSIBLE TOLERANCE FOR TRACK & ROLLING STOCK. THE KINEMATIC ENVELOPE AND STRUCTURE GAUGE WILL BE ALSO VALID FOR NEW ROLLING STOCK HAVING SIMILAR SUSPENSION SYSTEM AND DIMENSIONS.
6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 0KM/H.

Examined and found in order

Annexure - 4 to Addendum no. 1

Director/UT/Civil/RDSO



LEGEND:

KINEMATIC ENVELOPE OF COACH
STATIC PROFILE OF COACH

DRAWING NO. : MEGA/GEN/SOD/UND-02	REFERENCE PARA NO.: 1.5
-----------------------------------	-------------------------

DRAWING NO. : MFGA/GEN/SOD/JIND-02

 Gujarat Metro Rail Corporation (GMRC) Limited

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

CONSULTANTS:

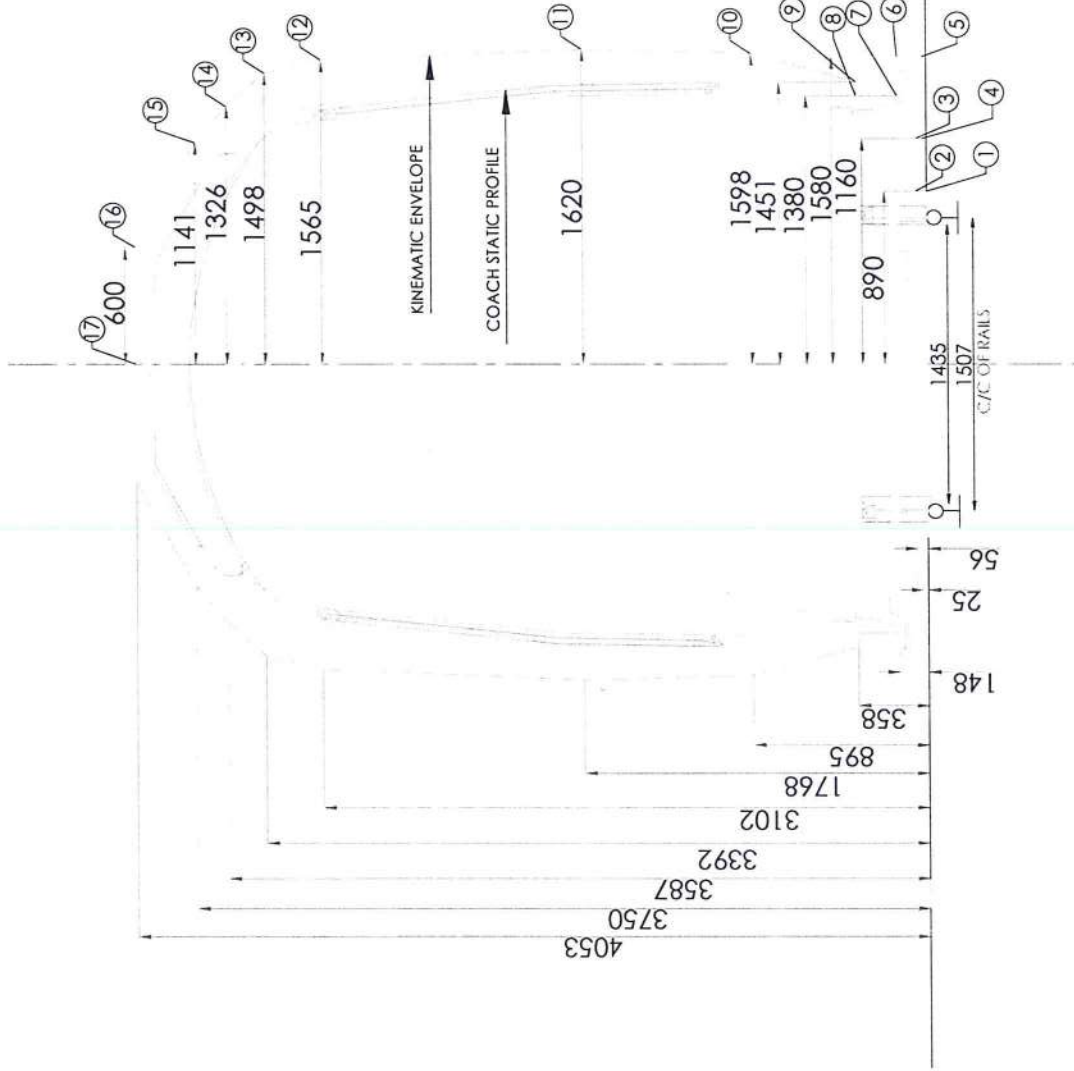
JANUARY -2024

MARK	DATE	DETAILS OF REVISION

Not to Scale

Page no : 43

KINEMATIC ENVELOPE FOR UNDERGROUND SECTION
WITH BALLASTLESS TRACK ON LEVEL/CONSTANT GRADE
(TANGENT TRACK) OUTSIDE STATION



COORDINATES:

POINT	X	Y
1	890	0
2	890	56
3	1160	56
4	1160	25
5	1580	25
6	1580	148
7	1380	148
8	1380	358
9	1451	358
10	1598	895
11	1620	1768
12	1565	3102
13	1498	3392
14	1326	3587
15	1141	3750
16	600	4053
17	0	4053

- Note:
1. ALL DIMENSIONS ARE IN mm.
 2. HORIZONTAL AND VERTICAL CLEARANCES 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.
 4. COACH SIZE W-2900, H-3980.
 5. THE KINEMATIC ENVELOPE IS FOR DESIGN SPEED OF 90 KM/H WITH MAXIMUM PERMISSIBLE TOLERANCE FOR TRACK & ROLLING STOCK. THE KINEMATIC ENVELOPE AND STRUCTURE GAUGE WILL BE ALSO VALID FOR NEW ROLLING STOCK HAVING SIMILAR SUSPENSION SYSTEM AND DIMENSIONS.
 6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 100 KM/H.

Annexure - 4 to Addendum no. 1

Examined and found in order

[Signature]

Director/UT/Civil/RDSO

DRAWING NO.: MEGA/GEN/SOD/ATG-01

REFERENCE PARA NO.: 1.5

Gujarat Metro Rail Corporation (GMRCL) Limited

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

KINEMATIC ENVELOPE FOR SURFACE (AT-GRADE) SECTION
BALLASTED TRACK ON LEVEL/CONSTANT GRADE
(TANGENT TRACK) OUTSIDE STATION

DATE: JANUARY -2024

SCALE: Not to Scale

CONSULTANTS:

