Guidelines for Framing

SCHEDULE
OF
DIMENSIONS

FOR

STANDARD GAUGE (1435mm)
&
BROAD GAUGE (1676 mm)

By
Metro Organisations

OCTOBER – 2021

URBAN TRANSPORTATION & HIGH SPEED DIRECTORATE

RESEARCH DESIGN & STANDARDS ORGANISATION

LUCKNOW-11

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Basic Principles for framing SOD for Metro Organisation.

1. The Kinematic envelope of the proposed rolling stock should be prepared at 10% higher speed than the proposed operating speed.
2. The distance between two kinematic envelopes (up & down trains) should be kept in accordance with type of fastening used which decide the gap between the running rail and the derailment containment guard (derailment guard). In any case it should not be less than 300 mm.
3. The top of derailment guard should not be lower than 25 mm from the running rail top. Derailment guard should be provided 200 m before the face of tunnel and should continue up to 50 m inside the tunnel, similarly while exiting from the tunnel, Derailment guard should start from 50 m before the end of tunnel and continue up to 200 m outside the tunnel.
4. Derailment guards are to be provided on all such locations inside the tunnel which are considered as critical locations (derailment prone or high hazard areas) to safeguard the tunnel lining and the various fixed strictures.
5. Distance between the platform coping stone and an isolated structure should be kept minimum 2500 mm and distance between platform coping stone and continuous structure should be kept minimum 3000 mm (irrespective of provision of platform screen door {PSD} or not). (NFPA guidelines for clear passage for emergency egress.)
6. Distance between the centrelines of two adjacent tracks at platform or outside, other than the depots will be kept considering the item no 2, as stated above.
7. In no condition the kinematic envelope should infringe the structure gauge during operation or after derailment (when the coach wheel touches the derailment guard).
8. The cross wind speed for calculating the K.E should be considered as 100 Kmph on viaduct, 70 Kmph on elevated stations and 42 - 45 Kmph on Underground station. (Reference is to be mentioned.)
9. The platform is to be preferably made on tangent and level track, and the minimum horizontal radius should be kept as 1000 m, and the maximum gradient should be 1 in 1200. (IR SOD revised 2004 with latest amendments.)
10. The Minimum length of any horizontal alignment element (circular curve and straight) between two transition curves should be 20 m. (BS EN 13803:2017)
11. The ruling gradient (compensated) shall be 4%.
12. All the Electrical clearances shall be measured from the Kinematic Envelope.
13. Clearances from power line crossings shall follow IR ACTM with latest amendments / IE-RULEs.
14. The clearance between S&T gear and Kinematic Envelope should always be kept more than 25 mm. (As per the already approved SODs of Metro Rail by Railway Board).
15. The placement of passenger information display boards/Electronic screens/clocks etc. on platform are to be beyond 2000 mm above the Platform surface and 1000 mm horizontally away from coping stone and are to secured with additional fastening (safety loops) to avoid accidental falling and infringing with K.E.

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16. The Train operation will be halted in following conditions:
    a) If the wind speed reaches beyond 90 Kmph on viaduct and at grade sections, 60 Kmph on elevated stations, and 40 Kmph in underground stations.
    b) If any of the train (up or down) derails in a section or at any station.

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PREAMBLE

The Schedule of Dimensions (SOD) has been prepared for the …….. Metro Rail project having Standard Gauge (1435mm)/ Broad Gauge (1676 mm), with OHE/ Third Rail bottom current collection using 750V DC Traction system and end-to-end/Front evacuation.

This SOD has been prepared based on the following guiding factors:

1. The SOD has been developed assuming certain coach dimensions and design characteristics as well as track and coach maintenance tolerance. Whenever, a new stock is introduced the track and coach tolerance for maintenance should be laid down. The suitability of the Rolling Stock for operation with these maintenance tolerances should be established and sanction shall be obtained from the competent authority before the operation of the Rolling Stock.

2. The Kinematic Envelope has been developed for 2900 /3200 mm wide and 4080/4120 mm high rolling stock and the max height of Kinematic Envelope is defined as 4200 mm. (Standards from MoHUA 2013)

3. The clearances are based on the assumption that windows are sealed, and doors are closed during movement/operation of Rolling Stock.

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, platform screen doors/gates, hand railing in back of house of platform edge, track access gates, conductor third rail, its feeding arrangement and its support structure.

6. The vehicle Kinematic Envelope at wind speed of 70 Kmph shall be applied for the platform area on At-Grade, Elevated stations and 42 Kmph* side wind speed for Underground Stations within the confines of stations. At all other location, 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 42 Kmph* side wind speed for underground sections (outside the station area). The Kinematic Envelop has been developed taking into account all Track defects and rolling Stock defects.

   (* 42 Kmph side wind represents 100 Pa gauge pressure considered as buffeting effect.)

7. 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. (Metro operation and Maintenance manual-MoHUA).

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8. Maximum speed is 90 Kmph and operation speed shall be 80 Kmph (Except at stations). Operating speed at station shall be 70 Kmph. Operating speed in depots shall be 25 Kmph. Minimum 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 45Kmph.
   (ii) Weldable CMS crossing (1 in 9) and thick web switch with 190 m radius of lead curve rail shall be 35Kmph.
   (iii) Weldable CMS crossing (1 in 7) and thick web switch with 190 m radius of lead curve rail shall be 25Kmph.
   (iv) Weldable CMS crossing (1 in 7) and thick web switch with 140 m radius of lead curve rail shall be 25Kmph.

   (RB letter no. 2010, dated 23.12.2011).

9. No work/workmen/equipment is allowed between vehicle and Structure gauge during operation of trains.

10. All the Electrical clearance shall be measured from Kinematic Envelope of rolling stock.

11. The train operation will be stopped in affected section by Central Control if any one 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.

12. Note: As per the basic principles of preparation of SOD, the gap between kinematic envelope remains very less of the order of 30 mm only, once any of the train derails.

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This document (Guidelines for framing the SOD for SG/BG by Metro organisations) has been prepared collectively. We have gone through- Preamble, all concerned chapters/paras, appendixes, drawings, and found it in order. If any discrepancy comes to notice later on will be addressed in due course.

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SCHEDULE OF DIMENSIONS

STANDARD GAUGE (1435mm) & BROAD GAUGE (1676 mm)

(For 2900/ 3200mm wide stock)

INTRODUCTION

The dimension given in this Schedule of Dimensions are to be observed in all works on 1435mm, Standard Gauge/ 1676 mm, Broad Gauge, and 2900/3200 mm wide Rolling Stock, 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.

This Schedule of Dimensions is applicable to Under Ground, Elevated and At-Grade sections of ……..Metro which shall be with 25 kV AC Traction system and Over Head current collection/ Third Rail bottom current collection using 750V DC Traction system. The Rolling Stock shall be 2900/3200 mm wide with sealed windows and doors closed while in motion.

The Under Ground system may be with a Circular Tunnel or Rectangular Box or of any other suitable shape while Elevated system may be with suitable Over Ground Structures such as Viaducts. Both, Under Ground and Elevated systems shall have suitably designed Ballastless (DFF) track. For depot, the track may be ballasted/ ballastless.

The schedule of Dimensions (SoD) has been divided into five chapters as under:

Chapter 1 ..... General
Chapter 2..... Station
Chapter 3 ..... Rolling Stock
Chapter 4 ..... Electric Traction
Chapter 5 ..... Platform Gate

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CHAPTER – 1
GENERAL

1.1 SPACING OF TRACKS

1.1.1 Minimum distance, centre to centre of tracks without any structure between tracks for tangent (straight) track for:

(a) Under Ground Sections, it should be greater than : KE+300 mm
(b) Elevated Sections, it should be greater than : KE+300 mm
(c) At-Grade Sections , it should be greater than : KE+300 mm

(Ref: The dimension of 300 mm is based on maximum lateral shift of 270 mm for wheel after derailment)

Note: See Appendix-1 for minimum track centres on curves.

1.2 CURVES

1.2.1 Minimum radius of curves(horizontal)

(a)	On main running lines		
	i) Under Ground Sections	200	m
	ii) Elevated and At-Grade Sections	120	m
(b)	Depot and other non-passenger Lines	100	m
(c)	At passenger platforms	1000	m

1.2.2 Minimum Transition length (horizontal)

(a)	On main running lines		
	i) Under Ground Sections	15	m
	ii) Elevated and At-Grade Sections	15	m
(b)	At passenger platforms	15	m

(Ref: IRPWM, June 2020)

1.2.3 Minimum length of alignment elements (horizontal)

The Minimum length of alignment elements (circular curves and straights) between two transition curves should be 20 m. (BS EN 13803:2017)

1.2.4 Check Rail/Restraining Rail:

(a) Check rail/Restraining Rail shall be provided on curves on main line where radius is 190 m (for SG) / 218 m (for BG) or less. (RB letter no 2010/Proj/Gnl-3/3, dated 23.12.2011). Check rail/Restraining Rail shall not be mandatory for curves in depots, yards and non-passenger lines where speed is less than 25Kmph.

(b) The clearance between check/restraining rail and running rail shall be suitably decided by metro depending upon study of track vehicle interaction.

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Minimum radius of vertical curve: 1500 m

(To keep vertical acceleration in range of 0.3 to 0.45 m/s$^{2)}$

Minimum length of vertical curve: 20 m

1.2.5 Cant and Cant Deficiency (suggested values)

Criteria	SG (1435 mm)		BG (1676 mm)	
Maximum Cant Gradient	1 in 440		1 in 440	
Maximum Cant on curves	110 mm	Angle ≅ 4^o	125 mm	Angle ≅ 4^o
Maximum Cant Deficiency	85 mm		100 mm	
Desirable rate of change of Cant	40 mm/ sec		40 mm/ sec	
Desirable rate of change of Cant deficiency	40 mm/ sec		40 mm/ sec	
Maximum Lateral acceleration	0.55 m/sec^2		0.55 m/sec^2	

Note- If Metro is proposing the above said values more than the suggested values as above, the detailed calculation and the International standards followed for the same is to be submitted along with SOD as ready reference.

1.3 GRADIENTS

1.3.1 The maximum grade (compensated) shall be 4%.

Note- (i) There will be no change of gradient in transition portion of curves.
(ii) The gradient will be compensated for curvature at the rate of 0.04% per degree of curve.

(Ref: Railway Board letter no. 2010/Proj./Bangalore/30/4-Vol.II (Pt.) dated 23.09.2015)

1.4 BUILDINGS AND STRUCTURES

1.4.1 Indicative Minimum horizontal distance from centre of track to any structure for heights above rail level on level / constant grade tangent track shall be as under:

(a) Under Ground Sections

(i) Circular tunnels

S.N.	Height from rail level	Horizontal distance from C.L. of track
(i)	Up to 348 mm	1680 mm
(ii)	At 348 mm	1554 mm
(iii)	348 mm to 679 mm	1554 mm increasing to 1638 mm
(iv)	679 mm to 885 mm	1638 mm increasing to 1676 mm
(v)	885 mm to 2884 mm	1676 mm increasing to 1729 mm

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(vi)	2884 mm to 3320 mm	1729 mm
(vii)	3220 to 4064 mm	1729 mm decreasing to 1170 mm
(viii)	4064 mm to 4246 mm	1170 mm decreasing to 1040 mm
(ix)	4246 mm to 4300 mm	1040 mm decreasing to 833 mm

Also refer to Figure No. 6

(ii) Rectangular Box Tunnels

S.N.	Height from rail level	Horizontal distance from C.L. of track
(i)	Up to 348 mm	1680 mm
(ii)	At 348 mm	1554 mm
(iii)	348 mm to 679 mm	1554 mm increasing to 1638 mm
(iv)	679 mm to 885 mm	1638 mm increasing to 1676 mm
(v)	885 mm to 2884 mm	1676 mm increasing to 1729 mm
(vi)	2884 mm to 3320 mm	1729 mm
(vii)	3220 to 4064 mm	1729 mm decreasing to 1170 mm
(viii)	4064 mm to 4246 mm	1170 mm decreasing to 1040 mm
(ix)	4246 mm to 4300 mm	1040 mm decreasing to 833 mm

Also refer to Figure No. 6

(b) Elevated and At-Grade Sections

S.N.	Height from rail level	Horizontal distance from C.L. of track
(i)	From RL to 348	1730 mm
(ii)	At 348 mm	1730 mm decreasing to 1607 mm
(iii)	348 mm to 666 mm	1607 mm increasing to 1696 mm
(iv)	666 mm to 879 mm	1696 mm increasing to 1736 mm
(v)	879 mm to 2873 mm	1736 mm increasing to 1808 mm
(vi)	2873 mm to 3338 mm	1808 mm
(vii)	3338 mm to 4058 mm	1808 mm decreasing to 1374 mm
(viii)	4058 mm to 4350 mm	1374 mm decreasing to 1366 mm

Also refer to Figure no. 5

Notes for (a) and (b) above:

i) Extra allowance shall be provided for curves as laid down at para 1.7
ii) The term ‘structure’ covers any item including light ones like ladders, isolated posts, cable etc., erected alongside the track.
iii) Minimum lateral clearance for OHE masts for tangent track shall be 2150mm from centre line of nearest track.
iv) For passenger platform refer to para 2.2.1 to 2.2.3 of chapter 2.

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1.5 KINEMATIC ENVELOPE

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

a) Figure No.-1 for At-Grade and Elevated Sections
b) Figure No. -3for Under Ground Sections

1.6 STRUCTURE GAUGE

1.6.1 Under Ground Sections

The Indicative Structure Gauge (Fixed Structure Line) has been arrived at by allowing a minimum clearance of 100 mm to Kinematic Envelope and minimum electrical clearance of 270mm from 25 kV live parts conforming to the stipulation in chapter – 4 of this SOD. (Ref: Approved SOD of DMRC).

Refer to Figure No.-6 for Structure Gauge for Outside station on level or constant grade tangent track.

Note:
Extra allowance shall be provided for curves as laid down at para 1.7.

1.6.2 Elevated Sections

The Structure Gauge (Fixed Structure Line) has been arrived at by allowing minimum clearance of 150 mm to Kinematic Envelope and minimum electrical clearance of 320 mm from 25 kV live parts conforming to the stipulations in chapter – 4 of this SOD. (Ref: Approved SOD of DMRC).
Refer to Figure No -5, for Structure Gauge for outside stations on level or constant grade tangent track.

Note:
Extra allowance shall be provided for curves as laid down at para 1.7

1.6.3 At-Grade Sections

The Structure Gauge (Fixed Structure Line) has been arrived at by allowing minimum clearance of 150 mm to Kinematic Envelope and minimum electrical clearance of 320mm from 25kV live parts, conforming to stipulations in chapter 4 of this SOD. (Ref: Approved SOD of DMRC).
Refer to Figure No. -5 for Structure Gauge for outside stations on level or constant grade tangent track.

Note:
Extra allowance shall be provided for curves as laid down in para 1.7.

1.7 EXTRA CLEARANCE ON CURVES

Following are the extra allowances considered for curves.
Abbreviations used in para 1.7

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C is the distance between centres of bogies in metres
C1 is the coach (Vehicle) length in metres

R is the radius of curve in metres
Ca is the Cant applied in mm
h is the height from rail level in mm and
g is the distance between centres of rails in mm

1.7.1 Inside the Curve

(A) Curvature effect

i) Mid throw at the centre of the vehicle = V (in mm) = $125xC^2/R$
ii) Allowance due to gauge widening on curves

For values of items (i) and (ii) above, refer to Appendix-2A

Note:
Lateral shift of 32.0mm due to nosing is included in Kinematic Envelope for tangent track (and as a result, included in Structure Gauge also) shall be subtracted from the total extra allowance worked out as at para 1.7.1(A)-i and ii above for inside of a curve in case the value of mid throw (V) is equal to or greater than 32.0 mm. In case the value of mid throw (V) is less than 32.0mm, the curvature effect shall be due to widening of the gauge only. (The Mid throw minus 32.0mm shall be taken as zero). Refer to Appendix-2.

(B) Allowance for super elevation

(a) Under Ground (Box Structures), Elevated and At-Grade Sections

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

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

For values of Structure Gauge (E_1) for inside of a curve with cant effect only, (as shown in Figure No. -8) refer to:
(i) Appendix -3 (TNL) for Under Ground Sections
(ii) Appendix-3 for At-Grade and Elevated Sections

(b) Circular Tunnels

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

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The Rigid OCS (if applicable) shall also be rotated with the tunnel so as to be along the centre line of canted track.

For values of horizontal and vertical shifts of centre of Circular Tunnel for different values of cant, refer to Appendix-4 and Figure No. -7.

(C) Allowance for vertical curve (vertical throw)

Vertical throw V_1 and V_2 (in mm) for vertical curve shall be calculated as under:

V_1 (with vertical centre in sag or vehicle end on summit) = 125 x C^2/R

V_2 (with vehicle centre on summit or vehicle end in sag)

= 125 x C_1^2/R)-(125xC^2/R)

Values of vertical throw due to vertical curves of different radii are given in Figure No.-10.

1.7.2 OUTSIDE OF CURVE

(A) Curvature effect

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

= 125 x C_1^2/R)-(125xC^2/R)

ii) Allowance due to gauge widening on curves

iii) Additional nosing due to gauge widening on curves

The values of items (i) and (iii) are shown in Appendix -2B.

(B) Allowance for super elevation

(a) Under Ground (Box Structures), Elevated and At-Grade Sections

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

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

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

Note:

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

Values of Structure Gauge (F_1) on outside of curve with cant effect only (as shown in Figure No. -8), refer to:

i) Appendix 3 (TNL) for Under Ground Sections

ii) Appendix 3 for Elevated and At-Grade Sections

(b) Circular Tunnels

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

The Rigid OCS (if applicable) shall also be rotated with the tunnel so as to be along the centre line of canted track.

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For the values of horizontal and vertical shifts of centre of Circular Tunnel for different values of cant, refer to Appendix-4 and Figure No-7.

(C) Allowance for vertical curve (vertical throw)

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

1.8 MINIMUM TRACK SPACING ON CURVES

Under Ground, Elevated and At-Grade Sections

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

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**),
b) $\mathbf{T_1}$(Extra lateral clearance due to curvature on inside of curve),
c) $\mathbf{T_2}$(Extra lateral clearance due to curvature on outside of curve),
d) Minimum clearance between adjacent Kinematic Envelope stipulated is as under:
   i) 300 mm for Under-Ground Sections
   ii) 300 mm for Elevated and At-Grade Sections.

Where,

'**E**' is the 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 (Figure No. -9) and,

'**F**' is the 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 (Figure No.-9).

Notes:

i) The value of '**F'**, calculated from the formula at Figure No.-9 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**, $\mathbf{T_1}$and $\mathbf{T_2}$, refer to the Appendices as shown below:

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	SECTIONS	For E & F	For T_1&T_2
i)	Under Ground	3A (TNL)	2A & 2B
ii)	Elevated and At-Grade	3A	2A & 2B

1.8.1 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) (E_1+T_1) Minimum clearance to the structure from center line of track on inside of curve (for outer track),
b) (F_1+T_2) 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,

E_1 is the horizontal distance from vertical axis of center line of track to canted Structure Gauge on inside of curve for a given cant (Figure No.-8),

$F_1$is the horizontal distance from vertical axis of center line of track to canted Structure Gauge on outside of curve for a given cant (Figure No.-8),

T_1 is extra lateral clearance due to curvature on inside of curve and **T_2** is extra lateral clearance due to curvature on outside of curve

Notes:

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

(ii) Minimum track spacing, so worked out with a structure between the adjacenttracksshallnotbelessthanthatcalculatedasperpara1.8.1 for tracks without any structure between adjacent tracks.

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

	SECTIONS	**For E_1& F_1**	**For T_1& T_2**
i)	Under Ground	3 (TNL)	2A & 2B
ii)	Elevated and At-Grade	3	2A & 2B

1.9 WALKWAYS:

(a)	Minimum unobstructed clear width of walkway	610 mm (NFPA-130)
(b)	Minimum height of walkway	1000 mm
(c)	Maximum height of Walkway	1200 mm

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Notes: Extra allowance shall be provided for curves, as laid down at para 1.7

(i) Maximum and minimum heights of walkway on curves are above inner rail.

(ii) No structure other than signaling and minor signaling telecom equipment post, shall be permitted within the minimum width of walkway.

(iii) Minimum clearance to walkway at the nearest edge from kinetic envelope shall be of 100 mm for underground section.

(iv) Walkway should be used by Metro inspection groups only in non-operation period.

1.10 DERAILMENT GUARD

(a) Derailment Guard should be provided on inside/outside of running rail on viaduct as well as in tunnel and at grade section at locations specified by the Metro Railway. In tunnel, 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:
(RB letter no 2010/Proj/Gnl-3/3, dated 23.12.2011).

1. Entry of tunnel 200 m from tunnel portal outside the tunnel to 50 m inside the tunnel.

2. Exit of tunnel 50 m from inside of tunnel portal to 200 m outside of tunnel

3. In curved track having radius 500m or less including transition portion but excluding location where check rail is provided.

4. Location of all-important installations e.g. Location of any substation or hazardous structure inside the tunnel, etc. damage to which in the assessment of the metro rail administration can result into serious loss of life or / and infrastructure as a result of relevant in tunnel.

The above is subject to the condition that metro railway shall carry out of the risk assessment analysis for derailment in the tunnel and ensure that the maintenance practices in the maintenance manual as per the risk assessment mitigation plan. (Submit sample of Risk analysis).

(b) Lateral Clearance between the running rail and the derailment Guard should be 210 ± 30 mm. It shall not be lower than 25 mm below the top of running rail and should be clear of the rail fastenings to permit installation, replacement and maintenance. (RB letter no 2010/Proj/Gnl-3/3, dated 23.12.2011).

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Note:

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

derailed vehicle are within the main rail and derailment guard and also the KE of derailed rolling stock shall not have any infringement with the structure gauge.

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CHAPTER-2

STATION

2.1 SPACING OF TRACKS AT STATIONS

Minimum spacing of tracks at station on straight and on curve of radius of 1000m and flatter, without any structure between tracks At-Grade, Elevated and Under-Ground Stations (more than mentioned in para 1.1) ……..mm.

2.2 PLATFORMS

2.2.1 Horizontal distance from Centre of track to face of passenger platform coping shall be provided as such: 5 mm clear gap left to KE of Rolling stock at Platform, subject to maximum gap between stationary car body and platform should not exceed 75 mm.

Condition	Value
For Elevated, At Grade section, Underground section	Minimum value: …. mm Maximum value: …. mm

Notes:

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

Condition	2900 mm	3200 mm
Elevated, At Grade section,	1590±5	1795±5
Underground section	1575±5	1785±5

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

2.2.2 Height above rail level for passenger platform:

	Maximum	**Minimum**
(a) At-Grade ……	1085 mm	1075 mm
(b) Elevated/Under Ground ……	1095 mm	1085 mm

2.2.3

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

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(Metro to submit design calculation for PF width for evacuating the passengers in case of emergency, considering peak flow & design life of structure in compliance to NFPA guidelines as Annexure.)

Notes:

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 continuous structure.

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.-11 and Figure No.-13 for Elevated/at grade station and Figure no.-12 and Figure No.-14 for underground station. 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.

2.2.4 For Structure Gauge at station platform, refer to following figures:

a) For under Ground Station Figure No. -12 & 14

b) For At-Grade and Elevated Stations Figure No. -11 & 13

2.3 TRACK GRADIENT

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2.3.1 TRACK GRADIENTS IN PLATFORM

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

Note: 1.There shall be no change of grade within station platform track.
2. Any gradient steeper than 1 in 1200 and up to 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.

2.3.2 GRADIENT ON TURNOUTS

Maximum permissible gradient on turnouts

On Ballasted Track	0.25%
On Ballastless Track	3.00%

(RB letter no.2011.Proj./MoU/31/1 Vol.I dated 21.04.2017)

Notes:

(i) There shall be no change of gradient (i.e. vertical curve) on and within 15.0 m (desirable)/3.0m (minimum) length from 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.

(ii) There shall be no horizontal curve within 15.0 m length (desirable)/3.0m (minimum) from any turnout on Ballastless track and 30 meters from any turnout on Ballasted Track.

(iii) 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 190 m. The negotiability of rolling stock on such turnout 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 15m 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 ensured by metro that the Rolling Stock is fit to negotiate these gradients.

(vi) The above stipulations shall also be applicable for turnout to be laid outside station limit, if any.

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2.4 INTERLOCKING AND SIGNAL GEAR

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

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(a) <u>For Under Ground Stations</u>

- From CL of track to 1450mm — 25mm
- From 1450mm to 1585mm — 25mm rising to 65 mm
- From 1585mm to 1720mm — 65mm rising to 200mm

(b) <u>For Surface and Elevated Stations</u>

- From CL of track to 1450mm — 25mm
- From 1450mm to 1585mm — 25mm rising to 65 mm
- From 1585mm to 1745mm — 65mm rising to 200mm

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

(*Guiding principal: The above values are indicative only and may be adjusted based on the Parameters of "Structure Gauge" and "Kinematic Envelope". It shall be ensured that the permissible limit for S&T gears shall have minimum clearance of 25 mm from the corresponding limit of Kinematic Envelope, so that there shall not be any possibility for damage of S&T gears from running train considering wear & tear of wheels and other scenarios).*

2.5 Points and Crossings:

Para	Description	SG (1435mm)	BG (1676mm)
2.5.1	Maximum clearance of check rail opposite nose of crossing	44 mm	48 mm
2.5.2	Minimum clearance of check rail opposite nose of crossings	41 mm	44 mm
2.5.3	Minimum clearance between switch rail and stock rail at heel of Switch Rail	52 mm	52 mm
2.5.4	Maximum clearance of wing rail at nose of crossing	44 mm	48 mm
2.5.5	Minimum clearance of wing rail at nose of crossings	41 mm	44 mm
2.5.6	Minimum clearance between toe of open switch and stock rail (depend upon type of point machine)	160 mm	160 mm
2.5.7	Minimum radius of curvatures for slip points, turnouts and crossover	190 m	218 m

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2.5.8. On main lines, the turnouts and diamond crossings shall be of the following types or flatter:-

For SG:

a) 1 in 9 type turnout 300 m radius
b) 1 in 7 type turnout 190 m radius
c) Scissors cross-over of 1 in 9 type consisting of 4 turnouts and 1 diamond crossing
d) Scissors cross-over of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing

For BG:

a) 1 in 16 type turnout 785 m radius
b) 1 in 12 type turnout 410 m radius
c) 1 in 8.5 type turnout 218 m radius
d) Scissors cross-over of 1 in 8.5 type consisting of 4 turnouts and 1 diamond crossing

2.5.9 On depot lines, the turnouts and diamond crossings shall be of the following types or flatter:

For SG:

a) 1 in 7 type turnout 190 m radius
b) Scissors cross-over of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing
c) 1 in 7 derailing switches / 1 in 7 type symmetrical split turnout

For BG:

a) 1 in 8.5 type turnout 218 m radius
b) Scissors cross-over of 1 in 8.5 type consisting of 4 turnouts and 1 diamond crossing
c) 1 in 8.5 derailing switches / 1 in 8.5 type symmetrical split turnout

2.5.10 Diamond crossings not to be flatter than 1 in 4.5

Note:

a) The above restrictions shall not apply to moveable diamond crossings.
b) There must be no change of superelevation (of outer rail over inner rail) between points 18 metres outside toe of switch rail and nose of crossings respectively, except in the case of special crossing leading to snag dead – ends or under circumstances as provided for in item 2.6 below.

2.5.11 Minimum length of tongue rail: 9000 mm for SG, & as per RDSO approved drawings for BG.

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2.6 Superelevation and speed at stations on curves with turnouts of contrary and similar flexure.

2.6.1 Main Line:

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

2.6.2 Turnouts:

i) Curves of contrary flexure

The equilibrium super elevation (s) in mm should be = $(G/127)(V^2/R)$
Where G = Dynamic gauge in mm, R = radius of turnout in metres and V is speed on turnout in kmph.
The permissible negative super elevation on the turnout (which is also the actual super elevation of the main line) may then be = (Cant deficiency-s) mm.

ii) Curves of Similar Flexure

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

2.7 ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES

The additional clearance for platforms on curves is to be provided as shown at appendix-5

Note:

i) As the minimum radius of horizontal curve for station platform line is 1000 metres, there will be no super elevation and gauge widening at stations on passenger platform lines.

ii) 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 3 – Rolling Stock

3.1 Passenger Rolling Stock (All the values are indicative in nature. Metro is free to select its own combination)

Note: all dimensions are in mm

S. No.	Description	Specified Value
1.	Gauge	1676/1435 (BG/SG)
2.	**a)** Maximum Length of the coach body (including end fairings)	19314 to 23000
	b) Maximum length of coach over couplers	19980 to 23708
	c) Maximum Width of the Coach Body	2900 / 3200
	d) Height of the coach body (maximum with pantograph in locked down condition)	3848 to 4200
3.	**a)** Distance between bogie centres*	12600 to 15500
	b) Maximum distance apart between any two adjacent axles*	12500 to 12900
	c) Length of rigid wheel base for single bogie*	2200 to 2600
Note: * The above dimensions a), b), c) should commensurate to each other as per the design selected by Metro considering the maneuverability of the coach and the entire train on sharper curves and maximum gradient to avoid any infringement to the structure gauge.		
4.	Kinematic Envelope for level tangent track (indicative)	**Please mention figure no.**
	a) For underground Sections	Please refer the relevant drawing as given in the annexure related to drawings separately for OHE and third rail arrangement
	b) For underground Sections at Platforms	
	c) For At-Grade and Elevated Sections	
	d) For At-Grade and Elevated Sections at Platforms	
	e) Same Pantograph shall be used for underground and Elevated corridors	
5.	**a)** Minimum clearance from rail level under fully loaded condition for bogie mounted equipment in worst condition***** (*****_The worst condition means wheels with maximum tread wear and primary springs with maximum deflection_) in static condition.	75
	b) Minimum clearance from rail level under fully loaded condition for body mounted equipment in worst condition***** (*****_The worst condition means deflated secondary air spring, wheels with maximum tread_	102

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	wear and primary springs with maximum deflection) in static condition.	
	c) Minimum clearance from rail level, under dynamic condition of fully loaded vehicle, with maximum tread wear and primary springs with maximum deflection, with the exception of wheels & attachments there to (vide note below #). **Note:** *# A tyre or an attachment to a wheel or sand pipes or wheel / Track Lubrication Nozzle in line with the wheel may project below the minimum height of 50mm from a distance of 51mm inside to 216mm outside of the gauge face of wheel.*	50
6.	**a)** Wheel Profile.	UIC 510-2/EN 13715 / 15313 / SK-91146 (or any other profile accepted internationally)
	b) Incline of Tread.	1:20/1:40 (to be selected as per wheel profile)
7.	**Wheel** **a)** Maximum wheel gauge back-to-back distance	1360
	b) Minimum wheel gauge back-to-back distance	1358
8.	**a)** Maximum wheel diameter on the tread measured at **ref. point (as per profile)** from wheel gauge face.	860
	b) Minimum wheel diameter on the tread measured at **ref. point (as per profile)** from wheel gauge face.	780
9.	**a)** Maximum projection for flange of new wheel measured from tread at **ref. point (as per profile)** from the wheel gauge face.	As per any profile accepted internationally and selected by Metro
	b) Minimum projection for flange of new wheel measured from tread at **ref. point (as per profile)** from the wheel gauge face.	As per any profile accepted internationally and selected by Metro
10.	**a)** Maximum thickness of flange of wheel measured from wheel gauge face at **ref. point (as per profile)** from outer edge of flange.	As per any profile accepted internationally and selected by Metro
	b) Minimum thickness of flange of wheel measured from wheel gauge face at **ref. point (as per profile)** from outer edge of flange.	As per any profile accepted internationally and

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		selected by Metro
11.	Minimum width of Wheel as per respective wheel profile	As per any profile accepted internationally and selected by Metro
12.	**a)** Maximum height above rail level for floor of any unloaded vehicle	1130 to 1140
	b) Minimum height above rail level for floor of fully loaded normal vehicle	1087 to 1100
13.	**a)** Maximum height of centre coupler above rail level for unloaded vehicle	735 to 815
	b) Minimum height of centre coupler above rail level for fully loaded vehicle	685 to 740

3.2 LOCOMOTIVE AND ENGINEERING SERVICE VEHICLES

Other items of Rolling Stock viz. shunting locomotives, OHE maintenance and inspection cars, emergency re-railing van, track machines etc., used on (mention name of the Metro) Metro System (where these cars should be plying) will confirm with the kinematic envelope of the Passenger Electric Multiple Units as detailed in the annexure of KE drawings.

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CHAPTER-4

TRACTION

A) OVERHEAD ELECTRIC TRACTION 25 KV/AC 50 CYCLES PER SECOND

Note:

i) Electrical Clearances are compiled as per Table 2 of Electrical Clearances under 'Para 5.1.3 – Clearances between live parts of contact lines and earth' of BS EN 50119:2009. However, These Electrical clearances are minimum and may be increased depending on various parameters e.g. Absolute humidity, the Ambient Temperature range, Air Pressure, Pollution, Relative Air Density, Shape and material for both energised and earth Structures. Metro may consider each case individually as suggested in BS EN 50119:2009.

ii) Wherever electric traction is in use, special precautions must be taken to maintain following clearances:

4.1 Electrical Clearances for under ground

Minimum height from rail level to the underside of the Wearing Copper / Metal Conductor of Rigid OCS (Overhead Contact System) in Tunnel would be (Load gauge of Rolling Stock + required static Electrical Clearance in Tunnel) - 4318 mm.

Note:

(a) Location of level crossing from the exit point of the tunnel will take into consideration the OHE height of 4318 mm at the tunnel exit and the permissible contact wire gradient.

(b) In the Depot deck portion, where Rigid OCS is provided and the track is Ballastless, the Electrical clearances laid down at paras 4.1.1 to 4.1.4 shall be applicable.

(c) For location of rigid OCS in circular tunnel with canted track, refer to para 1.7.1(B)-b and 1.7.2(B)-b.

(d) It shall be ensured that environment level inside the tunnel is controlled suitably so that no extra air clearance, over and above the minimum separation prescribed in para 4.1.3 and 4.1.4 on account of pollution, fog etc. is required.

4.1.1 Stagger of Rigid OCS Conductor in Tunnels shall not be more than (IRS Code)

(a) On Straight ……± 200 mm (from IR SOD)

(b) On Curves ……..± 300 mm (from IR SOD)

Note: If the span increases or decreases accordingly the stagger shall be calculated considering the above as Span Length is based on width of the Current Collecting Carbon Surface of pantograph.

4.1.2 Prescribed minimum clearance between live parts of contract lines and bodies of structures.

Air clearance between bodies of structures and live un-insulated parts of contact lines, feeders and current collectors for 25 KV shall be as per IEC 60913 as under:

	Condition	Minimum clearance between live parts and structures	Absolute minimum dynamic clearance between live parts and structure
a)	Long duration (Static)	270 mm	-
b)	Short Duration (Dynamic)	170 mm	150 mm*

*in exceptional cases and considering operating in climatic conditions (Ref: IEC 60913)

4.1.3 Prescribed minimum clearance between live parts of contract lines and bodies of vehicles

	Condition	Clearance (mm)
a)	Long duration (Static)	290 mm
b)	Short Duration (Dynamic)	190 mm

4.1.4 Maximum width of pantograph – under dynamic condition: (indicative)

The Kinematic Envelope for the underground system with Ballast less track is shown in Figure No.-3. The pantograph adopted should be such that its actual half KE width does not exceed 820 mm and 980 mm at the top and bottom respectively in pantograph raised condition for a contract wire height of 4318 mm to fulfill electrical clearances as per item 4.1.3.

4.2 ELECTRICAL CLEARANCES FOR AT-GRADE AND ELEVATED SECTIONS

4.2.1 Minimum vertical distance between any live bare conductor (overhead equipment or pantograph) and any earthed structure or other bodies (rolling stock, over bridges, signal gantries etc.)

	Condition	For Flexible OHE
a)	Long duration (Static)	320 mm
b)	Short Duration (Dynamic)	270 mm

Note: A minimum vertical distance of 340 mm shall normally be provided between rolling stock and contact wire to allow for a 20 mm temporary raising of the tracks during maintenance. Wherever the allowance required for track maintenance

exceeds 20 mm, the vertical distance between rolling stock and contact wire shall correspondingly be increased.

4.2.2 Minimum lateral distance between bare live conductor (over head equipment or pantograph) or any earthed structure or other bodies (rolling stock, over bridges, signal gantries etc.)

	Condition	For Flexible OHE
a)	Long duration (Static)	320 mm
b)	Short Duration (Dynamic)	270 mm

4.2.3 Height of contact wire: (indicative)

Minimum height from rail level to the underside of live Conductor wire.

a)	Under bridges, in tunnels and in ramp area (Load gauge of Rolling Stock + required static Electrical Clearance in open area)	4388 mm
b)	In the open	5000 mm
c)	At level crossings	5500 mm
d)	In running and carriage sheds wherever staff are expected To work on the roof of rolling stock	5200 mm

(Ref: RITES Design Manual Voll.-04)

Note: On curves, all vertical distances specified in items 4.2.3 above, shall be measured above level of the inner rail, increased by half the super elevation.

4.2.4 Maximum variation of the live conductor wire on either side of the centre line of the track under static conditions:

i) On straight …… ±200 mm
ii) On curves …… ±300 mm

Note: These limits would not apply to special locations like insulated overlaps and out of run wires.

4.2.5 Maximum width of pantograph collector:

The Kinematic Envelope with the size of Pantograph adopted shall be within the Kinematic Envelope shown at Figure No -1.

B). Electric Traction: 750 V DC, Third Rail With Bottom Current Collection

4.1	**750 V DC, Third Rail With Bottom Current Collection**		
4.1.1	**(a)**	Minimum height from rail level to current collecting Surface of the conductor rail.	As per design aspects of Metro Rail Systems
	(b)	Maximum height from rail level to current collecting Surface of the conductor rail including fully worn-out condition	
4.1.2	**(a)**	Minimum distance between center line of the conductor rail from the track center	As per design aspects of Metro Rail Systems
	(b)	Maximum distance between center line of the conductor rail from the track center	
4.1.3	Minimum clearance between the shroud and the conductor rail.		As per design aspects of Metro Rail Systems
4.1.4	Maximum distance between the center line of the conductor Rail and the outer edge of the shroud structure.		As per design aspects of Metro Rail Systems
4.1.5	**(a)**	Minimum clearance between live parts of third rail and the earthed Structures 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
4.1.6	Any other allowances for Erection/maintenance		

Note: General arrangement drawing for 'Third Rail Current Collection arrangement' indicating all the clearances mentioned in Chapter-4 (B) need to be attached for reference as shown in Fig No.-18

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ANUBHAV AGRAWAL
DIRECTOR
ELECTRICAL

CHAPTER- 5

PLATFORM SCREEN DOOR (PSD)

(As per MoHUA guidelines issued in 2013, planning of Metro system with PSD is mandatory.)

5.1 Setting out Dimensions

S.N.	Particular	**2900 mm wide RS**	**3200 mm wide RS**
i.	Minimum Platform Screen Door Width (clear opening)	**2000 mm**	
ii.	Minimum Platform Screen Door Height from PF level (Full hight)	**2150 mm**	
iii.	Minimum Platform Screen Gate Height from PF level (Half hight)	**1500 mm**	
iv.	Minimum Platform Screen Door threshold offset from track centerline – straight track (Underground)	**1545 mm**	**1685 mm**
v.	Minimum Platform Screen Door panel offset from track centerline – straight track (underground)	1570 mm	1710 mm
vi.	Minimum Platform Screen Door threshold offset from track centerline – straight track (Elevated/At Grade)	1555 mm	1695 mm
vii.	Minimum Platform screen door panel offset from Track – centre line – straight track (Elevated/At-Grade)	**1580 mm**	**1720 mm**
viii.	The minimum size of object which can be sensed for retraction of doors (the dimensions given are only indicative, Metro may adopt more sensitive screen door which can sense lesser size as indicated).	15-30 mm (thickness) x 100 mm (length)	

Note:

(a) Above values are indicative only. Metro may adopt offset values according to design of Platform Screen Door.

(b) Stopping Accuracy of Metro Train is (+/-) 300 mm or less.

(c) For curved platforms, additional clearance as per appendix-5 to be considered.

(d) Platform Gates are considered as designated railway operational structure. Therefore, platform gates may infringe the structure gauge, but does not infringe the kinematic envelope of train in station.

(e) The deflector (if provided) attached to the bottom of the sliding door shall be designed in order not to protrude beyond the door threshold.