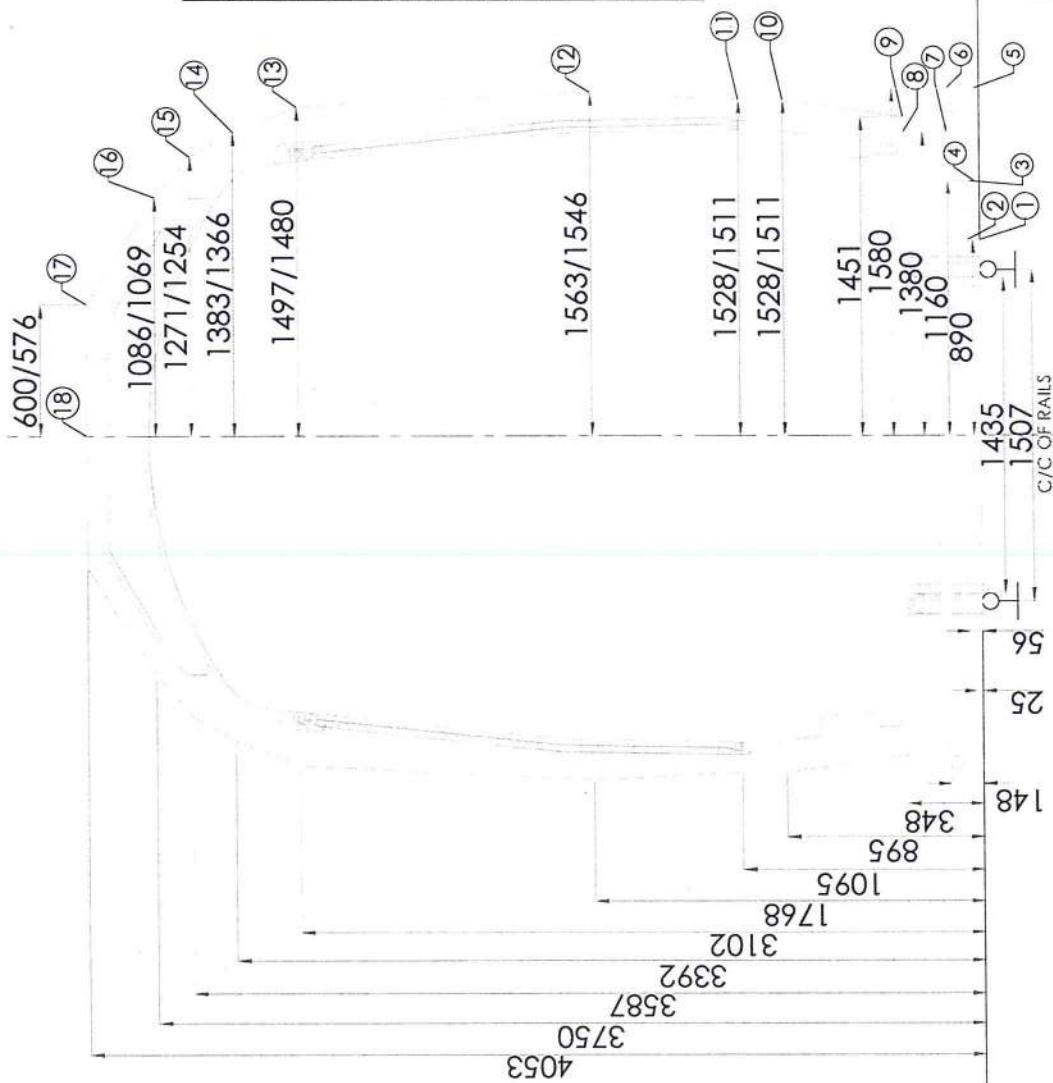
MARK	DATE	DETAILS OF REVISION

05/05/2013

Note:

1. ALL DIMENSIONS ARE IN mm.
2. HORIZONTAL AND VERTICAL CLEARANCES 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.
4. DESIGN SPEED OVER PLATFORM LINES SHALL NOT EXCEED 70KMPH
5. COACH SIZE W-2900, H-3980.
6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 70KMPH FOR ELEVATED/ AT-GRADE SECTION AND 0KMPH FOR UNDERGROUND SECTION

POINT	X FOR ELEVATED	X FOR UG	Y
1	890	890	0
2	890	890	56
3	1160	1160	56
4	1160	1160	25
5	1580	1580	25
6	1580	1580	148
7	1380	1380	148
8	1380	1380	348
9	1451	1451	348
10	1528	1511	895
11	1528	1511	1095
12	1563	1546	1768
13	1497	1480	3102
14	1383	1366	3392
15	1271	1254	3587
16	1086	1069	3750
17	600	576	4053
18	0	0	4053



Examined and found in order

Director/UT/Civil/RDSO

LEGEND:
KINEMATIC ENVELOPE OF COACH
STATIC PROFILE OF COACH

DRAWING NO. : MEGA/GEN/SODIELE & UND-70 KMPH	REFERENCE PARA NO.: 1.5
--	-------------------------

: MEGA/GEN/SOD/ELE & UND-70 KMPH



Gujarat Metro Rail Corporation (GMRC) Limited

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

KINEMATIC ENVELOPE FOR UNDERGROUND & AT-GRADE SECTION
AND ELEVATED SECTION WITH BALLASTLESS TRACK OVER
PLATFORM LINE ON LEVEL/CONSTANT GRADE (TANGENT TRACK)
(DESIGN SPEED - 70KM/PH)

Page no : 45

CONSULTANTS:

JANUARY -2024

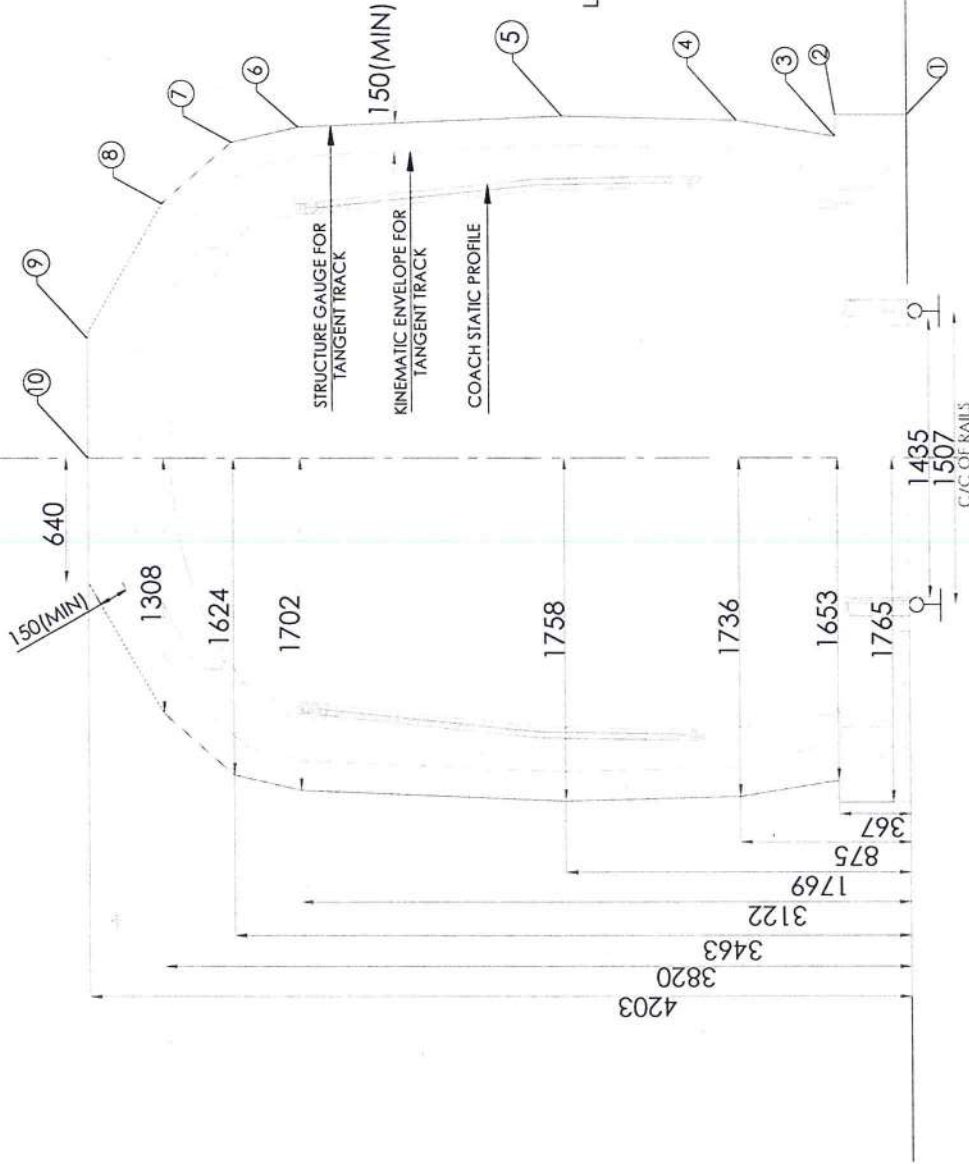
Not to Scale

SCALE:

DETAILS OF REVISION

ATE

MARK



COORDINATES:

POINT	X	Y
1	1765	0
2	1765	367
3	1653	367
4	1736	875
5	1758	1769
6	1702	3122
7	1624	3463
8	1308	3820
9	640	4203
10	0	4203

LEGEND:

KINEMATIC ENVELOPE OF COACH
STATIC PROFILE OF COACH
STRUCTURE GAUGE

RAIL LEVEL

Note:

1. ALL DIMENSIONS ARE IN mm.
2. HORIZONTAL AND VERTICAL CLEARANCES DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA.
3. STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
4. MIN. CLEARANCE BETWEEN KINEMATIC ENVELOPE & STRUCTURE GAUGE IS 150mm
5. COACH SIZE W-2900, H-3980.
6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 100KM/PH.