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APPENDIX-1

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

PERMISSIBLE SPEED, CANT AND MINIMUM TRACK SPACING ON CURVES UNDERGROUND (TUNNELS), ELEVATED AND AT- GRADE SECTIONS

(REFERENCE: PARA 1.1)

RADIUS OF CURVE	CANT	MAXIMUM PERMISSIBLE SPEED	MINIMUM DISTANCE BETWEEN ADJACENT TRACKS	
			BALLASTLESS	
			UNDERGROUND	ELEVATED & AT- GRADE
metres	mm	kmph	mm	Mm
≥ 3000	10	80	3700	3700
2800	15	80	3700	3700
2400	15	80	3700	3700
2000	20	80	3700	3700
1600	25	80	3700	3700
1500	25	80	3700	3700
1400	30	80	3700	3700
1200	35	80	3700	3700
1000	40	80	3700	3700
800	50	80	3700	3700
600	65	80	3700	3750
500	75	80	3700	3750
450	90	80	3750	3800
400	110	80	3750	3800
350	110	75	3750	3800
300	110	70	3800	3850
200	110	55	3900	3950
190	110	55	NA	4000
150	110	50	NA	4050
120	110	45	NA	4150

Notes:

(a) 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.

(b) Tack spacing shown in the table above is not applicable to stations which should be calculated depending on specific requirement but the spacing should not be less than the spacing stipulated in para 2.1.

(c) For in between radius, sharper radius is to be adopted to arrive in required track spacing.

(d) Cant provided is limited to desirable value of 110 mm.

(e) Maximum cant deficiency is 85 mm.

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APPENDIX-2A

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

EXTRA HORIZONTAL
ALLOWANCE ON CURVES
(CURVATURE EFFECT)
INSIDE OF CURVE

REFERENCE: PARA 1.7.1

RADIUS	MID THROW (28500/R)	NOSING INCLUDED IN K.E./STRUCTURE GAUGE FOR TANGENT TRACK	EXTRA GAUGE WIDENING ON CURVES	EXTRA HORIZONTAL SHIFT ON CURVE	REMARKS
(metres)	(mm)	(mm)	(mm)	(mm)	
(R)	(V)	(N)	(G)	(T1)	
120	237.5	28	9	218	(G) EXTRA GUAGE TOLERANCE ON CURVES SHARPER THAN 1000 M RADIUS: 9 mm FOR CURVES WITH RADIUS SHARPER THAN 500 M RADIUSAND 5 mm FOR CURVES OF WITH RADIUS OF 500 M TO LESS THAN 1000M **T1 = V-N+G FOR V EQUAL TO OR GREATER THAN (N) AND T1 = G FOR V < (N)** Mohammad Faiz Ansari Digitally signed by Mohammad Faiz Ansari Date: 2021.10.30 14:30:00 +05'30'
150	190.0	28	9	171	
175	162.9	28	9	144	
190	150.0	28	9	131	
200	142.5	28	9	123	
250	114.0	28	9	95	
300	95.0	28	9	76	
350	81.4	28	9	62	
400	71.3	28	9	52	
450	63.3	28	9	44	
500	57.0	28	5	34	
550	51.8	28	5	29	
600	47.5	28	5	24	
650	43.8	28	5	21	
700	40.7	28	5	18	
750	38.0	28	5	15	
800	35.6	28	5	13	
850	33.5	28	5	10	
900	31.7	28	5	9	
950	30.0	28	5	7	
1000	28.5	28	0	0	
1100	25.9	28	0	0	
1200	23.8	28	0	0	
1300	21.9	28	0	0	
1400	20.4	28	0	0	
1500	19.0	28	0	0	
1600	17.8	28	0	0	

1700	16.8	28	0	0	
1800	15.8	28	0	0	
1900	15.0	28	0	0	
2000	14.3	28	0	0	
2200	13.0	28	0	0	
2400	11.9	28	0	0	
2600	11.0	28	0	0	
2800	10.2	28	0	0	
more	9.5	28	0	0	

Mid throw (in mm) V = (125 x C^2)/R = 28500/R
Where 'C' is the distance between bogie centres = 14.850+0.250 = 15.100 m OR 14.850-0.250 = 14.600 m
The worst case will be with C = 15.100 m
'R' is the radius of curve in metres

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APPENDIX 2B

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

EXTRA HORIZONTAL ALLOWANCE ON CURVES (CURVATURE EFFECT)

OUTSIDE OF CURVE

REFERENCE: PARA 1.7.2

RADIUS	END THROW (33910/R)	EXTRA GAUGE WIDENING ON CURVES	EXTRA NOSING DUE TO EXTRA GUAGE TOLERANCE	EXTRA HORIZONTAL SHIFT ON CURVE	REMARKS
(metres)	(mm)	(mm)	(mm)	(mm)	
(R)	(V0)	(G)	(EN)	(T2)	
120	282.6	9	2.3	294	(G) EXTRA GUAGE TOLERANCE ON CURVES SHARPER THAN 1000 M RADIUS: 9 mm FOR CURVES WITH RADIUS SHARPER THAN 500 M RADIUS AND 5 mm FOR CURVES OF WITH RADIUS OF 500 M TO LESS THAN 1000M **T2= V0+G+EN** **EN=G x 0.251986301** Mohammad Faiz Ansari Digitally signed by Mohammad Faiz Ansari Date: 2021.10.30 14:31:11 +05'30'
150	226.1	9	2.3	237	
175	193.8	9	2.3	205	
190	178.5	9	2.3	190	
200	169.6	9	2.3	181	
250	135.6	9	2.3	147	
300	113.0	9	2.3	124	
350	96.9	9	2.3	108	
400	84.8	9	2.3	96	
450	75.4	9	2.3	87	
500	67.8	5	1.3	74	
550	61.7	5	1.3	68	
600	56.5	5	1.3	63	
650	52.2	5	1.3	58	
700	48.4	5	1.3	55	
750	45.2	5	1.3	51	
800	42.4	5	1.3	49	
850	39.9	5	1.3	46	
900	37.7	5	1.3	44	
950	35.7	5	1.3	42	
1000	33.9	0	0.0	34	
1100	30.8	0	0.0	31	
1200	28.3	0	0.0	28	
1300	26.1	0	0.0	26	
1400	24.2	0	0.0	24	
1500	22.6	0	0.0	23	
1600	21.2	0	0.0	21	
1700	19.9	0	0.0	20	
1800	18.8	0	0.0	19	

1900	17.8	0	0.0	18	
2000	17.0	0	0.0	17	
2200	15.4	0	0.0	15	
2400	14.1	0	0.0	14	
2600	13.0	0	0.0	13	
2800	12.1	0	0.0	12	
3000 or more	11.3	0	0.0	11	

End throw (in mm) V = (125 x $C1^2$)/R - (125 x C^2)/R = 33910/R
Where 'C' is the distance between bogie centres = 14.850+0.250 = 15.100 m OR 14.850-0.250 = 14.600 m
The worst case will be with C = 14.6000 m
'C1' is the length of coach in metres = 22.010 m and R is the radius of curve in metres

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APPENDIX-3

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

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

ALL FIGURES ARE IN (mm)

Height above rail level measured perpedicular to plane of track					h= 348				h= 879				h= 2873				h= 3338				h= 4058				h= 4350			
Distance from centre line of track to Structure Gauge for tangent track					ab= 1730				ab= 1736				ab= 1808				ab= 1808				ab= 1374				ab= 1366			
Cant	Angle α	sin α	cos α	tan α	E1	F1	H1	H2	E1	F1	H1	H2	E1	F1	H1	H2	E1	F1	H1	H2	E1	F1	H1	H2	E1	F1	H1	H2
110	4.178	0.073	0.997	0.073	1751	1700	528	276	1795	1667	1058	805	2012	1594	3052	2789	2046	1560	3516	3252	1666	1075	4202	4002	1679	1045	4493	4294
105	3.987	0.070	0.998	0.070	1750	1702	520	279	1793	1671	1050	809	2003	1604	3044	2793	2036	1572	3508	3257	1653	1088	4196	4005	1665	1060	4487	4297
100	3.797	0.066	0.998	0.066	1749	1703	512	283	1790	1674	1042	812	1994	1614	3036	2797	2025	1583	3500	3261	1640	1102	4190	4008	1651	1075	4481	4300
95	3.607	0.063	0.998	0.063	1748	1705	504	286	1788	1677	1034	816	1985	1624	3029	2801	2014	1594	3493	3265	1627	1116	4184	4011	1637	1090	4475	4303
90	3.417	0.060	0.998	0.060	1748	1706	495	289	1785	1681	1026	819	1976	1634	3021	2805	2004	1606	3485	3269	1613	1130	4178	4014	1623	1104	4469	4306
85	3.227	0.056	0.998	0.056	1747	1708	487	293	1783	1684	1018	822	1967	1643	3013	2809	1993	1617	3477	3273	1600	1143	4171	4017	1609	1119	4462	4309
80	3.037	0.053	0.999	0.053	1746	1709	479	296	1780	1687	1010	826	1958	1653	3005	2813	1982	1629	3469	3278	1587	1157	4165	4020	1595	1134	4456	4312
75	2.847	0.050	0.999	0.050	1745	1711	471	299	1778	1690	1002	829	1948	1663	2997	2817	1972	1640	3461	3282	1574	1171	4159	4022	1580	1148	4450	4314
70	2.657	0.046	0.999	0.046	1744	1712	463	302	1775	1693	994	833	1939	1673	2989	2821	1961	1651	3453	3286	1561	1184	4152	4025	1566	1163	4444	4317
65	2.467	0.043	0.999	0.043	1743	1713	455	306	1772	1697	985	836	1930	1683	2981	2825	1950	1663	3445	3290	1547	1198	4146	4028	1552	1177	4437	4320
60	2.277	0.040	0.999	0.040	1742	1715	446	309	1770	1700	977	839	1921	1692	2973	2829	1939	1674	3437	3294	1534	1212	4139	4030	1538	1192	4431	4322
55	2.087	0.036	0.999	0.036	1742	1716	438	312	1767	1703	969	843	1911	1702	2964	2833	1928	1685	3429	3297	1521	1225	4133	4033	1524	1207	4424	4325
50	1.898	0.033	0.999	0.033	1741	1718	430	316	1764	1706	961	846	1902	1712	2956	2837	1918	1696	3421	3301	1508	1239	4126	4035	1509	1221	4418	4327
45	1.708	0.030	1.000	0.030	1740	1719	422	319	1761	1709	953	849	1893	1722	2948	2840	1907	1708	3413	3305	1494	1252	4120	4038	1495	1236	4411	4330
40	1.518	0.026	1.000	0.026	1739	1720	414	322	1759	1712	945	853	1883	1731	2940	2844	1896	1719	3405	3309	1481	1266	4113	4040	1481	1250	4405	4332
35	1.328	0.023	1.000	0.023	1738	1721	406	325	1756	1715	937	856	1874	1741	2932	2848	1885	1730	3397	3313	1468	1280	4106	4043	1466	1265	4398	4335
30	1.138	0.020	1.000	0.020	1737	1723	397	329	1753	1718	928	859	1865	1751	2923	2852	1874	1741	3388	3316	1454	1293	4099	4045	1452	1279	4391	4337
25	0.949	0.017	1.000	0.017	1736	1724	389	332	1750	1721	920	863	1855	1760	2915	2855	1863	1752	3380	3320	1441	1307	4093	4047	1438	1294	4385	4339
20	0.759	0.013	1.000	0.013	1734	1725	381	335	1747	1724	912	866	1846	1770	2907	2859	1852	1764	3372	3324	1428	1320	4086	4049	1423	1308	4378	4342
15	0.569	0.010	1.000	0.010	1733	1726	373	338	1745	1727	904	869	1836	1779	2898	2862	1841	1775	3363	3327	1414	1334	4079	4052	1409	1323	4371	4344
10	0.379	0.007	1.000	0.007	1732	1728	364	342	1742	1730	895	872	1827	1789	2890	2866	1830	1786	3355	3331	1401	1347	4072	4054	1395	1337	4364	4346
5	0.190	0.003	1.000	0.003	1731	1729	356	345	1739	1733	887	876	1818	1798	2881	2869	1819	1797	3346	3334	1387	1361	4065	4056	1380	1352	4357	4348
0	0.000	0.000	1.000	0.000	1730	1730	348	348	1736	1736	879	879	1808	1808	2873	2873	1808	1808	3338	3338	1374	1374	4058	4058	1366	1366	4350	4350

REFER TO DRAWING NO. UPMSG-4

E1=[Ab+(h x tan α)] x cos α
F1=[Ab-(h x tan α)] x cos α
H1=(Ca/2)+(h/cos α)+(Ab-h x tan α) x sin α
H2=(Ca/2)+(h/cos α)-(Ab+h x tan α) x sin α
ab=Ab= Distance from centre line of vehicle to Structure Gauge for tangent track at height 'h' from rail level.
ac=Distance from vertical centre line of canted track to Structure Gauge for tangent track at height 'h' from rail level.
bc= h x tan α= Lateral increment due to cant (measured along the line parallal to line joining the top of rails).

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(APPENDIX-3(TNL)

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

CANT EFFECT ON STRUCTURE GAUGE- HORIZONTAL

UNDERGROUNDSECTIONS(RECTANGULARBOX/TUNNEL)

ALL FIGURES ARE IN (mm)

Height above rail level measured perpendicular to plane of track					h=	348			h=	885			h=	2884			h=	3320			h=	4246			h=	4300		
Distance from centre line of track to Structure Gauge for tangent track					ab=	1680			ab=	1676			ab=	1729			ab=	1729			ab=	1040			ab=	833		
Cant	Angle α	sin α	cos α	tan α	E1	F1	H1	H2	E1	F1	H1	H2	E1	F1	H1	H2	E1	F1	H1	H2	E1	F1	H1	H2	E1	F1	H1	H2
110	4.178	0.073	0.997	0.073	1701	1650	524	280	1736	1607	1060	816	1934	1514	3057	2805	1966	1483	3492	3240	1347	728	4365	4214	1144	518	4404	4283
105	3.987	0.070	0.998	0.070	1700	1652	516	283	1733	1610	1052	819	1925	1524	3050	2809	1956	1494	3485	3244	1333	742	4361	4216	1130	532	4400	4284
100	3.797	0.066	0.998	0.066	1699	1653	508	286	1731	1614	1044	822	1916	1534	3042	2813	1945	1505	3477	3248	1319	757	4356	4218	1116	546	4396	4285
95	3.607	0.063	0.998	0.063	1699	1655	501	289	1728	1617	1036	825	1907	1544	3035	2817	1934	1517	3470	3252	1305	771	4351	4220	1102	561	4391	4287
90	3.417	0.060	0.998	0.060	1698	1656	493	292	1726	1620	1028	829	1898	1554	3027	2821	1924	1528	3462	3256	1291	785	4345	4221	1088	575	4387	4288
85	3.227	0.056	0.998	0.056	1697	1658	485	295	1723	1624	1020	832	1889	1564	3019	2825	1913	1539	3455	3260	1277	799	4340	4223	1074	590	4383	4289
80	3.037	0.053	0.999	0.053	1696	1659	477	299	1721	1627	1013	835	1879	1574	3012	2828	1902	1551	3447	3264	1263	814	4335	4225	1060	604	4378	4290
75	2.847	0.050	0.999	0.050	1695	1661	469	302	1718	1630	1005	838	1870	1584	3004	2832	1892	1562	3439	3268	1250	828	4330	4227	1046	618	4374	4291
70	2.657	0.046	0.999	0.046	1694	1662	461	305	1715	1633	997	841	1861	1593	2996	2836	1881	1573	3432	3271	1236	842	4325	4228	1031	633	4369	4292
65	2.467	0.043	0.999	0.043	1693	1663	452	308	1713	1636	989	845	1852	1603	2988	2839	1870	1584	3424	3275	1222	856	4319	4230	1017	647	4364	4293
60	2.277	0.040	0.999	0.040	1693	1665	444	311	1710	1640	981	848	1842	1613	2980	2843	1860	1596	3416	3279	1208	870	4314	4231	1003	661	4360	4294
55	2.087	0.036	0.999	0.036	1692	1666	436	314	1707	1643	973	851	1833	1623	2973	2847	1849	1607	3408	3282	1194	885	4309	4233	989	676	4355	4294
50	1.898	0.033	0.999	0.033	1691	1668	428	317	1704	1646	965	854	1824	1633	2965	2850	1838	1618	3400	3286	1180	899	4303	4234	975	690	4350	4295
45	1.708	0.030	1.000	0.030	1690	1669	420	320	1702	1649	957	857	1814	1642	2957	2854	1827	1629	3393	3289	1166	913	4298	4236	961	704	4345	4296
40	1.518	0.026	1.000	0.026	1689	1670	412	323	1699	1652	949	860	1805	1652	2949	2857	1816	1640	3385	3293	1152	927	4292	4237	947	719	4341	4296
35	1.328	0.023	1.000	0.023	1688	1671	404	326	1696	1655	941	863	1795	1662	2941	2861	1805	1652	3377	3297	1138	941	4286	4238	932	733	4336	4297
30	1.138	0.020	1.000	0.020	1687	1673	396	330	1693	1658	933	867	1786	1671	2933	2864	1795	1663	3369	3300	1124	955	4281	4239	918	747	4331	4298
25	0.949	0.017	1.000	0.017	1686	1674	388	333	1690	1661	925	870	1777	1681	2925	2867	1784	1674	3361	3303	1110	970	4275	4241	904	762	4326	4298
20	0.759	0.013	1.000	0.013	1684	1675	380	336	1688	1664	917	873	1767	1691	2917	2871	1773	1685	3353	3307	1096	984	4269	4242	890	776	4321	4299
15	0.569	0.010	1.000	0.010	1683	1676	372	339	1685	1667	909	876	1758	1700	2909	2874	1762	1696	3345	3310	1082	998	4264	4243	876	790	4316	4299
10	0.379	0.007	1.000	0.007	1682	1678	364	342	1682	1670	901	879	1748	1710	2900	2877	1751	1707	3336	3313	1068	1012	4258	4244	861	805	4310	4299
5	0.190	0.003	1.000	0.003	1681	1679	356	345	1679	1673	893	882	1739	1719	2892	2881	1740	1718	3328	3317	1054	1026	4252	4245	847	819	4305	4300
0	0.000	0.000	1.000	0.000	1680	1680	348	348	1676	1676	885	885	1729	1729	2884	2884	1729	1729	3320	3320	1040	1040	4246	4246	833	833	4300	4300

REFER TO DRAWING NO. UPMSG-4

E1=[Ab+(h x tan α)] x cos α
F1=[Ab-(h x tan α)] x cos α
H1=(Ca/2)+(h/cos α)+(Ab-h x tan α) x sin α
H2=(Ca/2)+(h/cos α)-(Ab+h x tan α) x sin α
ab=Ab= Distance from centre line of vehicle to Structure Gauge for tangent track at height 'h' from rail level.
ac=Distance from centre line of canted track to Structure Gauge for tangent track at height 'h' from rail level.
bc= h x tan α= Lateral increment due to cant (measured along the line parallel to line joining the top of rails).