17/4/2024
Approved on
17/4/2024

Annexure - 4 to Addendum no. 1

Examined and found in order

Director/UT/Civil/RDSO

DRAWING NO. : MEGA/GEN/SOU/ILE-02

REFERENCE PARA NO.: 1.4 B & 1.6.2

Gujarat Metro Rail Corporation (GMRC) Limited

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

STRUCTURE GAUGE ON ELEVATED & AT-GRADE SECTION
BALLASTLESS TRACK ON LEVEL/CONSTANT GRADE
TRACK (TANGENT TRACK) OUTSIDE STATION

DATE: JANUARY -2024

SCALE: Not to Scale

CONSULTANTS:

MARK	DATE	DETAILS OF REVISION

Note:

1. ALL DIMENSIONS ARE IN mm.
2. HORIZONTAL AND VERTICAL CLEARANCES 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.
4. COACH SIZE W-2900, H-3980.
5. THE KINEMATIC ENVELOPE IS FOR A DESIGN SPEED OF 90 KMPH WITH MAXIMUM PERMISSIBLE TOLERANCE FOR TRACK & ROLLING STOCK. THE KINEMATIC ENVELOPE AND STRUCTURE GAUGE WILL BE ALSO VALID FOR NEW ROLLING STOCK HAVING SIMILAR SUSPENSION SYSTEM AND DIMENSIONS.
6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 0KMPH.

COORDINATES:

POINT	X	Y
1	1730	0
2	1730	88
3	1768	88
4	1768	3197
5	1428	3659
6	628	4153
7	0	4153

Annexure - 4 to Addendum no. 1

Examined and found in order

Director/UT/Civil/RDSO

DRAWING NO.: MEGA/CEH/SOD/IND/01 REFERENCE PARA NO.: 1.4 A 1 & 1.6.1

Gujarat Metro Rail Corporation (GMRC) Limited

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

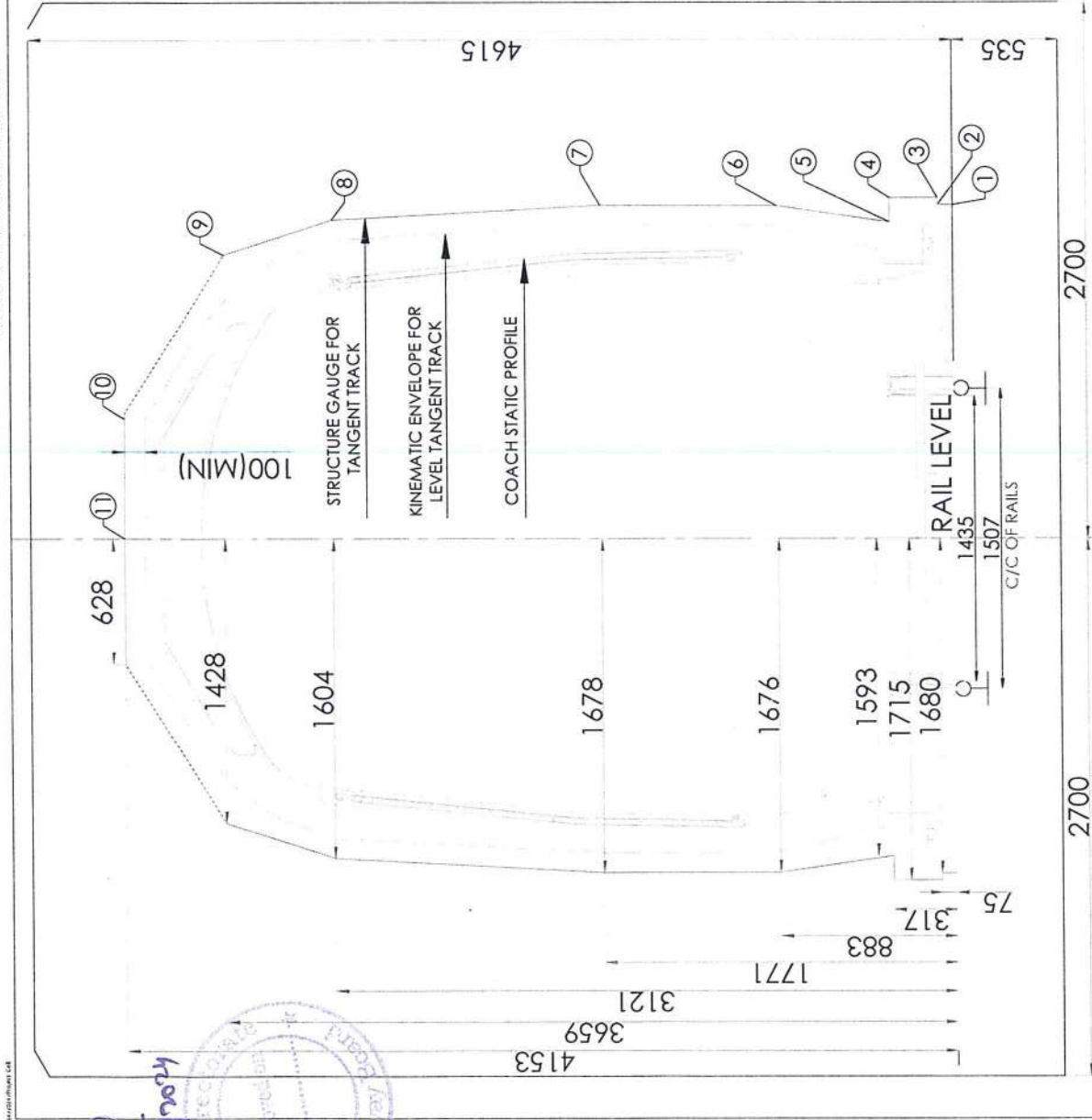
STRUCTURE GAUGE FOR UNDERGROUND SECTION (CIRCULAR TUNNELS) WITH BALLASTLESS TRACK ON LEVEL/CONSTANT GRADE (TANGENT TRACK)

DATE: JANUARY -2024

SCALE: Not to Scale

CONSULTANTS:

MARK	DATE	DETAILS OF REVISION



COORDINATES:

POINT	X	Y
1	1680	0
2	1680	75
3	1715	75
4	1715	317
5	1593	317
6	1676	883
7	1678	1771
8	1604	3121
9	1428	3659
10	628	4153
11	0	4153

- Note:
- ALL DIMENSIONS ARE IN mm.
 - HORIZONTAL AND VERTICAL CLEARANCES DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA.
 - CANT WILL BE PROVIDED BY RAISING OUTER RAIL
 - KINEMATIC ENVELOPE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
 - MIN. CLEARANCE BETWEEN KINEMATIC ENVELOPE & STRUCTURE GAUGE IS 100mm
 - COACH SIZE W-2900, H-3980.
 - THE KINEMATIC ENVELOPE IS FOR A DESIGN SPEED OF 90 KMPH WITH MAXIMUM PERMISSIBLE TOLERANCE FOR TRACK & ROLLING STOCK. THE KINEMATIC ENVELOPE AND STRUCTURE GAUGE WILL BE ALSO VALID FOR NEW ROLLING STOCK HAVING SIMILAR SUSPENSION SYSTEM AND DIMENSIONS.
 - THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 0KMPH.