Mohammad Faiz Ansari
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Date: 2021.10.30 14:32:47 +05'30'

APPENDIX-3A

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

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

(ALL FIGURES ARE IN

(mm)

Height above rail level measured perpendicular to plane of track					h= 348				h= 895				h= 2876				h= 3296				h= 4014				h= 4200			
Distance from centre line of track to K.E. for tangent track					ab= 1451				ab= 1586				ab= 1658				ab= 1658				ab= 1225				ab= 1220			
Cant	Angle α	sin α	cos α	tan α	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2
110	4.178	0.073	0.997	0.073	1472	1422	508	296	1647	1517	1063	832	1863	1444	3044	2803	1894	1413	3463	3221	1514	929	4148	3969	1523	911	4333	4155
105	3.987	0.070	0.998	0.070	1472	1423	501	299	1644	1520	1056	835	1854	1454	3037	2806	1883	1425	3456	3225	1501	943	4142	3972	1509	925	4327	4157
100	3.797	0.066	0.998	0.066	1471	1425	493	301	1642	1523	1048	838	1845	1464	3029	2810	1873	1436	3449	3229	1488	956	4136	3974	1495	939	4322	4160
95	3.607	0.063	0.998	0.063	1470	1426	486	304	1639	1527	1041	841	1836	1474	3022	2813	1862	1447	3441	3233	1475	970	4131	3976	1482	953	4316	4162
90	3.417	0.060	0.998	0.060	1469	1428	479	306	1637	1530	1033	844	1826	1484	3015	2817	1852	1459	3434	3236	1462	984	4125	3979	1468	967	4310	4165
85	3.227	0.056	0.998	0.056	1468	1429	472	308	1634	1533	1025	847	1817	1493	3007	2821	1841	1470	3427	3240	1449	997	4119	3981	1454	982	4305	4167
80	3.037	0.053	0.999	0.053	1467	1431	464	311	1631	1536	1018	850	1808	1503	3000	2824	1830	1481	3419	3244	1436	1011	4113	3983	1441	996	4299	4169
75	2.847	0.050	0.999	0.050	1466	1432	457	313	1628	1540	1010	853	1799	1513	2992	2828	1820	1492	3412	3247	1423	1024	4107	3986	1427	1010	4293	4172
70	2.657	0.046	0.999	0.046	1466	1433	450	315	1626	1543	1003	856	1790	1523	2985	2831	1809	1503	3404	3251	1410	1038	4101	3988	1413	1024	4287	4174
65	2.467	0.043	0.999	0.043	1465	1435	443	318	1623	1546	995	858	1780	1533	2977	2834	1798	1515	3397	3254	1397	1051	4096	3990	1400	1038	4281	4176
60	2.277	0.040	0.999	0.040	1464	1436	435	320	1620	1549	987	861	1771	1542	2970	2838	1788	1526	3389	3258	1384	1065	4090	3992	1386	1052	4275	4178
55	2.087	0.036	0.999	0.036	1463	1437	428	322	1618	1552	980	864	1762	1552	2962	2841	1777	1537	3382	3261	1370	1078	4083	3994	1372	1066	4269	4180
50	1.898	0.033	0.999	0.033	1462	1439	421	325	1615	1555	972	867	1752	1562	2954	2845	1766	1548	3374	3264	1357	1091	4077	3996	1358	1080	4263	4182
45	1.708	0.030	1.000	0.030	1461	1440	414	327	1612	1559	964	870	1743	1572	2947	2848	1755	1559	3366	3268	1344	1105	4071	3998	1345	1094	4257	4184
40	1.518	0.026	1.000	0.026	1460	1441	406	329	1609	1562	957	873	1734	1581	2939	2851	1745	1570	3359	3271	1331	1118	4065	4000	1331	1108	4251	4186
35	1.328	0.023	1.000	0.023	1459	1443	399	332	1606	1565	949	875	1724	1591	2931	2854	1734	1581	3351	3274	1318	1132	4059	4002	1317	1122	4245	4188
30	1.138	0.020	1.000	0.020	1458	1444	392	334	1603	1568	941	878	1715	1601	2923	2857	1723	1592	3343	3277	1305	1145	4053	4004	1303	1136	4238	4190
25	0.949	0.017	1.000	0.017	1457	1445	384	336	1601	1571	934	881	1705	1610	2916	2861	1712	1603	3335	3281	1291	1158	4046	4006	1289	1150	4232	4192
20	0.759	0.013	1.000	0.013	1455	1446	377	339	1598	1574	926	884	1696	1620	2908	2864	1702	1614	3328	3284	1278	1172	4040	4007	1276	1164	4226	4193
15	0.569	0.010	1.000	0.010	1454	1447	370	341	1595	1577	918	887	1686	1629	2900	2867	1691	1625	3320	3287	1265	1185	4033	4009	1262	1178	4219	4195
10	0.379	0.007	1.000	0.007	1453	1449	363	343	1592	1580	910	889	1677	1639	2892	2870	1680	1636	3312	3290	1252	1198	4027	4011	1248	1192	4213	4197
5	0.190	0.003	1.000	0.003	1452	1450	355	346	1589	1583	903	892	1668	1648	2884	2873	1669	1647	3304	3293	1238	1212	4021	4012	1234	1206	4207	4198
0	0.000	0.000	1.000	0.000	1451	1451	348	348	1586	1586	895	895	1658	1658	2876	2876	1658	1658	3296	3296	1225	1225	4014	4014	1220	1220	4200	4200

REFER TO DRAWING NO. UPMSG-4A

E=[Ab+(h x tan α)] x cos α
F=[Ab-(h x tan α)] x cos α
H1=(Ca/2)+(h/cos α)+(Ab-h x tan α) x sin α
H2=(Ca/2)+(h/cos α)-(Ab+h x tan α) x sin α
ab=Ab= Distance from centre line of vehicle to Kinematic Envelope for tangent track at height 'h' from rail level.
ac=Distance from centre line of canted track to Kinematic Envelope for tangent track at height 'h' from rail level.
bc= h x tan α= Lateral increment due to cant (measured along the line parallal to line joining the top of rails).

Mohammad Faiz Ansari

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Date: 2021.10.30 14:33:15 +05'30'

APPENDIX-3A(TNL)

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

CANT EFFECT ON KINEMATIC ENVELOPE - HORIZONTAL

UNDERGROUNDSECTIONS(RECTANGULARBOX/TUNNEL)

ALL FIGURES ARE IN (mm)

Height above rail level measured perpendicular to plane of track					h= 348				h= 895				h= 2885				h= 3287				h= 4158				h= 4200			
Distance from centre line of track to K.E. for tangent track					ab= 1451				ab= 1576				ab= 1629				ab= 1629				ab= 980				ab= 820			
Cant	Angle α	sin α	cos α	tan α	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2
110	4.178	0.073	0.997	0.073	1472	1422	508	296	1637	1507	1062	833	1835	1415	3051	2814	1864	1385	3452	3215	1280	674	4273	4131	1124	512	4304	4184
105	3.987	0.070	0.998	0.070	1472	1423	501	299	1634	1510	1055	836	1826	1424	3044	2817	1854	1396	3445	3218	1267	688	4269	4132	1110	526	4299	4185
100	3.797	0.066	0.998	0.066	1471	1425	493	301	1632	1513	1047	839	1816	1434	3037	2821	1843	1408	3438	3222	1253	702	4264	4134	1096	540	4295	4186
95	3.607	0.063	0.998	0.063	1470	1426	486	304	1629	1517	1040	842	1807	1444	3029	2824	1833	1419	3430	3226	1240	716	4259	4136	1083	554	4291	4188
90	3.417	0.060	0.998	0.060	1469	1428	479	306	1627	1520	1032	844	1798	1454	3022	2828	1822	1430	3423	3229	1226	730	4254	4137	1069	568	4286	4189
85	3.227	0.056	0.998	0.056	1468	1429	472	308	1624	1523	1025	847	1789	1464	3015	2831	1811	1441	3416	3233	1213	744	4249	4139	1055	582	4282	4190
80	3.037	0.053	0.999	0.053	1467	1431	464	311	1621	1526	1017	850	1780	1474	3007	2835	1801	1453	3409	3236	1199	758	4244	4140	1041	596	4278	4191
75	2.847	0.050	0.999	0.050	1466	1432	457	313	1619	1530	1010	853	1770	1484	3000	2838	1790	1464	3401	3240	1185	772	4239	4142	1028	610	4273	4192
70	2.657	0.046	0.999	0.046	1466	1433	450	315	1616	1533	1002	856	1761	1494	2992	2841	1780	1475	3394	3243	1172	786	4234	4143	1014	624	4268	4192
65	2.467	0.043	0.999	0.043	1465	1435	443	318	1613	1536	995	859	1752	1503	2985	2845	1769	1486	3387	3246	1158	800	4229	4144	1000	638	4264	4193
60	2.277	0.040	0.999	0.040	1464	1436	435	320	1610	1539	987	862	1742	1513	2977	2848	1758	1497	3379	3250	1144	814	4224	4146	986	652	4259	4194
55	2.087	0.036	0.999	0.036	1463	1437	428	322	1608	1542	979	865	1733	1523	2970	2851	1748	1508	3372	3253	1131	828	4218	4147	972	666	4255	4195
50	1.898	0.033	0.999	0.033	1462	1439	421	325	1605	1546	972	867	1724	1533	2962	2854	1737	1519	3364	3256	1117	842	4213	4148	959	680	4250	4196
45	1.708	0.030	1.000	0.030	1461	1440	414	327	1602	1549	964	870	1714	1542	2955	2858	1726	1530	3357	3259	1103	856	4208	4149	945	694	4245	4196
40	1.518	0.026	1.000	0.026	1460	1441	406	329	1599	1552	956	873	1705	1552	2947	2861	1716	1541	3349	3263	1090	870	4203	4151	931	708	4240	4197
35	1.328	0.023	1.000	0.023	1459	1443	399	332	1596	1555	949	876	1695	1562	2939	2864	1705	1552	3341	3266	1076	883	4197	4152	917	722	4235	4197
30	1.138	0.020	1.000	0.020	1458	1444	392	334	1593	1558	941	879	1686	1571	2932	2867	1694	1563	3334	3269	1062	897	4192	4153	903	736	4230	4198
25	0.949	0.017	1.000	0.017	1457	1445	384	336	1591	1561	933	881	1677	1581	2924	2870	1683	1574	3326	3272	1049	911	4186	4154	889	750	4226	4198
20	0.759	0.013	1.000	0.013	1455	1446	377	339	1588	1564	926	884	1667	1591	2916	2873	1672	1585	3318	3275	1035	925	4181	4155	876	764	4220	4199
15	0.569	0.010	1.000	0.010	1454	1447	370	341	1585	1567	918	887	1658	1600	2909	2876	1662	1596	3311	3278	1021	939	4175	4156	862	778	4215	4199
10	0.379	0.007	1.000	0.007	1453	1449	363	343	1582	1570	910	890	1648	1610	2901	2879	1651	1607	3303	3281	1008	952	4169	4156	848	792	4210	4199
5	0.190	0.003	1.000	0.003	1452	1450	355	346	1579	1573	903	892	1639	1619	2893	2882	1640	1618	3295	3284	994	966	4164	4157	834	806	4205	4200
0	0.000	0.000	1.000	0.000	1451	1451	348	348	1576	1576	895	895	1629	1629	2885	2885	1629	1629	3287	3287	980	980	4158	4158	820	820	4200	4200

REFER TO DRAWING NO. UPMSG-4A

E=[Ab+(h x tan α)] x cos α
F=[Ab-(h x tan α)] x cos α
H1=(Ca/2)+(h/cos α)+(Ab-h x tan α) x sin α
H2=(Ca/2)+(h/cos α)-(Ab+h x tan α) x sin α
ab=Ab= Distance from centre line of vehicle to Kinematic Envelope for tangent track at height 'h' from rail level.
ac=Distance from centre line of canted track to Kinematic Envelope for tangent track at height 'h' from rail level.
bc= h x tan α= Lateral increment due to cant (measured along the line parallal to line joining the top of rails).

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Date: 2021.10.30 14:33:50 +05'30'

APPENDIX-4

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

LATERAL AND VERTICAL SHIFT OF CENTRE OF CIRCULAR TUNNEL

FOR DIFFERENT CANT VALUES

(WITH D1 = 630 mm)

ALL FIGURES ARE IN (mm)

Cant (mm)	Sin α = cant/g, g=1510	Angle α in degrees	tan θ= (r-D1)/(g/2)	Angle θ in degrees	Lateral shift of tunnel centre=X	Vertical shift of tunnel centre=Y	REMARKS
110	0.0728	4.1776	2.8742	70.8159	160	49	
105	0.0695	3.9874	2.8742	70.8159	153	47	
100	0.0662	3.7972	2.8742	70.8159	145	45	
95	0.0629	3.6071	2.8742	70.8159	138	43	
90	0.0596	3.4170	2.8742	70.8159	131	41	
85	0.0563	3.2270	2.8742	70.8159	123	39	
80	0.0530	3.0370	2.8742	70.8159	116	37	
75	0.0497	2.8470	2.8742	70.8159	109	35	
70	0.0464	2.6570	2.8742	70.8159	101	33	
65	0.0430	2.4671	2.8742	70.8159	94	30	
60	0.0397	2.2773	2.8742	70.8159	87	28	
55	0.0364	2.0874	2.8742	70.8159	80	26	
50	0.0331	1.8976	2.8742	70.8159	72	24	
45	0.0298	1.7077	2.8742	70.8159	65	22	
40	0.0265	1.5179	2.8742	70.8159	58	19	
35	0.0232	1.3282	2.8742	70.8159	51	17	
30	0.0199	1.1384	2.8742	70.8159	43	15	
25	0.0166	0.9486	2.8742	70.8159	36	12	
20	0.0132	0.7589	2.8742	70.8159	29	10	
15	0.0099	0.5692	2.8742	70.8159	22	7	
10	0.0066	0.3794	2.8742	70.8159	14	5	
5	0.0033	0.1897	2.8742	70.8159	7	2	
0	0.0000	0.0000	2.8742	70.8159	0	0	

(a) The cant is provided by raising the outer rail which will mean, rotating the tunnel about the mid point of top of innerrail.

(b) 'X' is lateral shift of the centre of tunnel towards inside of curve

X=[{2 x (r-D1)/sin θ } x { sin a/2}] x cos(90-θ-a/2**)**

(c) 'Y' is vertical shift of the centre of tunnel upwards

Y=[{2 x (r-D1)/sin θ } x { sin a/2}] x sin(90-θ-a/2)

'r' is internal radius of the circular tunnel=5600/2=2800 mm

D1 = depth from rail level to invert of circular tunnel=630 mm

a = angle of rotation=sin-1 (Cant/g)and

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

=tan^{-1}[(r-D1)/(g/2)] in degrees =70.81587171

g= Centre to centre of rails = 1435+75=1510 mm

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Date: 2021.10.30 14:34:40 +05'30'

APPENDIX-5

(Sample Appendix for SG for guidance. Actual Appendix shall be prepared in following pattern on the basis of related parameters of concerned Metro)

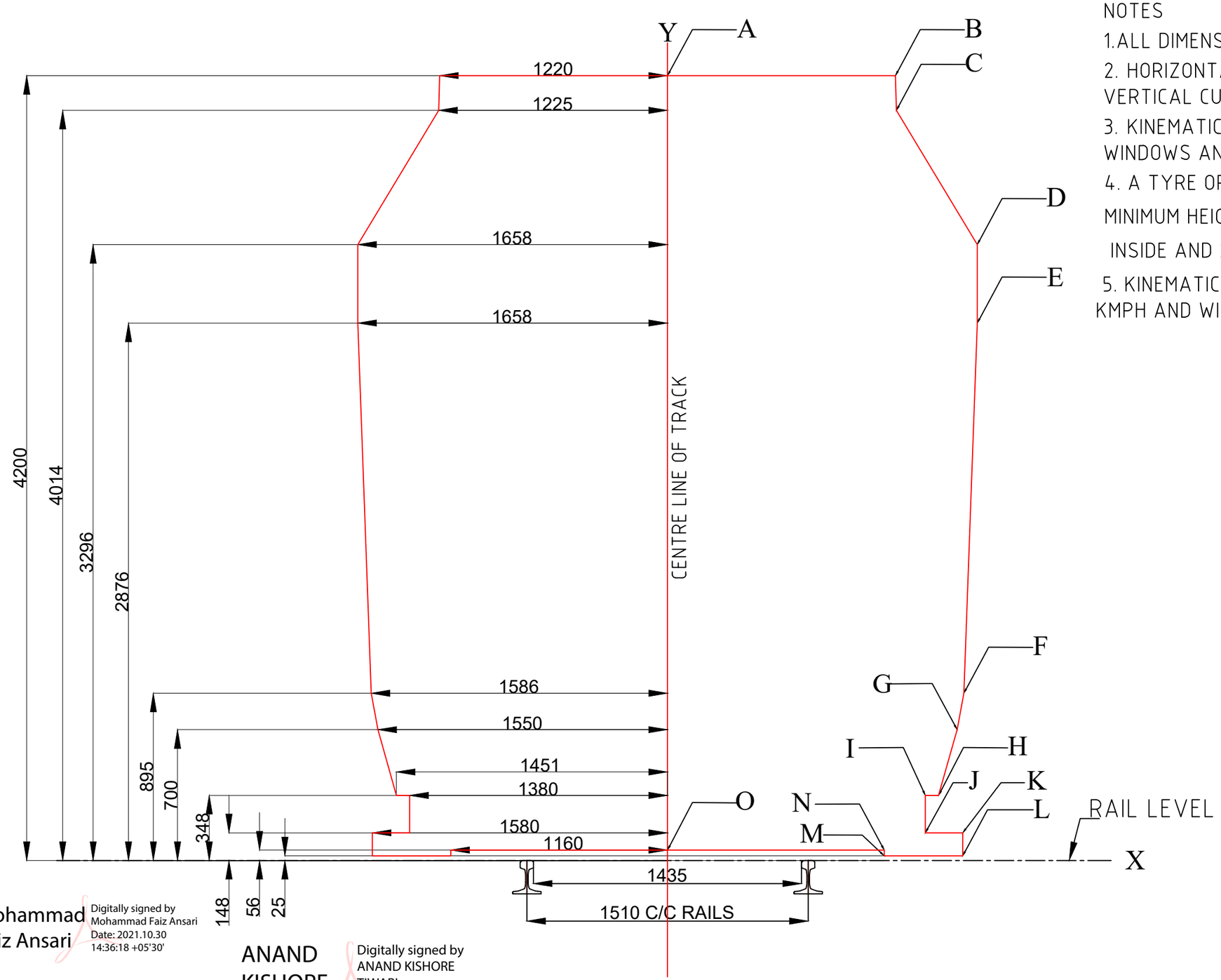
ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES

RADIUS (meters)	CANT Ca(mm)	EXTRA ALLOWANCE (mm) FOR PASSENGER PLATFORM		REMARKS
		INSIDE OF CURVE	OUTSIDE OF CURVE	
3000	0	10	11	Extra Allowance for curves
2800	0	10	12	(a) Inside of curve =Mid throw = 28500/R
2600	0	11	13	Outside of curve = End throw = 33910/R
2400	0	12	14	Please see Appendix 2A & 2B.
2200	0	13	15	Additional sway (nosing Effect) has been neglected in the calculation as a measure of additional safety to passengers.
2000	0	14	17	
1800	0	16	19	
1700	0	17	20	
1600	0	18	21	
1500	0	19	23	
1400	0	20	24	
1300	0	22	26	
1200	0	24	28	
1100	0	26	31	
1000	0	29	34	

Mohammad Faiz Ansari
Digitally signed by Mohammad Faiz Ansari
Date: 2021.10.30 14:35:17 +05'30'

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HIRENDRA KUMAR RAGHU
Digitally signed by HIRENDRA KUMAR RAGHU
Date: 2021.11.03 10:58:41 +05'30'



NOTES

1.ALL DIMENSIONS ARE IN mm.

2. HORIZONTAL AND VERTICAL CLEARANCE 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. A TYRE OR ATTACHMENT OF A WHEEL MAY PROJECT BELOW THE MINIMUM HEIGHT OF KINEMATIC ENVELOPE FOR A DISTANCE OF 51 mm INSIDE AND 216 mm OUTSIDE OF THE GAUGE FACE OF THE RAIL.