LEGEND:

- KINEMATIC ENVELOPE OF COACH
- STATIC PROFILE OF COACH
- STRUCTURE GAUGE

Examined and found in order

[Signature]

Director/UT/Civil/RDSO

Annexure - 4 to Addendum no. 1

DRAWING NO. : MEGA/GEN/SOD/UND-03	REFERENCE PARA NO.: 1.4 A 2 & 1.6.1
Gujarat Metro Rail Corporation (GMRC) Limited	
STANDARD GAUGE (1435) - 750 VOLT D.C. TRACTION	
STRUCTURE GAUGE FOR UNDERGROUND SECTION (RECTANGULAR BOX TUNNELS) WITH BALLASTLESS TRACK ON LEVEL/CONSTANT GRADE (TANGENT TRACK)	
MARK	DATE
DETAILS OF REVISION	

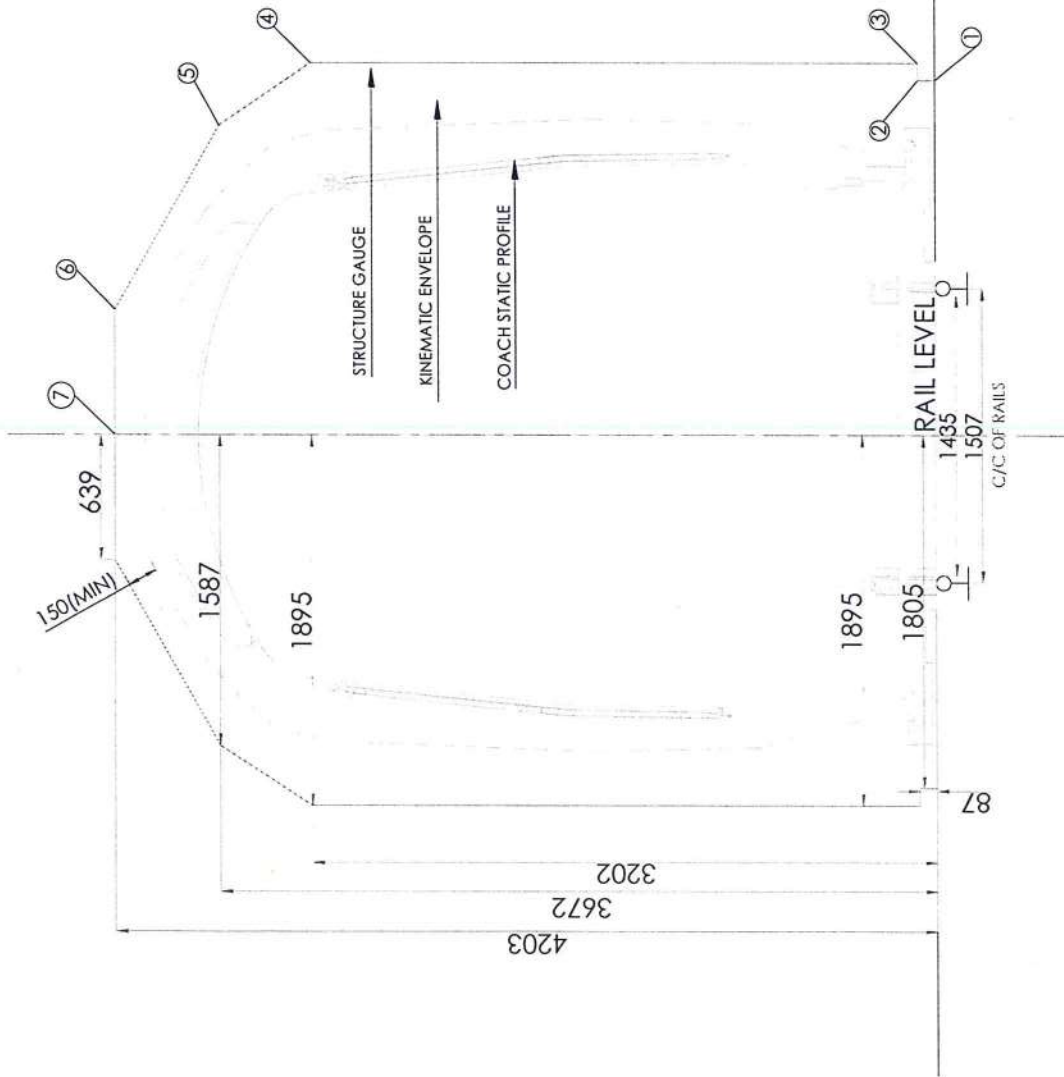
DATE: JANUARY -2024

SCALE: Not to Scale

- Note:
1. ALL DIMENSIONS ARE IN mm.
 2. HORIZONTAL AND VERTICAL CLEARANCES DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA.
 3. STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
 4. MIN. CLEARANCE BETWEEN KINEMATIC ENVELOPE & STRUCTURE GAUGE IS 150mm
 5. COACH SIZE W-2900, H-3980.
 6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 100KM/PH.

COORDINATES:

POINT	X	Y
1	1805	0
2	1805	87
3	1895	87
4	1895	3202
5	1587	3672
6	639	4203
7	0	4203



LEGEND:

- KINEMATIC ENVELOPE OF COACH
- STATIC PROFILE OF COACH
- STRUCTURE GAUGE
- RAIL LEVEL

Annexure - 4 to Addendum no. 1

Examined and found in order

Director/UT/Civil/RDSO

DRAWING NO.: MEGA/GEN/SOD/AIG-02

REFERENCE PARA NO.: 1.4 C & 1.6.3

Gujarat Metro Rail Corporation (GMRC) Limited

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

STRUCTURE GAUGE FOR AT-GRADE SECTION
(BALLASTED) TRACK ON LEVEL/CONSTANT
TRACK (TANGENT TRACK) OUTSIDE STATION

DATE: JANUARY -2024

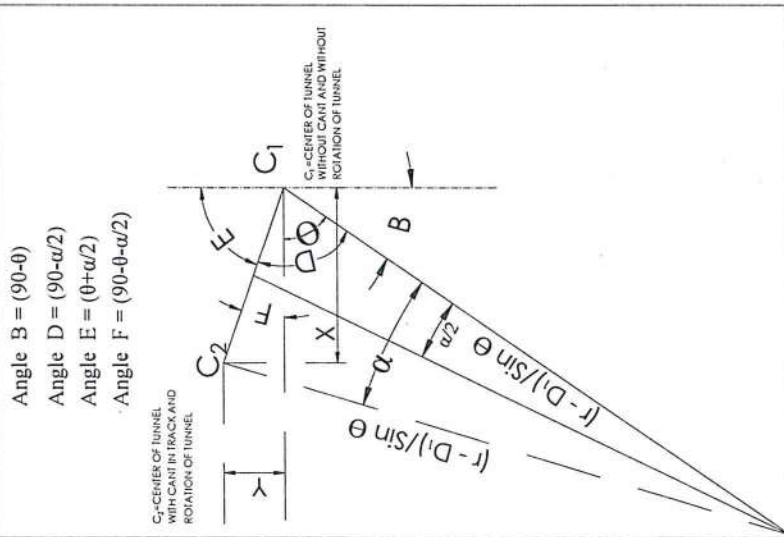
SCALE: Not to Scale

CONSULTANTS:

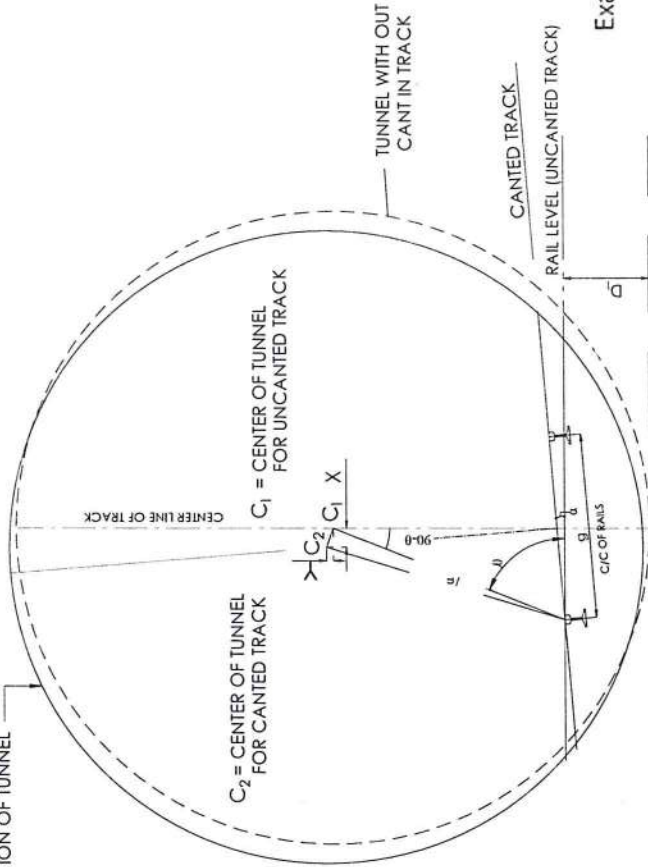
MARK	DATE	DETAILS OF REVISION

$\tan \theta = (r-D_1) / (g/2)$
 $\theta = \tan^{-1} [(r-D_1) / (g/2)]$
 $\sin \alpha = \cos \theta / g$
 $\alpha = \sin^{-1} (\cos \theta / g)$
 Chord $C_1 C_2 = 2 \times [(r-D_1) / \sin \theta] \times (\sin \alpha / 2)$
 $X = C_1 C_2 \times \cos (90 - \theta - \alpha / 2)$
 $= 2 \times [(r-D_1) / \sin \theta \times (\sin \alpha / 2)] \times \cos (90 - \theta - \alpha / 2)$
 $Y = 2 \times [(r-D_1) / \sin \theta \times (\sin \alpha / 2)] \times \sin (90 - \theta - \alpha / 2)$
 Where 'r' is internal radius of tunnel,
 D_1 = depth from Rail level to invert of tunnel
 g = distance between centers of rails
 $= 1507 \text{ mm}$

DETAIL AT CENTER OF TUNNEL



POSITION OF TUNNEL WITH CANT AND ROTATION OF TUNNEL



Annexure - 4 to Addendum no. 1

Note:

1. THE CIRCULAR TUNNEL IS ROTATED ABOUT CENTER OF TOP OF INNER RAIL.
2. FOR VALUES OF CLEARANCE 'X' AND 'Y' FOR VARIOUS VALUES OF CANT, REFER TO APPENDIX - 4

12/1/2024



Examined and found in order

[Signature]

Director/UT/Civil/RDSO

DRAWING NO : MEGA/GEN/SOD/UND-04

REFERENCE PARA NO.: 1.7.1B (b) AND 1.7.2 B (b)

Gujarat Metro Rail Corporation (GMRC) Limited

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

DATE: JANUARY -2024

SCALE: Not to Scale

CONSULTANTS:

SHIFT OF THE CENTER OF CIRCULAR TUNNEL DUE TO ROTATION OF TUNNEL FOR CANT

Page no :50

1992

1. ALL DIMENSION ARE IN MM.
2. CLEARANCE FOR CURVE SHALL BE EXTRA, HOWEVER THE TRACK CENTERS (A) WILL NOT BE AFFECTED FOR CURVES OF RADIUS 1000 M AND FLATTER IF THERE IS NO STRUCTURE BETWEEN THE TRACKS. IN CASE OF A STRUCTURE BETWEEN THE TRACKS, (A) SHALL BE CALCULATED.
3. VERTICAL THROW DUE TO VERTICAL CURVE IF ANY SHALL BE EXTRA
4. STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION
5. THE TRACK CENTERS DOES NOT ACCOUNT FOR PROVISION OF CROSS OVERS, STRUCTURES & OTHER SERVICES, IF REQUIRED, IN BETWEEN THE TRACKS
6. FOR KINEMATIC ENVELOPE OVER PLATFORM LINE REFER TO DRAWING NO. MEGA/GEN/SOD/ELE & UND-DESIGN SPEED 70KM/H AT PAGE 45
7. FOR PLATFORM SCREEN GATE DETAILS REFER TO DRAWING NO MEGA/GEN/SOD/PSD-2 AT PAGE NO 55
8. DESIGN SPEED OVER PLATFORM LINES SHALL NOT EXCEED 70KM/H.
9. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 70KM/H.

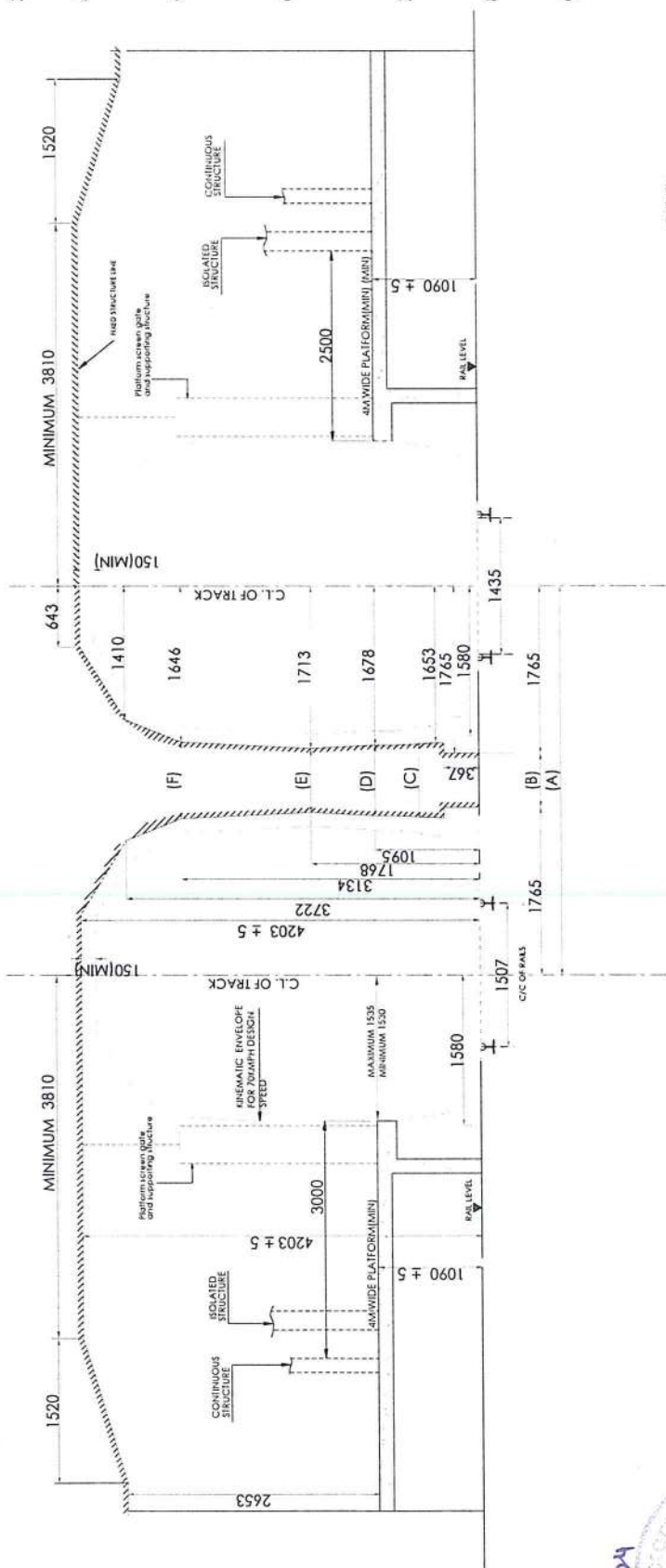
Examined and found in order

Director/UT/Civil/RDSO

DATE:	JANUARY -2024
SCALE:	Not to Scale

Page no : 51

TRACK CENTER (A)	B	C	D	E	F
3750	220	444	394	324	659
3800	270	494	444	374	709
3900	370	594	544	474	609
4000	470	694	644	574	709
4100	570	794	744	674	809
4150	620	844	794	724	859
4200	670	894	844	774	909
4250	770	944	894	874	959



LEGEND:

KINEMATIC ENVELOPE OF COACH

/// STRUCTURE GAUGE

Examined and found in order

Director/UT/Civil/RDSO

DATE:	JANUARY -2024
SCALE:	Not to Scale

Page no : 51

DRAWING NO. : MEGA/CEN/SOD/ELE-03

REFERENCE PARA NO.: 2.2.5

 Gujarat Metro Rail Corporation (GMRC) Limited

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

STRUCTURE GAUGE FOR ELEVATED/AT-GRADE STATION WITH
4m WIDE [MINIMUM] SIDE PLATFORMS WITH BALLASTLESS
TRACK ON LEVEL/CONSTANT GRADE TRACK WITH/WITHOUT
PLATFORM SCREEN GATE

(5) *and* *or*
 means: *and* or *or*

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 OVER PLATFORM LINE REFER TO DRAWING NO. MEGA/GEN/SOD/ELE & UND-DESIGN SPEED 70KM/PH AT PAGE 45
6. FOR PLATFORM SCREEN GATE DETAILS REFER TO DRAWING NO MEGA/GEN/SOD/PSD-2 AT PAGE NO 55
7. DESIGN SPEED OVER PLATFORM LINES SHALL NOT EXCEED 70KM/PH
8. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 70KM/PH.