5. KINEMATIC ENVELOPE IS VALID FOR THE MAXIMUM SPEED OF 90 KMPH AND WIND SPEED OF 100 KMPH .

CO-ORDINATES		
SL.NO.	**X**	**Y**
A	0	4200
B	1220	4200
C	1225	4014
D	1658	3296
E	1658	2876
F	1586	895
G	1550	700
H	1451	348
I	1380	348
J	1380	148
K	1580	148
L	1580	25
M	1160	25
N	1160	56
O	0	56

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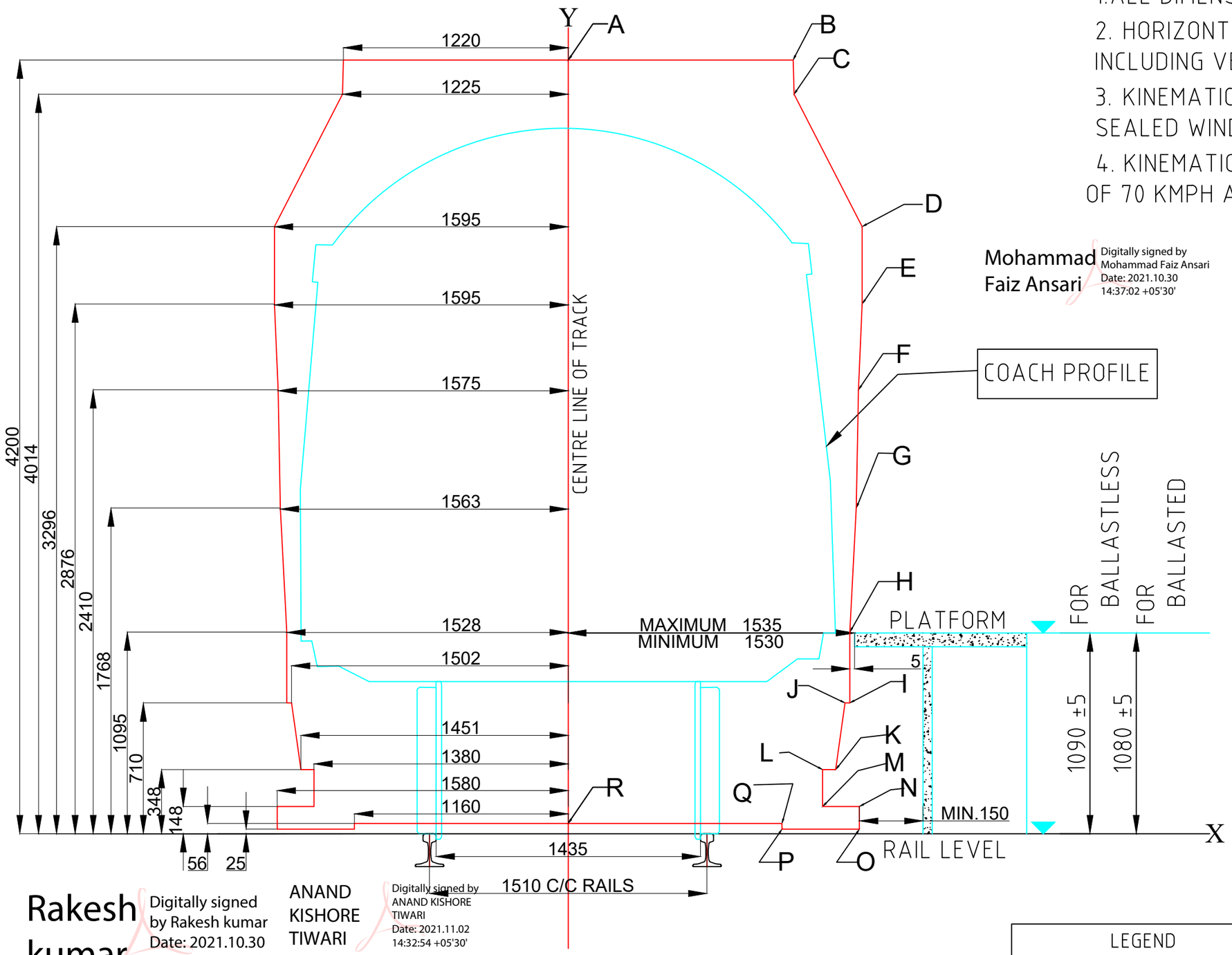
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AT GRADE AND ELEVATED SECTIONS

Fig 1: Kinematic Envelope – At grade and Elevated Sections on level or constant grade tangent track

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. HORIZONTAL AND VERTICAL CLEARANCE 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. KINEMATIC ENVELOPE IS VALID FOR THE MAXIMUM SPEED OF 70 KMPH AND WIND SPEED OF 70 KMPH.



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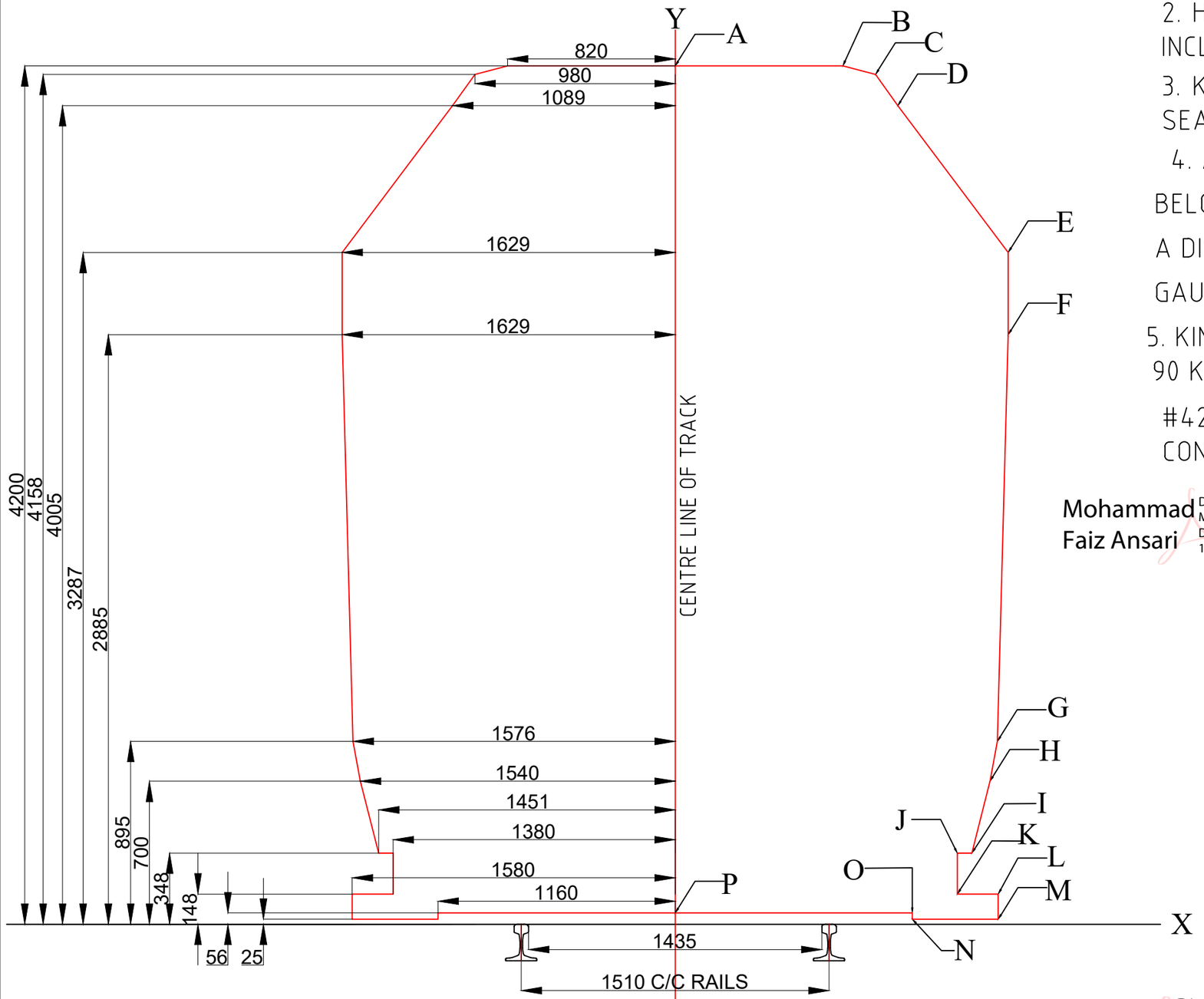
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AT GRADE AND ELEVATED SECTIONS PLATFORM

LEGEND	
	COACH PROFILE
	KINEMATIC ENVELOPE

CO-ORDINATES		
SL.NO.	**X**	**Y**
A	0	4200
B	1220	4200
C	1225	4014
D	1595	3296
E	1595	2876
F	1575	2410
G	1563	1768
H	1525	1095
I	1525	710
J	1502	710
K	1451	348
L	1380	348
M	1380	148
N	1580	148
O	1580	25
P	1160	25
Q	1160	56
R	0	56

Fig 2: Kinematic Envelope – At grade and Elevated Sections or constant grade tangent track at Platform



UNDER GROUND SECTION (TUNNELS)

Fig 3: Kinematic Envelope – Underground Sections (Tunnels) on level or constant grade Tangent Track

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. HORIZONTAL AND VERTICAL CLEARANCE DUE TO CURVES INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA.
3. KINEMATIC ENVELOPE IS VALID FOR VEHICLES WLTH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
4. A TYRE OR ATTACHMENT OF A WHEEL MAY PROJECT BELOW THE MINIMUM HEIGHT OF KINEMATIC ENVELOPE FOR A DISTANCE OF 51 MM INSIDE AND 216 MM OUTSIDE OF THE GAUGE FACE OF THE RAIL.
5. KINEMATIC ENVELOPE IS VALID FOR THE MAXIMUM SPEED OF 90 KMPH AND SIDE WIND SPEED OF 42# KMPH.

#42 KM/H SIDE WIND REPRESENTS 100 PA PRESSURE CONSIDERED AS BUFFETING EFFECT.

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CO-ORDINATES		
SL.NO.	X	Y
A	0	4200
B	820	4200
C	980	4158
D	1089	4005
E	1629	3287
F	1629	2885
G	1576	895
H	1540	700
I	1451	348
J	1380	348
K	1380	148
L	1580	148
M	1580	25
N	1160	25
O	1160	56
P	0	56

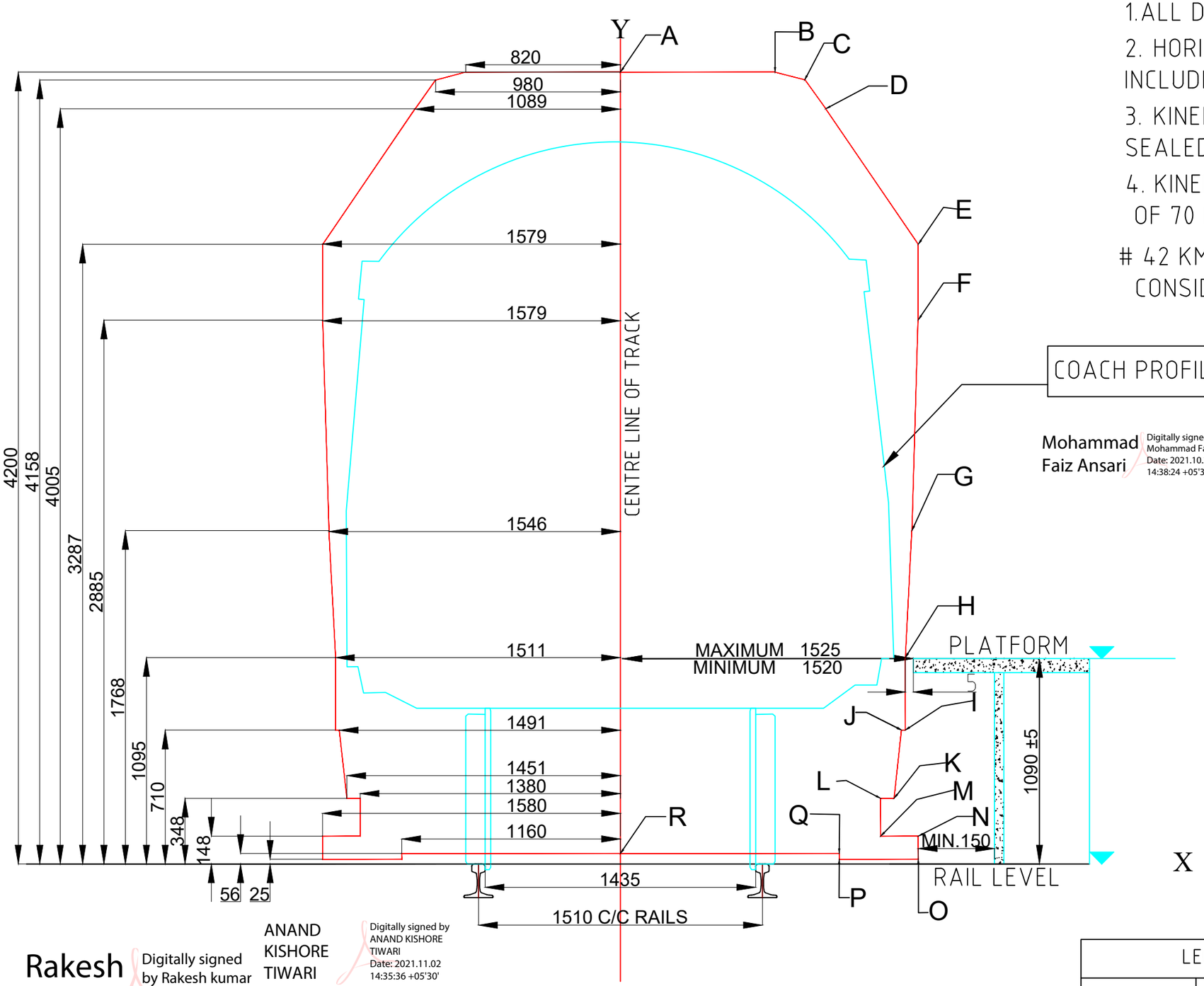
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NOTES

1. ALL DIMENSIONS ARE IN mm.
2. HORIZONTAL AND VERTICAL CLEARANCE 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. KINEMATIC ENVELOPE IS VALID FOR THE MAXIMUM SPEED OF 70 KMPH AND SIDE WIND SPEED OF 42# KMPH.

42 KM/H SIDE WIND REPRESENTS 100 PA PRESSURE CONSIDERED AS BUFFETING EFFECT.



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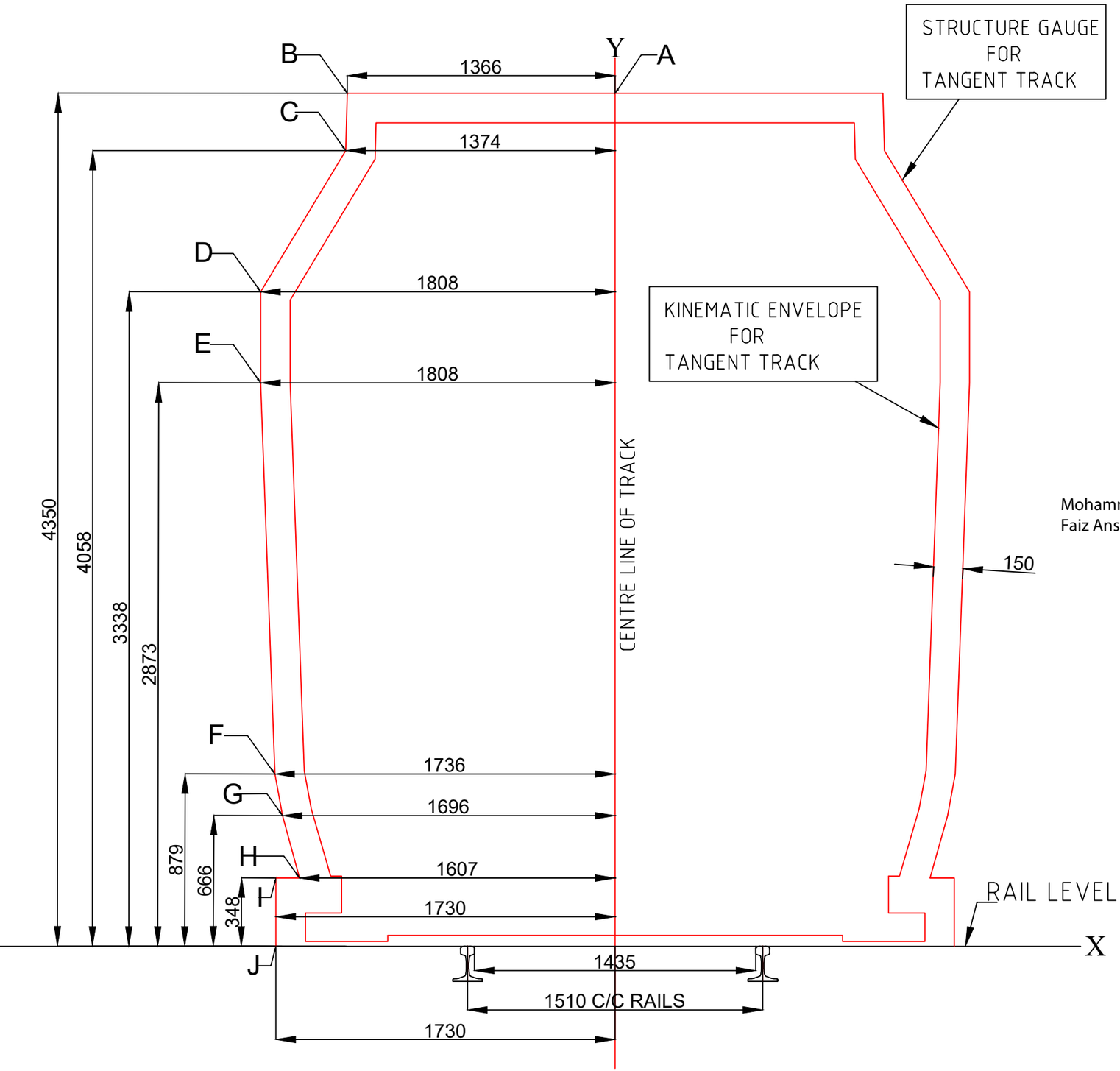
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UNDER GROUND SECTION (TUNNELS) PLATFORM

LEGEND	
	COACH PROFILE
	KINEMATIC ENVELOPE

CO-ORDINATES		
SL.NO.	**X**	**Y**
A	0	4200
B	820	4200
C	980	4158
D	1089	4005
E	1579	3287
F	1579	2885
G	1546	1768
H	1511	1095
I	1511	710
J	1491	710
K	1451	348
L	1380	348
M	1380	148
N	1580	148
O	1580	25
P	1160	25
Q	1160	56
R	0	56

Fig 4: Kinematic Envelope-Underground Section on Level or constant grade tangent track at Platform



AT GRADE AND ELEVATED SECTIONS

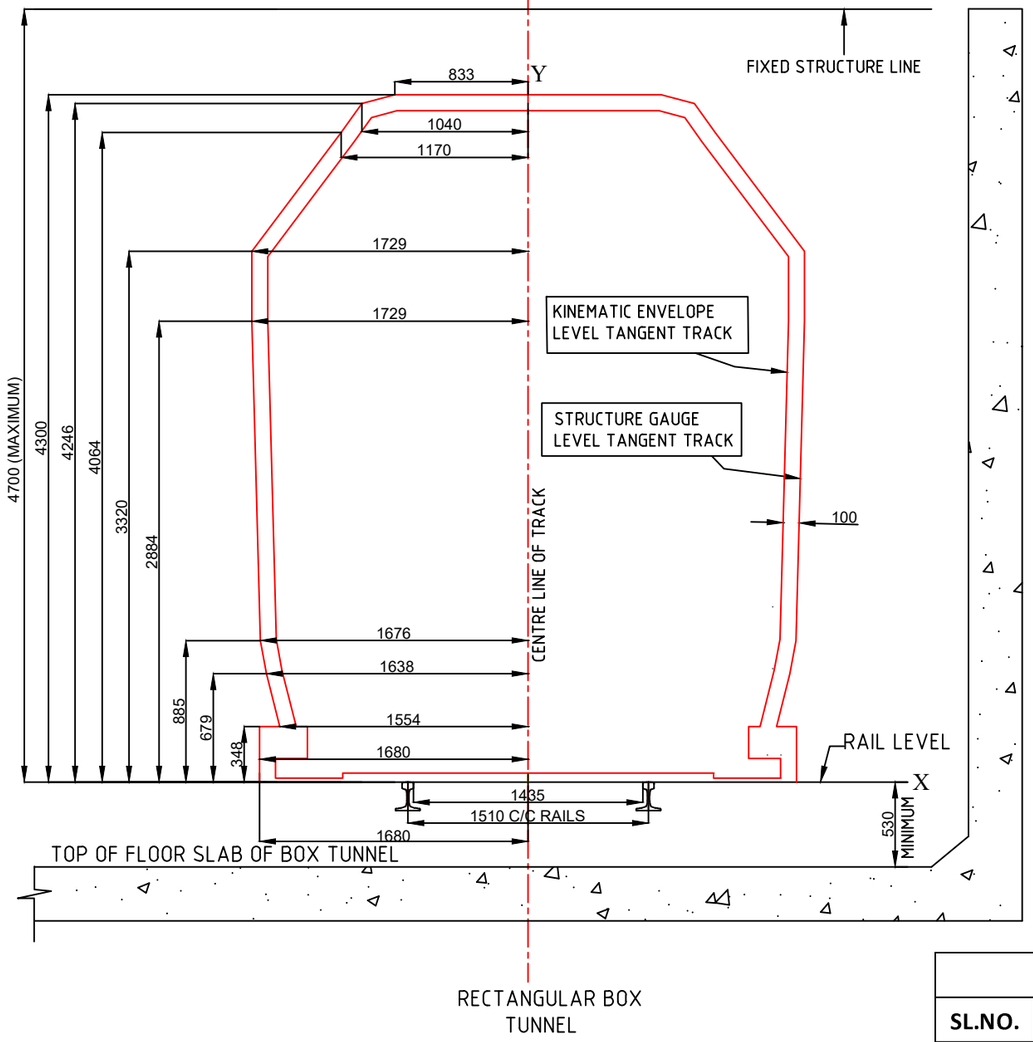
Fig 5: Structure Gauge – At Grade and Elevated Sections on level or Constant Grade Tangent Track (Outside Station)

NOTES

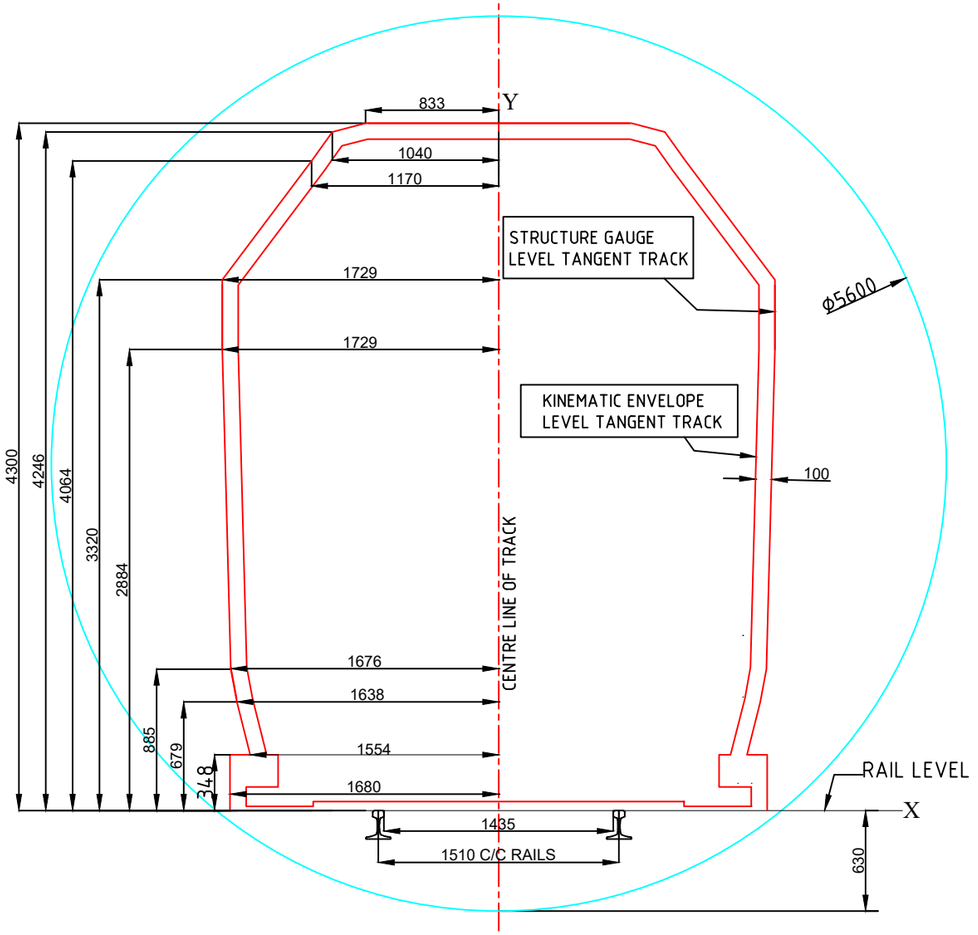
1. ALL DIMENSIONS ARE IN mm.
2. MINIMUM CLEARANCE BETWEEN KINEMATIC ENVELOPE AND STRUCTURE GAUGE WILL BE 150 mm.
3. THE KINEMATIC ENVELOPE & STRUCTURE GAUGE ARE VALID FOR ROLLING STOCK WITH SEALED WINDOWS & DOORS CLOSED WHILE IN MOTION.
4. HORIZONTAL & VERTICAL CLEARANCE DUE TO CURVES INCLUDING VERTICAL CURVE & CANT SHALL BE EXTRA.
5. FOR KINEMATIC ENVELOPE, REFER TO FIGURE-UPMSG-1
6. THE STRUCTURE GAUGE IS VALID FOR MAXIMUM SPEED OF 90 KMPH & WIND SPEED OF 70KMPH.

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CO-ORDINATES		
SL.NO.	**X**	**Y**
A	0	4350
B	1366	4350
C	1374	4058
D	1808	3338
E	1808	2873
F	1736	879
G	1696	666
H	1593	348
I	1730	348
J	1730	0



RECTANGULAR BOX
TUNNEL



CIRCULAR TUNNEL
5600mm DIA

CO-ORDINATES		
SL.NO.	**X**	**Y**
A	0	4300
B	833	4300
C	1040	4246
D	1170	4064
E	1729	3320
F	1729	2884
G	1676	885
H	1638	679
I	1554	348
J	1680	348
K	1680	0

NOTES

1.ALL DIMENSIONS ARE IN mm

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

3.STRUCTURE GAUGE FOR CURVE DOES NOT INCLUDE LATERAL SHIFT (LEAN) DUE TO CANT.

4. HORIZONTAL AND VERTICAL CLEARANCE DUE TO CURVES INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA.

5. CANT WILL BE PROVIDE BY RAISING OUTER RAIL ONLY AND SHIFTING OF THE CENTRE OF THE CIRCULAR TUNNEL TOWARDS INSIDE OF THE CURVE AND UPWARDS. THIS WILL BE SAME AS ROTATING THE CIRCULAR TUNNEL ABOUT THE MID POINT OF TOP OF INNER RAIL.

6. MINIMUM CLEARANCE BETWEEN KINEMATIC ENVELOPE AND STRUCTURE GAUGE=100 mm.

7. VERTICAL THROW DUE TO VERTICAL CURVE HAS NOT BEEN SHOWN IN THE FIGURE AND SHALL BE EXTRA.

8. FOR DETAILS OF KINEMATIC ENVELOP, REFER TO FIGURE No. UPMSG-1(TNL).

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Fig 6: Structure Gauge – underground section (tunnels) on level or constant grade tangent track (outside station)

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

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

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

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

Chord $c_1 c_2 = 2x[(r-D_1)/\sin\theta) \times (\sin\alpha/2)]$

$X = c_1 c_2 \times \cos(90-\theta-\alpha/2)$

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

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

Where 'r' is internal radius of tunnel.

D_1= depth from rail level to invert of tunnel

g= distance between centres of rails

= 1510mm

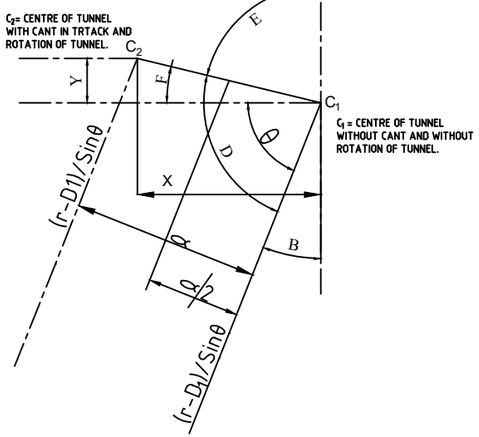
DETAIL AT CENTRE OF TUNNEL

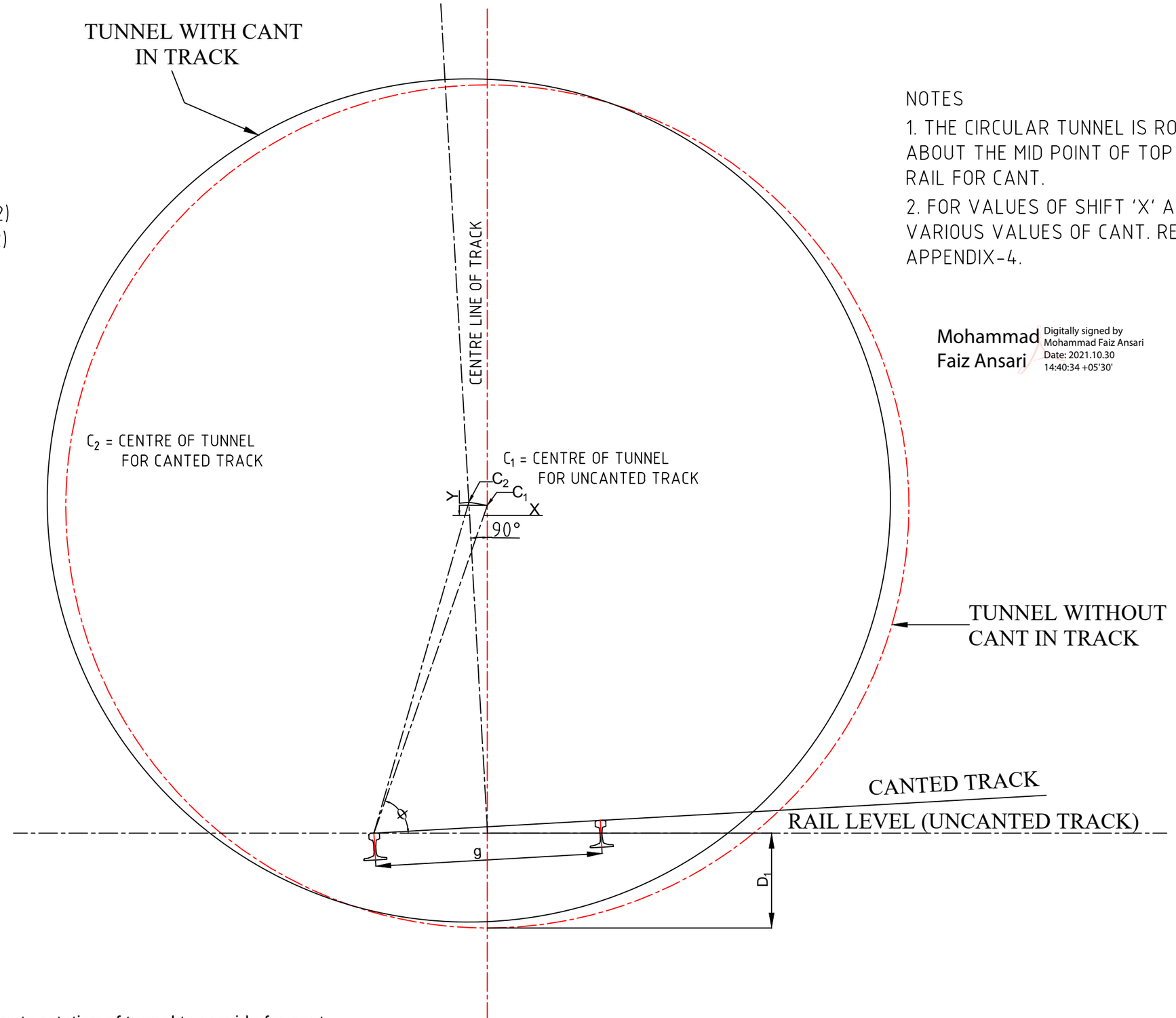
Angle B = $(90-\theta)$

Angle D = $(90-\alpha/2)$

Angle E = $(\theta+\alpha/2)$

Angle F = $(90-\theta-\alpha/2)$





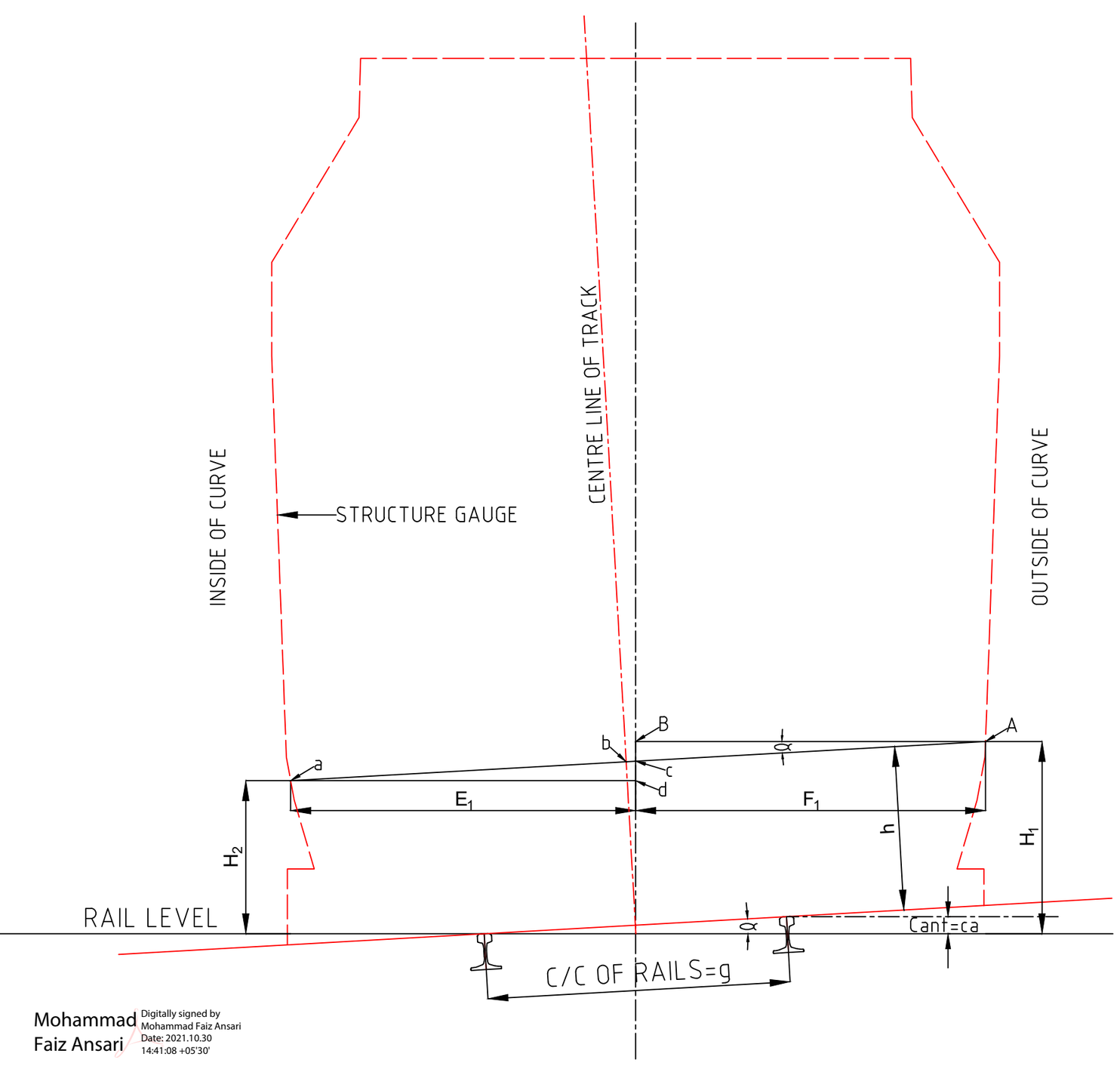
NOTES

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

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Fig 7: Shift of the centre of circular tunnel due to rotation of tunnel to provide for cant



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Fig 8: Effect of cant on Structure Gauge

ab= Ab= Distance from centreline of track to structure gauge for tangent track at height 'h'

$\sin\alpha$= cant/g

g= 1510mm

Ca= Cant applied

E_1= [ab+hx$\tan\alpha$)] x $\cos\alpha$

F_1= [ab-hx$\tan\alpha$)] x $\cos\alpha$

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

H_2= (Ca/2)+(h/$\cos\alpha$)-(Ab+hx$\tan\alpha$) x $\sin\alpha$

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

NOTES

1. STRUCTURE GAUGE FOR AT-GRADE/ELEVATED SECTION HAS BEEN SHOWN AS A TYPICAL FIGURE.
2. THE FORMULA FOR E_1,F_1,H_1 AND H_2 SHOWN THIS FIGURE WILL ALSO APPLY TO UNDER GROUND BOX TUNNELS.
3. KINEMATIC ENVELOPE IS VALID FOR THE MAXIMUM SPEED OF 90 KMPH, WIND SPEED OF 70 KMPH.
4. MAXIMUM CANT= 110 MM, MAXIMUM CANT DEFICIENCY = 85MM.

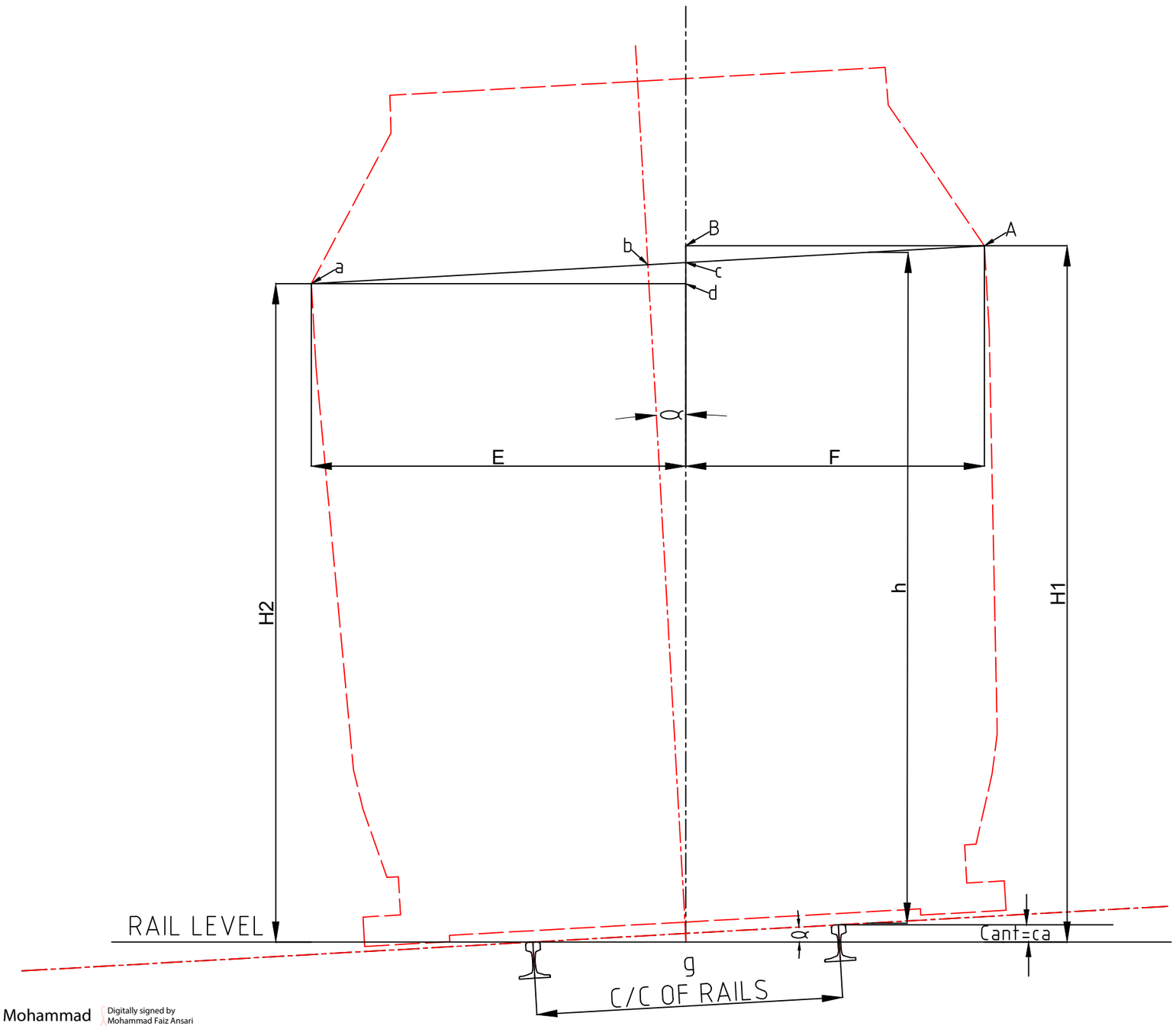


Fig 9: Effect of cant on Kinematic Envelope

ab= Ab= Distance from centreline of track to kinematic envelope for tangent track at height 'h'