LEGEND:

KINEMATIC ENVELOPE OF COACH

STRUCTURE GAUGE

7

CONSULTANTS:

Not to Scale

STRUCTURE GAUGE FOR ELEVATED/AT-GRADE STATION
WITH AN ISLAND PLATFORM WITH BALLASTLESS TRACK
ON LEVEL/CONSTANT GRADE (TANGENT TRACK)
WITH/WITHOUT PLATFORM SCREEN GATE

Page no : 52

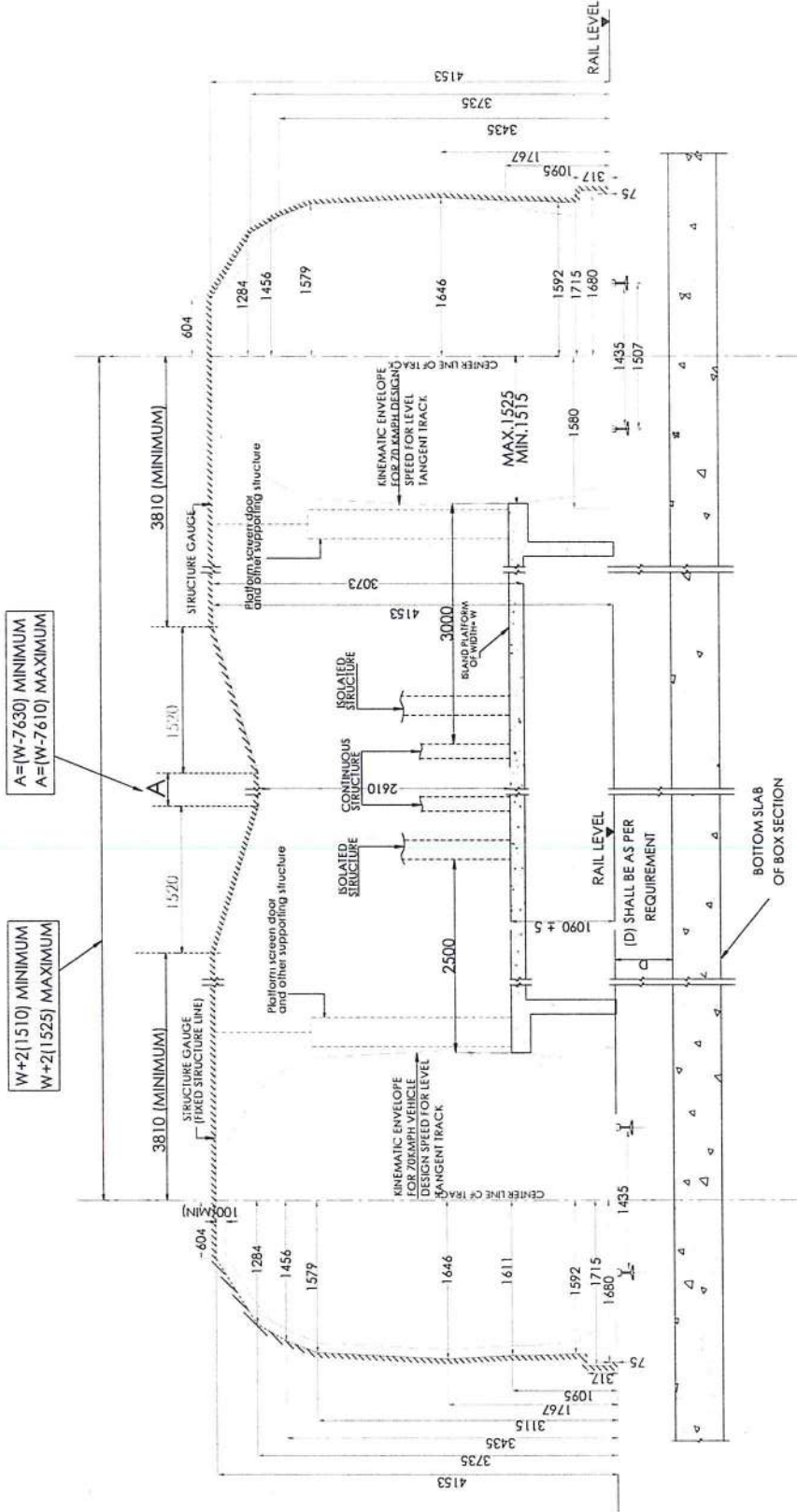
DRAWING NO. : MEGA/GEN/SOD/ELE-04	REFERENCE PARA NO.: 2.2.5
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FIG NO. : MEGA/GEN/SOD/ELE-04	REFERENCE
 Gujarat Metro Rail Corporation (GMRC) Limited	

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

[illegible]

- 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 DRAWING NO.-MEGA/GEN/SOD/ELE & UND-DESIGN SPEED 70KMPH AT PAGE 45
 6. PLATFORM SCREEN DOOR SHOWN IN DRAWING NO MEGA/GEN/SOD/PSD-1 AT PAGE 54, PLATFORM SCREEN GATE CAN ALSO BE USED IN PLACE OF PLATFORM SCREEN DOOR.
 7. DESIGN SPEED OVER PLATFORM LINES SHALL NOT EXCEED 70KMPH
 8. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 0KMPH.



LEGEND:
KINEMATIC ENVELOPE OF COACH
STRUCTURE GAUGE

Examined and found in order

[Signature]