sinα= cant/g

g= 1510mm

Ca= Cant applied

E= [ab+hxtanα)] x cosα

F= [ab-hxtanα)] x cosα

H_1= (Ca/2)+(h/cosα)+(Ab-hxtanα) x sinα

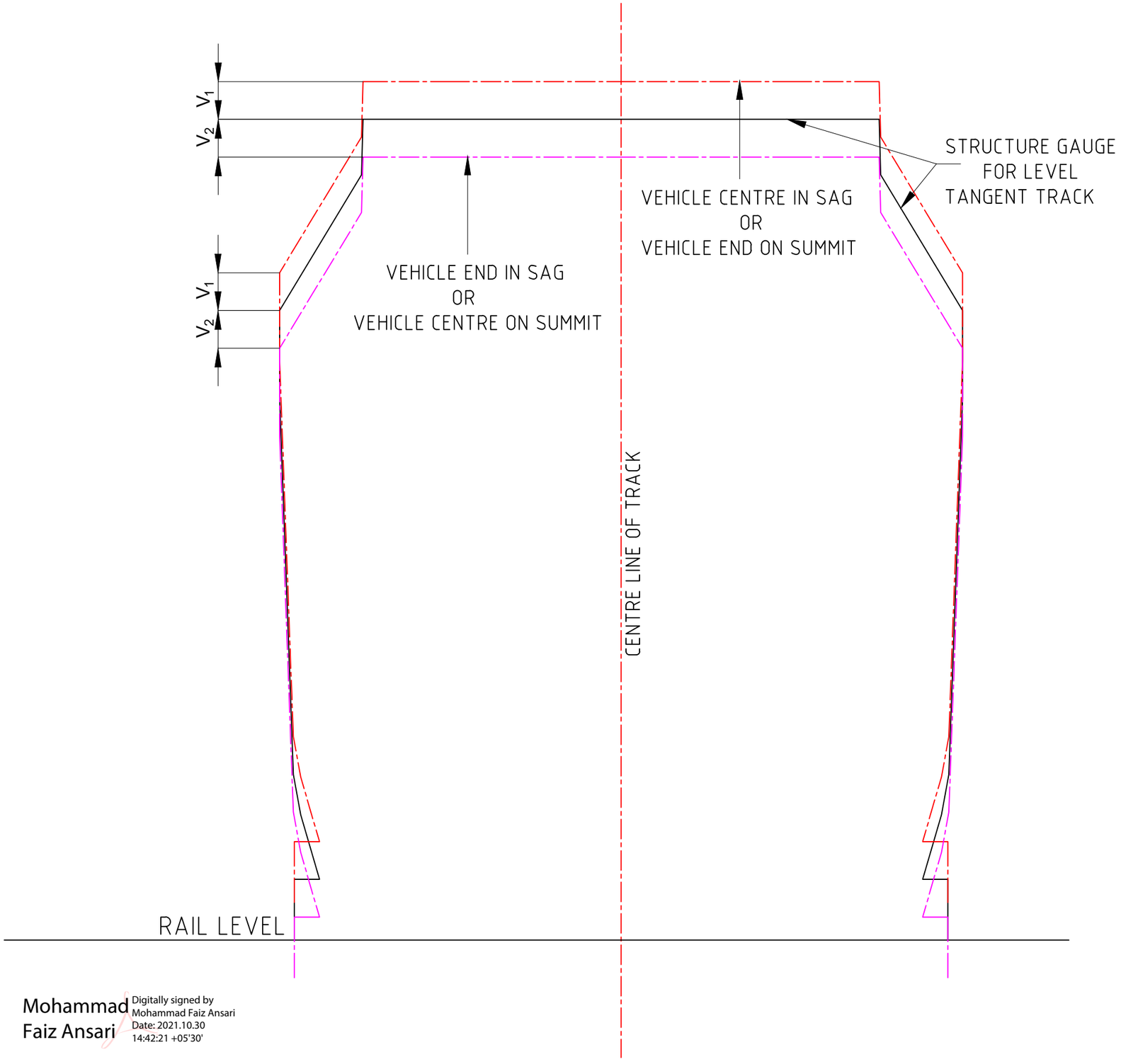
H_2= (Ca/2)+(h/cosα)-(Ab+hxtanα) x sinα

For values of E, F, H_1 and H_2, refer to Appendix 3A and 3A (TNL).

NOTES

1. KINEMATIC ENVELOPE FOR AT- GRADE/ELEVATED SECTION HAS BEEN SHOWN AS A TYPICAL FIGURE.
2. THE FORMULA FOR E,F,H_1 AND H_2 SHOWN THIS FIGURE WILL ALSO APPLY TO UNDER GROUND BOX TUNNELS.
4. MAXIMUM CANT= 110 MM, MAXIMUM CANT DEFICIENCY = 85MM.

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Fig 10: Effect of vertical curve on Structure Gauge

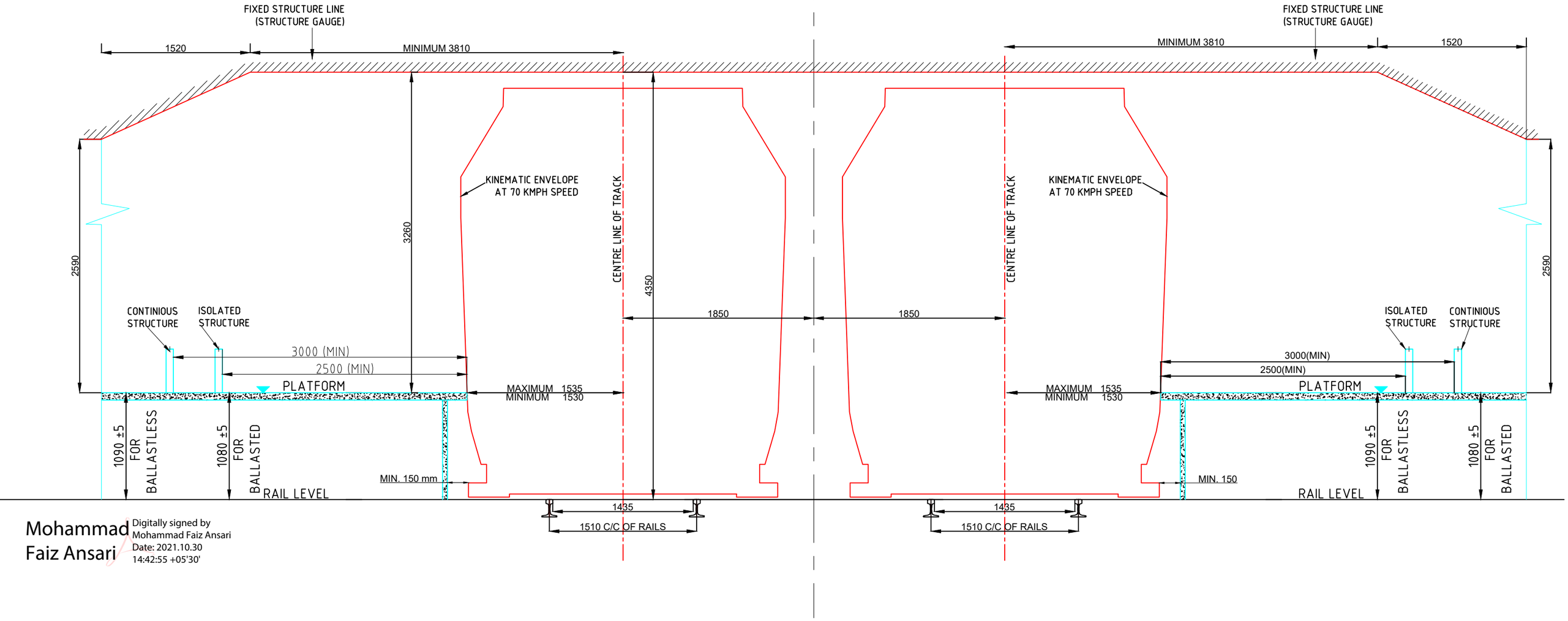
NOTES

1. THE FIGURE IS TYPICAL AND WILL APPLY TO UNDER GROUND ELEVATED AND AT-GRADE SECTIONS.
2. VALID FOR MAXIMUM SPEED OF 90 KMPH.

VERTICAL THROW		
RADIUS OF VERTICAL CURVE (M)	**V_1 (mm)**	**V_2 (mm)**
1500	19	22
1600	18	21
1700	17	20
1800	16	19
1900	15	18
2000	14	17
2100	14	16
2200	13	15
2300	12	15
2400	12	14
2500	11	14
2600	11	13
2700	11	12
2800	10	12
2900	10	12
3000	10	11

NOTES

1. ALL DIMENSIONS ARE IN mm.
2. CLEARANCE FOR CURVE SHALL BE EXTRA. HOWEVER THE TRACK CENTRES AT STATION WILL NOT INCREASE WITH CURVES OF RADIUS OF 1000 M & ABOVE.
3. STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS & DOORS CLOSED WHILE IN MOTION.

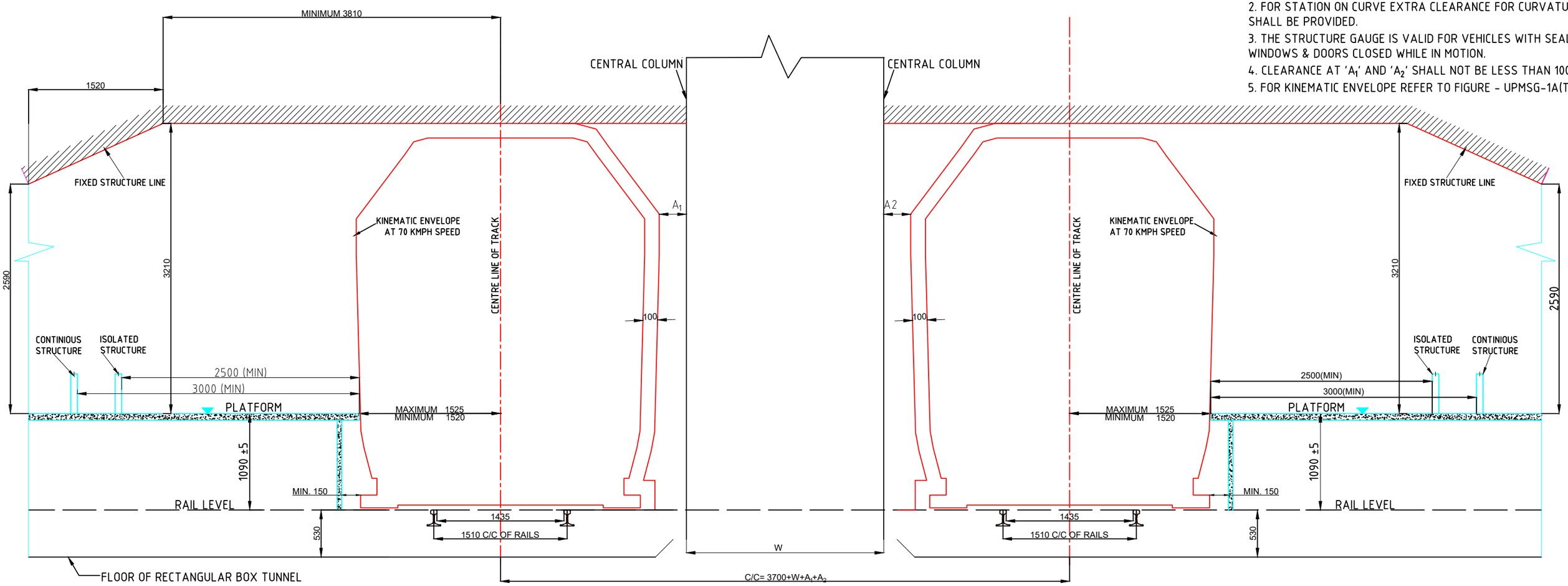


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Fig 11: Structure Gauge at –grade and elevated station with side palforms on level or constant grade tangent track

NOTES

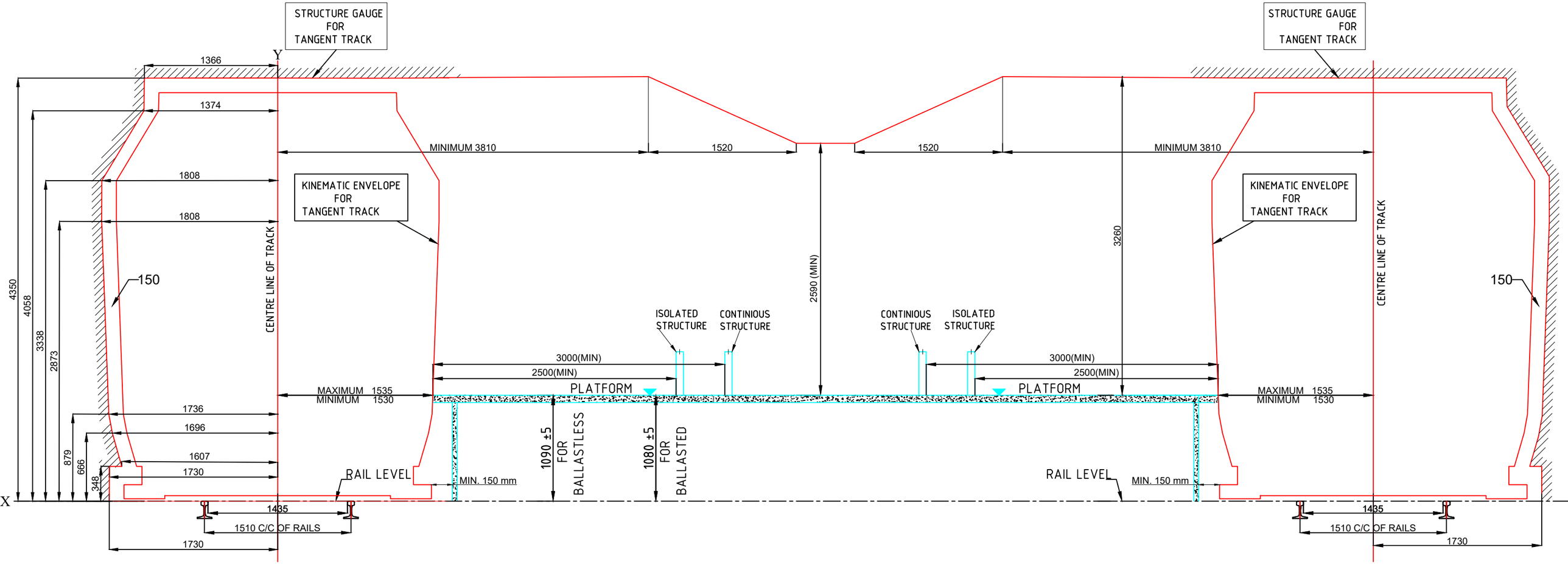
1. ALL DIMENSIONS ARE IN mm.
2. FOR STATION ON CURVE EXTRA CLEARANCE FOR CURVATURE SHALL BE PROVIDED.
3. THE STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS & DOORS CLOSED WHILE IN MOTION.
4. CLEARANCE AT 'A_1' AND 'A_2' SHALL NOT BE LESS THAN 100 MM.
5. FOR KINEMATIC ENVELOPE REFER TO FIGURE - UPMSG-1A(TNL)



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Fig 12: Structure gauge at underground station with side platforms, rectangular box tunnel on level or constant grade tangent track



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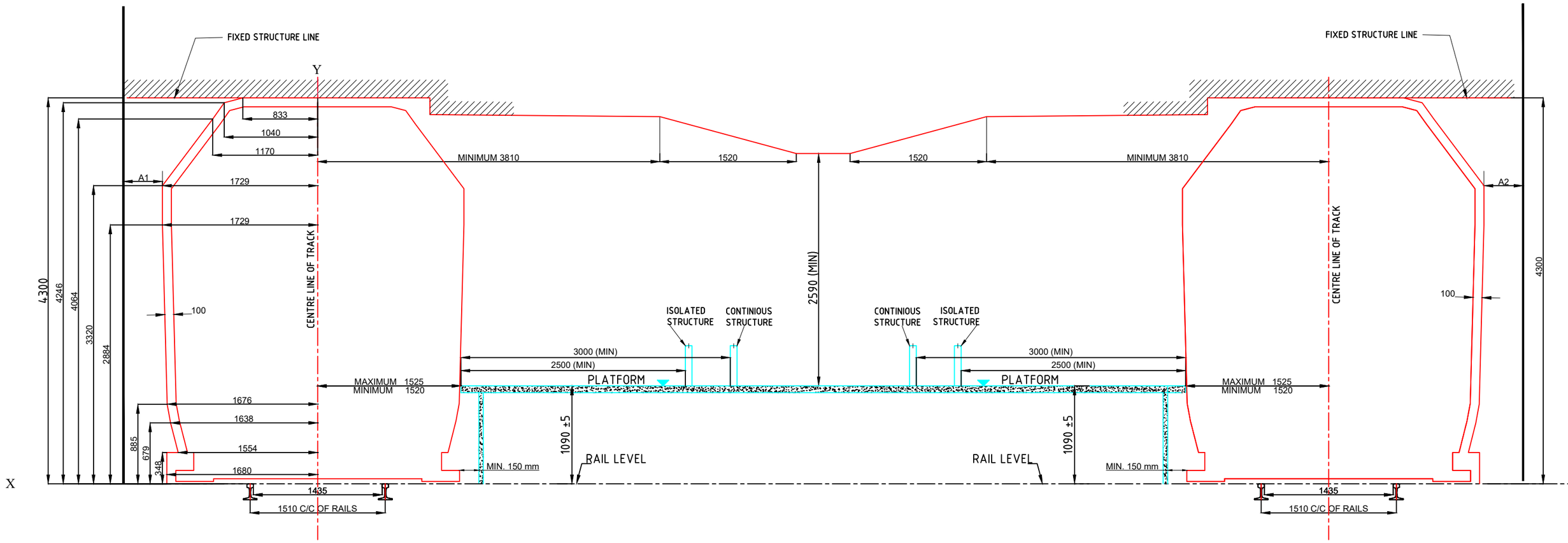
NOTES

1. ALL DIMENSIONS ARE IN mm.
2. CLEARANCE FOR CURVE SHALL BE EXTRA.
3. STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS & DOORS CLOSED WHILE IN MOTION.

TYPICAL FOR 8.0 m WIDE ISLAND PLATFORM

Fig 13: Structure gauge at elevated station with island platform on level or constant grade tangent track

CO-ORDINATES										
X	0	1366	1374	1808	1808	1736	1696	1607	1730	1730
Y	4350	4350	4058	3338	2873	879	666	348	348	0



TYPICAL FOR 8.0 m WIDE ISLAND PLATFORM

NOTES

1. ALL DIMENSIONS ARE IN mm.
2. CLEARANCE FOR CURVE SHALL BE EXTRA.
3. STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS & DOORS CLOSED WHILE IN MOTION.
4. CLEARANCES AT 'A1' & 'A2' SHALL NOT BE LESS THAN 100 MM.