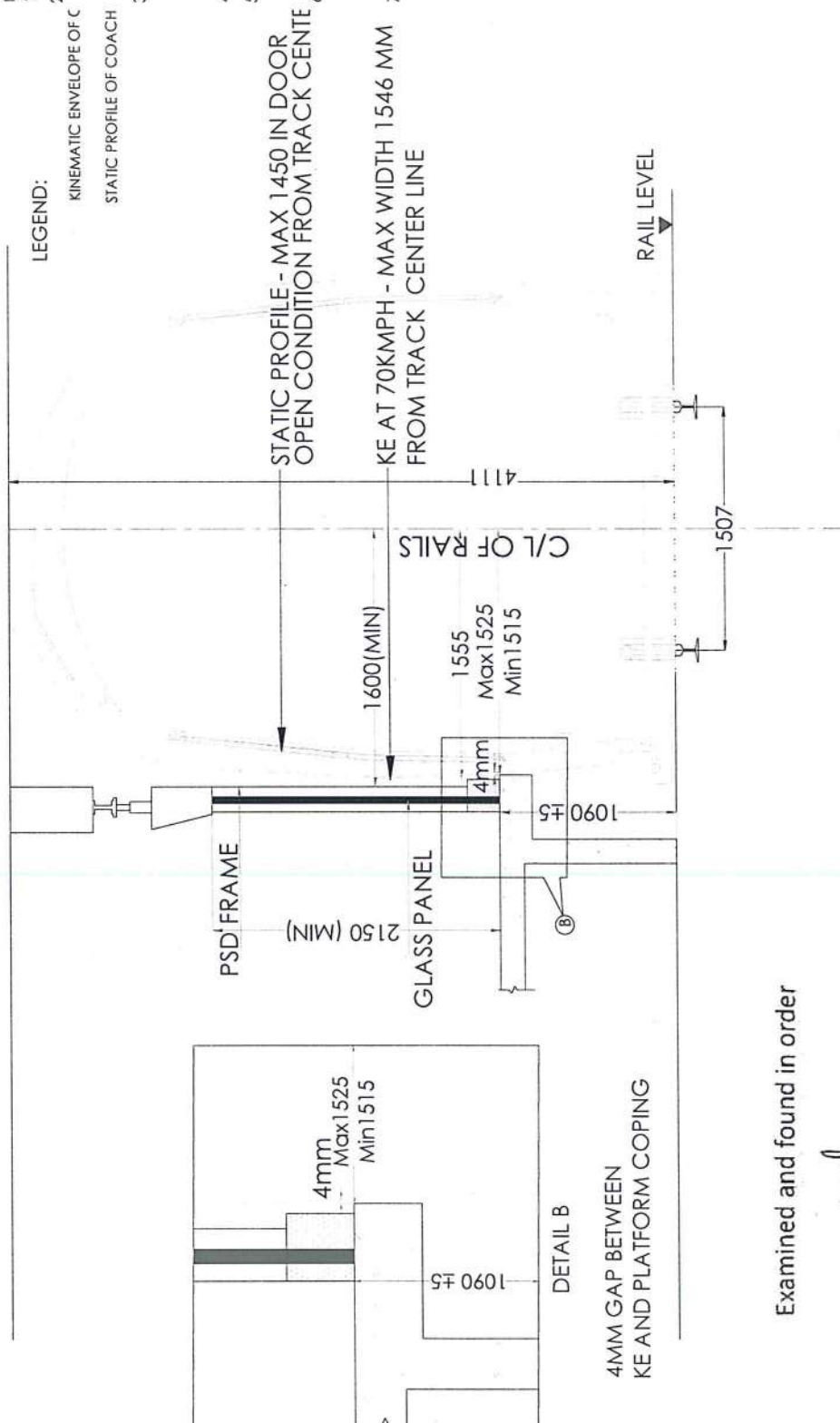
Director/UT/Civil/RDSO

DRAWING NO. : MEGA/GEN/SOD/UND-05	REFERENCE PARA NO.: 2.2.5
Gujarat Metro Rail Corporation (GMRC) Limited	
STANDARD GAUGE (1435) - 750 VOLT D.C. TRACTION	
STRUCTURE GAUGE FOR UNDERGROUND STATION WITH AN ISLAND PLATFORM ON LEVEL/CONSTANT GRADE (TANGENT TRACK) WITH/WITHOUT PLATFORM SCREEN DOOR	

DATE: JANUARY -2024
SCALE: Not to Scale

MARK	DATE	DETAILS OF REVISION

1. ALL DIMENSIONS ARE IN MM.
2. HORIZONTAL AND VERTICAL CLEARANCES 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.
4. COACH SIZE W-2900, H-3980.
5. FOR CURVED PLATFORM, THESE DIMENSIONS TO BE INCREASED IN TERMS OF TABLE
6. DESIGN SPEED OVER PLATFORM LINES SHALL NOT EXCEED 70KM/PH
7. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 0KM/PH.

KINEMATIC ENVELOPE OF C
STATIC PROFILE OF COACH

DETAIL B

4MM GAP BETWEEN
KE AND PLATFORM COPING

Examined and found in order

Director/UT/Civil/RDSO

CONSULTANTS:

JANUARY -2024

Not to Scale

DATE:

SCALE:

[illegible]

Page no : 54

Annexure - 4 to Addendum no. 1

DRAWING NO. : MEGA/GEN/SOU/PSD-I	REFERENCE PARA NO.: 1.5
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SR NO. : MEGA/GEN/SOD/PSD-I	REFERENCE
Gujarat Metro Rail Corporation (GMRC) Limited	

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

STATIC AND KINEMATIC ENVELOPE FOR UNDERGROUND STATIONS WITH PLATFORM SCREEN DOOR



LEGEND:

KINEMATIC ENVELOPE OF COACH

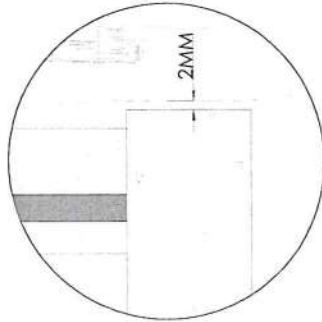
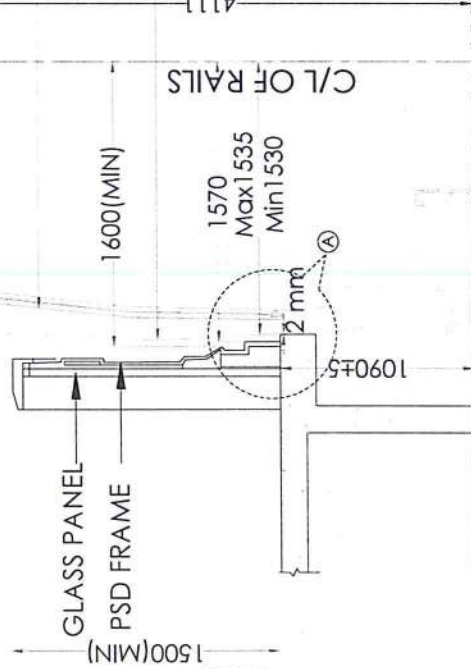
STATIC PROFILE OF COACH

Note:

1. ALL DIMENSIONS ARE IN mm.
2. HORIZONTAL AND VERTICAL CLEARANCES 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.
4. COACH SIZE W-2900, H-3980.
5. DESIGN SPEED OVER PLATFORM LINES SHALL NOT EXCEED 70KMPH
6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 70KMPH.

STATIC PROFILE - MAX 1450 IN DOOR
OPEN CONDITION FROM TRACK CENTER LINE

KE AT 70KMPH - MAX WIDTH 1563MM
FROM TRACK CENTER LINE



DETAIL A

2MM GAP BETWEEN
KE AND PLATFORM COPING

RAIL LEVEL

Examined and found in order

Director/UT/Civil/RDSO

12/4/2024

Annexure - 4 to Addendum no. 1

DRAWING NO.: MEGA/CEN/SOUP/PSD-2

REFERENCE PARA NO.: 1.5

Gujarat Metro Rail Corporation (GMRC) Limited

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

CONSULTANTS:

DATE:

JANUARY -2024

SCALE:

Not to Scale

PLATFORM GATE AT ELEVATED/AT-GRADE (PLATFORM)
ON LEVEL/CONSTANT GRADE (TANGENT TRACK)

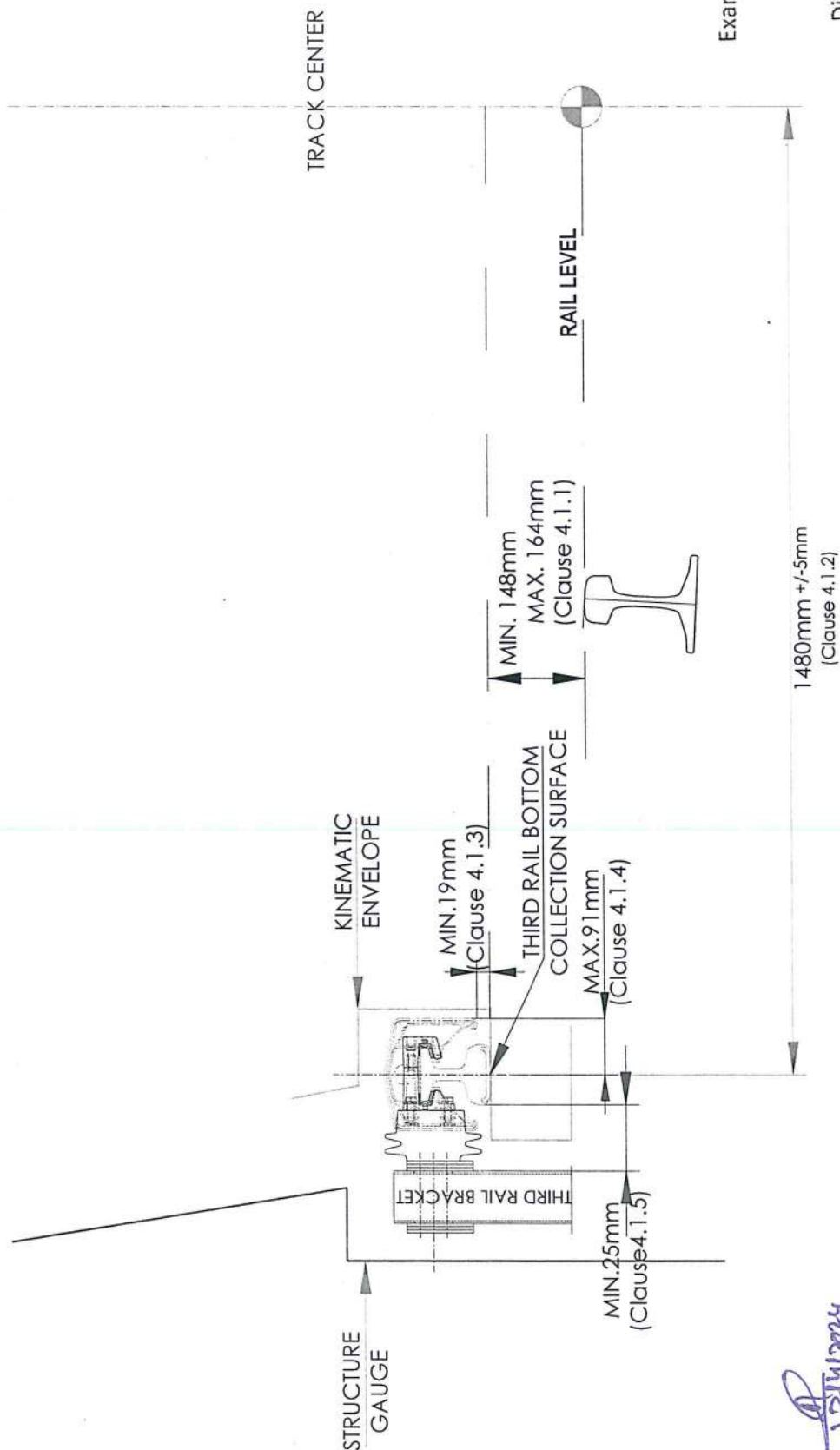
Page no : 55

Note:

1. ALL DIMENSIONS ARE IN MM.
2. HORIZONTAL AND VERTICAL CLEARANCES 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.
4. COACH SIZE W-2900, H-3980.

Examined and found in order

Director/UT/Civil/RDSO



hæ/hæi

100-1020

[illegible]

CONSULTANTS:

DATE: _____

JANUARY -2024

Not to Scale

STRUCTURE GAUGE / KINEMATIC ENVELOPE DETAILS OF THIRD RAIL SYSTEM

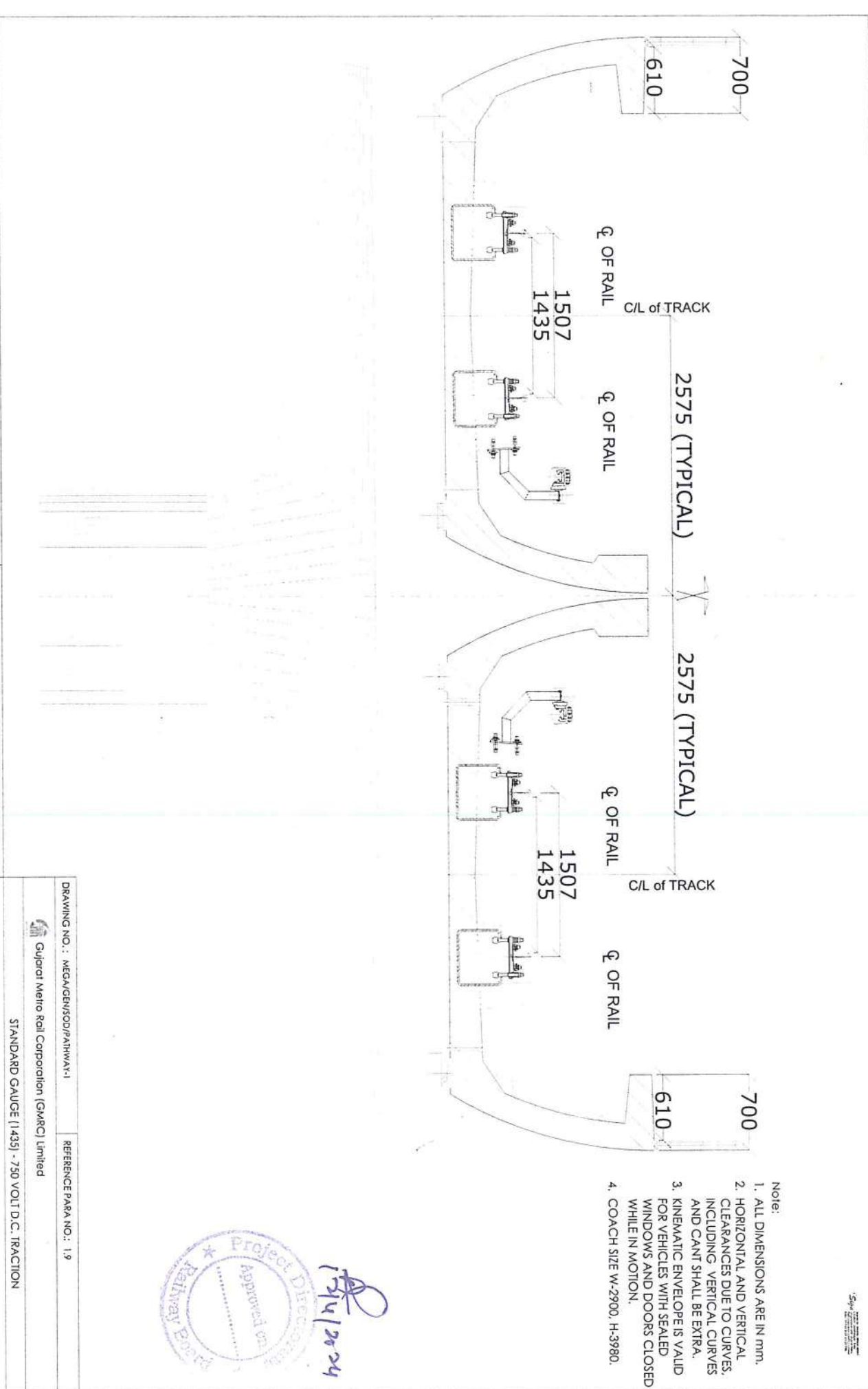
Page no : 56

DRAWING NO.: MEGA/GEN/SOD/PSY-1	REFERENCE PARA NO.: 4.1
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REFERENCE	G NO.: MEGA/GEN/SOD/PSY-1
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STANDARD GAUGE (1435) - 750 VOLT D.C. TRACTION

File No. 2024/196/Genl/Secy/19/16/500/20/15 (Consent No. 1440/15)



- Note:
1. ALL DIMENSIONS ARE IN mm.
 2. HORIZONTAL AND VERTICAL CLEARANCES 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.
 4. COACH SIZE W-2900, H-3980.



CONSULTANTS:		DATE:	
		JANUARY -2024	
DETAILS OF REVISION		SCALE:	
		Not to Scale	
MARK	DATE		

DRAWING NO. : MEGA/GEN/SOD/PAIHWAY-1	REFERENCE PARA NO. : 19
Gujarat Metro Rail Corporation (GMRC) Limited	
STANDARD GAUGE (1435) - 750 VOLT D.C. TRACTION	
W/D, I/P, E&K, Z/P, S/P, H/P, A/K, E/P, K&E, W/P, V/P, D/P, Z/P	