CO-ORDINATES											
X	0	833	1040	1170	1729	1729	1676	1638	1554	1680	1680
Y	4300	4300	4246	4064	3320	2884	885	679	348	348	0

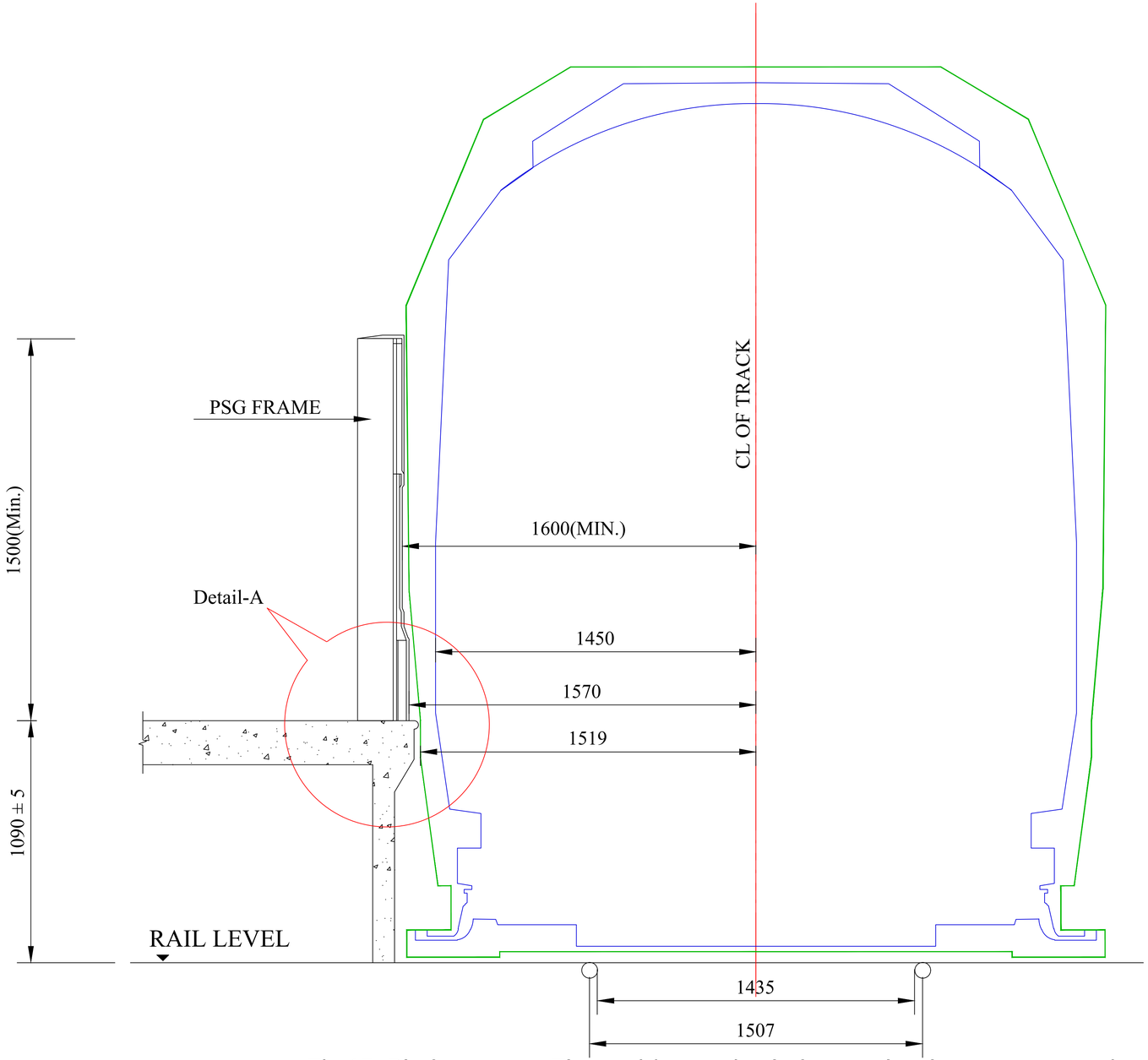
Fig 14: Structure gauge at underground station with island platform on level or constant grade tangent track

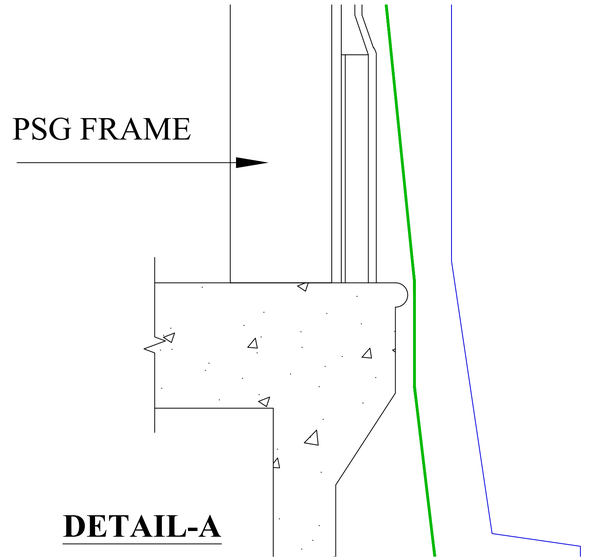
NOTE:

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 H-2900,V-3980.
5. DESIGN SPEED OVER PLATFORM LINES SHALL NOT EXCEED 70KMPH.
6. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 70KMPH.

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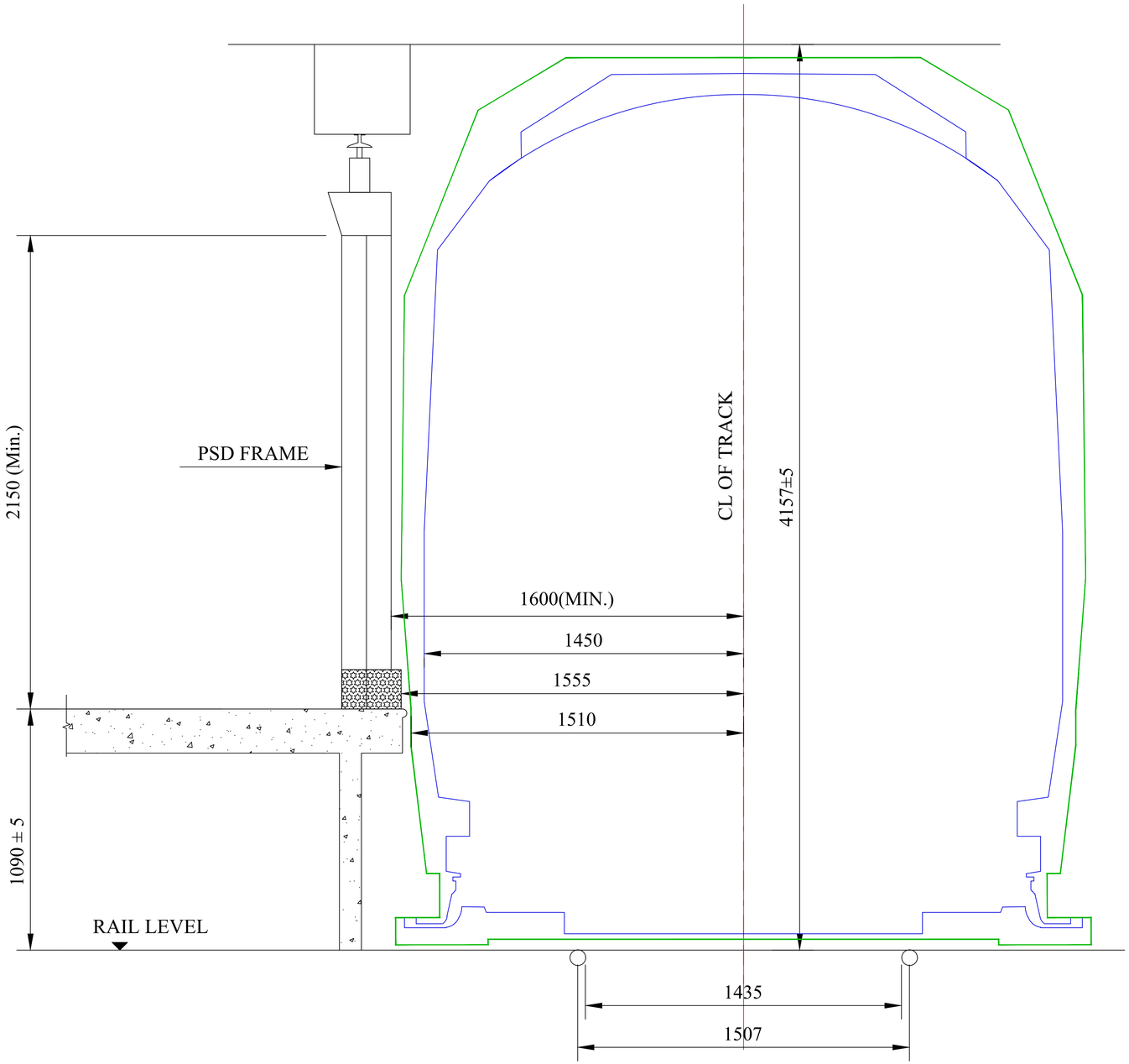




LEGEND

	COACH STATIC PROFILE
	KINEMATIC ENVELOPE OF COACH

Fig 15: Platform gate –Elevated / at grade platform on level or constant grade tangent track



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 H-2900,V-3980.
5. FOR CURVED PLATFORM,THESE DIMENSIONS TO BE INCREASED AS PER TABLE IN APPENDIX-5.
6. DESIGN SPEED OVER PLATFORM LINES SHALL NOT EXCEED 70KMPH.
7. THE KINEMATIC ENVELOPE IS VALID FOR A WIND SPEED OF 0KMPH.

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LEGEND

	COACH STATIC PROFILE
	KINEMATIC ENVELOPE OF COACH

Fig 16: Platform gate – underground platform on level or constant grade tangent track

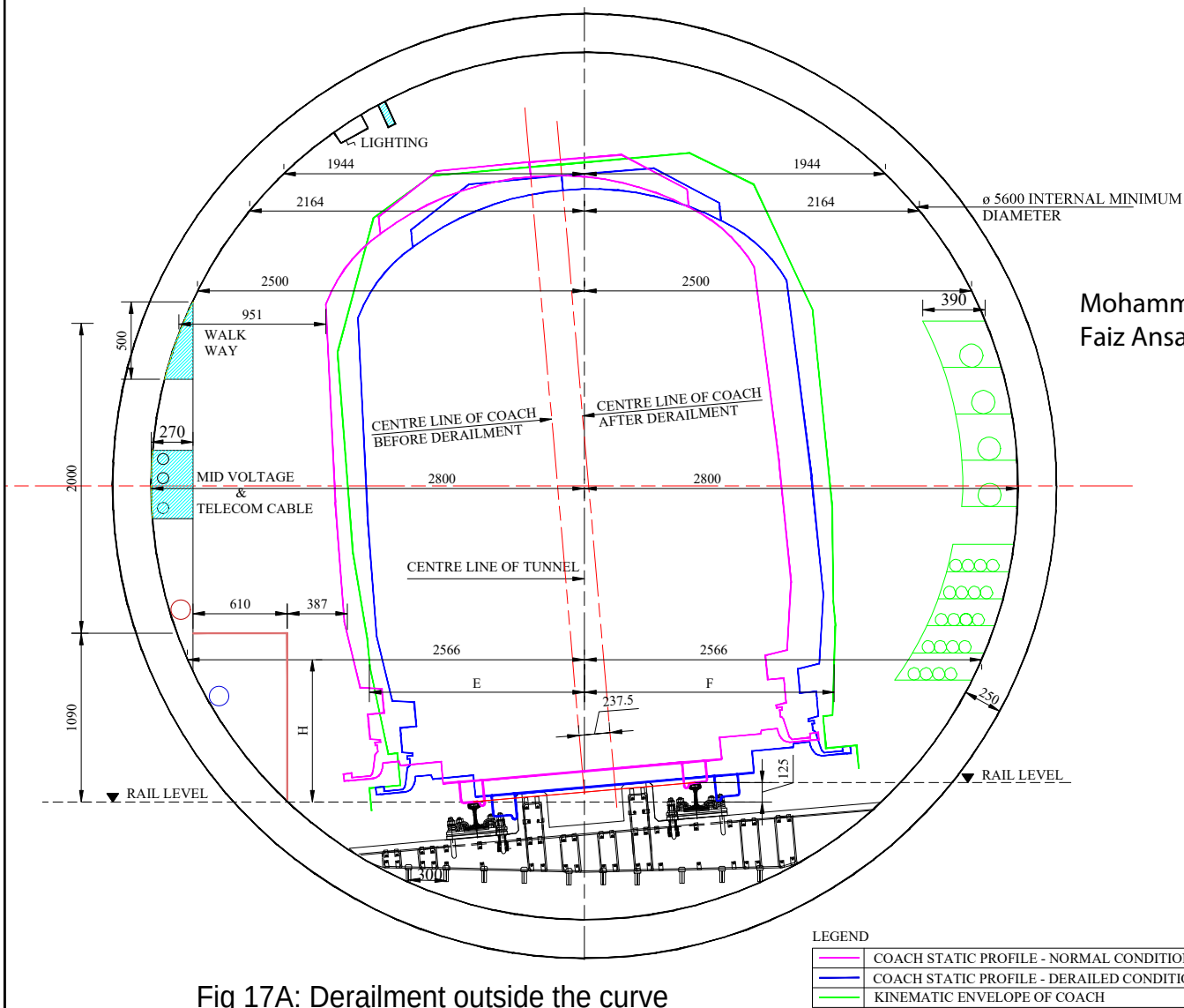


Fig 17A: Derailment outside the curve

LEGEND

	COACH STATIC PROFILE - NORMAL CONDITION
	COACH STATIC PROFILE - DERAILED CONDITION
	KINEMATIC ENVELOPE OF COACH

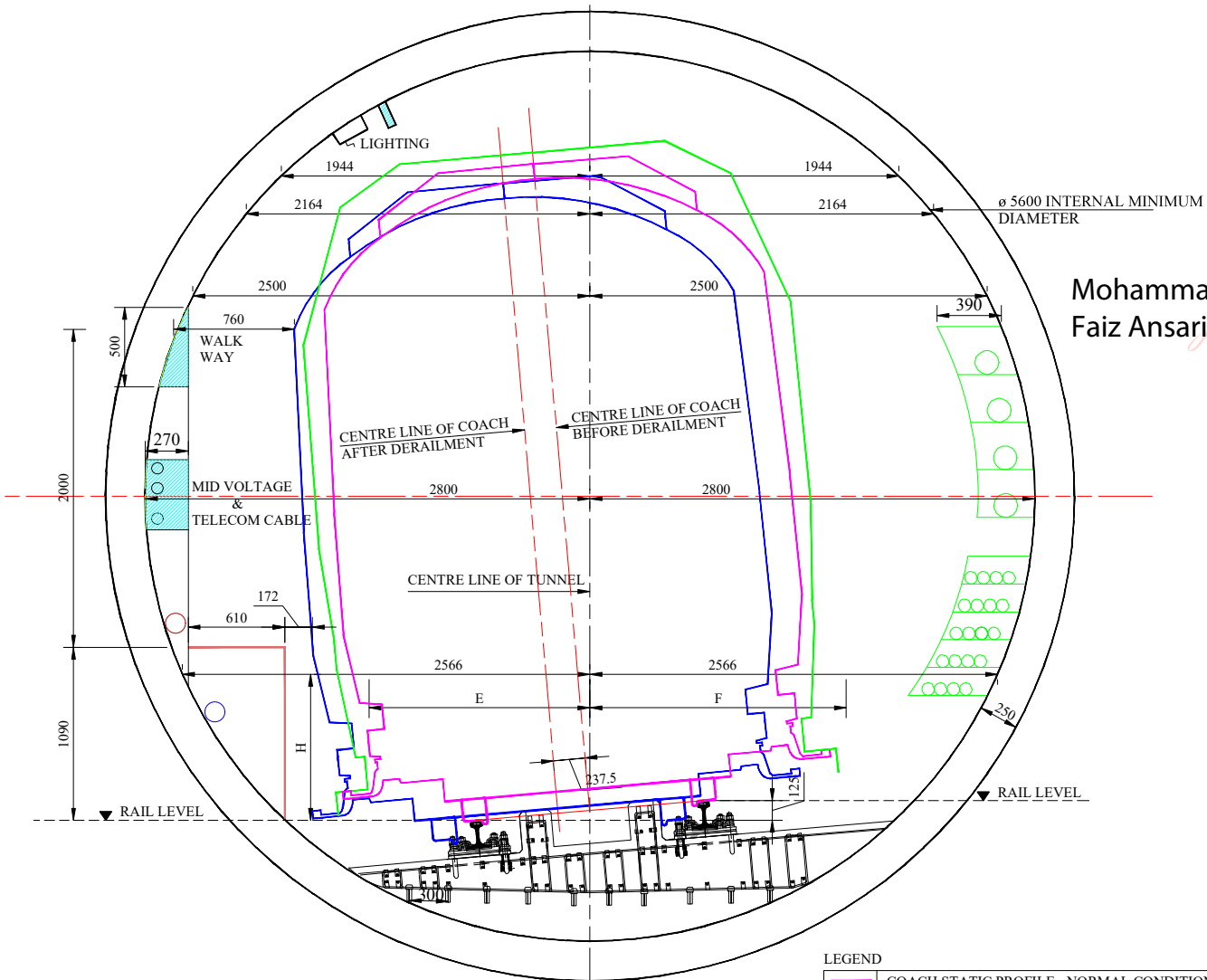
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Date: 2021.10.30 14:56:54 +05'30'

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 IS VALID FOR VEHICLES WITH SEALED WINDOWS AND CLOSED DOORS WHILE IN MOTION.
4. COACH SIZE WIDTH=2900 mm AND HEIGHT=3980 mm.
5. MIN. CLEARANCE BETWEEN KINEMATIC ENVELOPE & STRUCTURE GAUGE IS 100mm.

H Height above Rail Level	E as per table Appendix 3E	F as per table Appendix 3E	Distance between centre line of Track to Tunnel	Clearance	
				Inner Rail	Outer Rail
919	1673.7	1521.2	2566.0	892.3	1044.8
2024	1809.2	1473.4	2800.0	990.8	1326.6
3300	1929.0	1381.6	2500.0	571.0	1118.4
3817	1624.1	990.9	2164.0	539.9	1173.1
4055	1250.2	577.5	1944.0	693.8	1366.5



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Note:

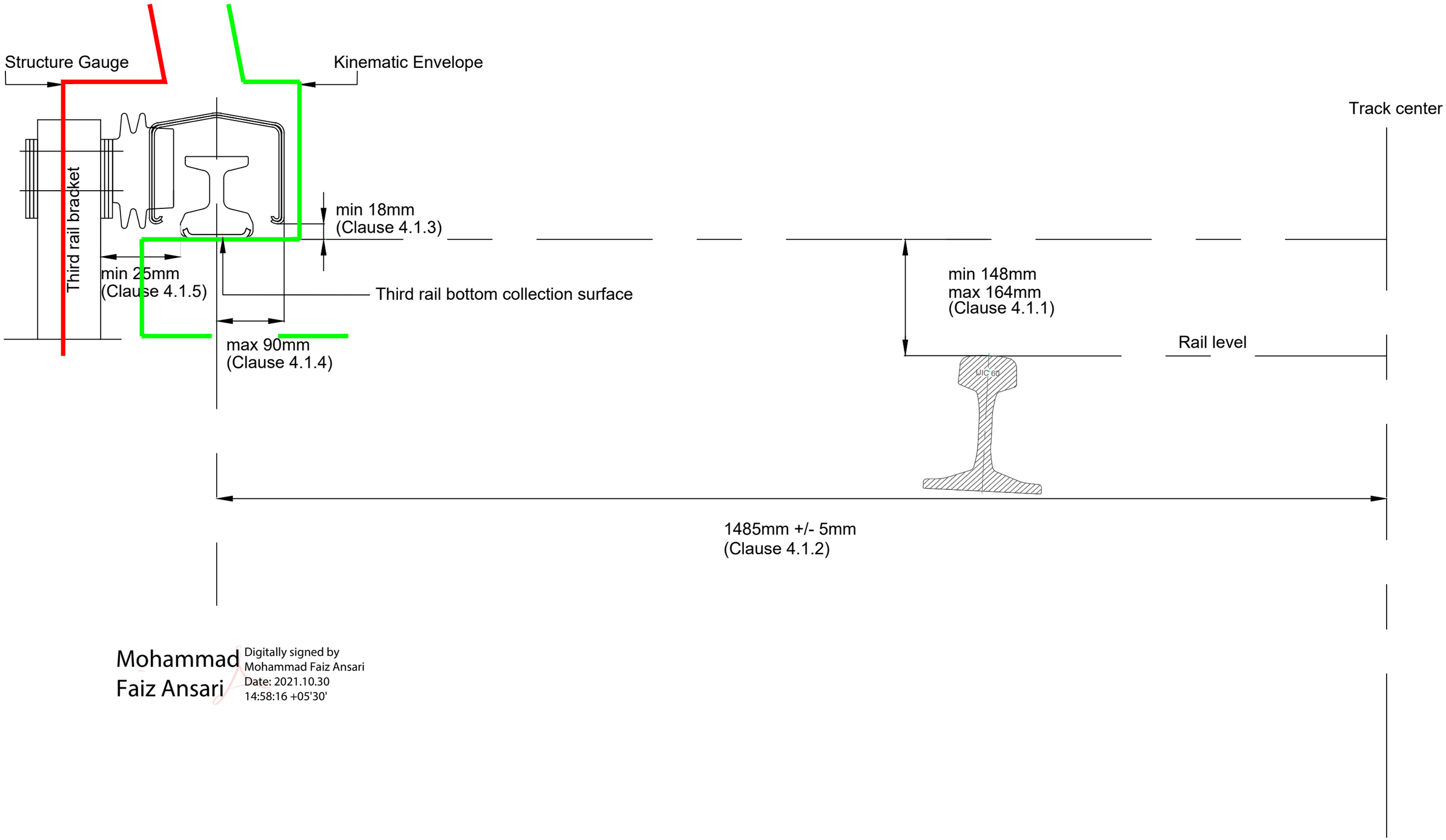
1. ALL DIMENSIONS ARE IN mm.
2. HORIZONTAL AND VERTICAL CLEARANCES DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA.
3. STRUCTURE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND CLOSED DOORS WHILE IN MOTION.
4. COACH SIZE WIDTH=2900 mm AND HEIGHT=3980 mm.
5. MIN. CLEARANCE BETWEEN KINEMATIC ENVELOPE & STRUCTURE GAUGE IS 100mm.

H Height above Rail Level	E as per table Appendix 3E	F as per table Appendix 3E	Distance between centre line of Track to Tunnel	Clearance	
				Inner Rail	Outer Rail
919	1673.7	1521.2	2566.0	892.3	1044.8
2024	1809.2	1473.4	2800.0	990.8	1326.6
3300	1929.0	1381.6	2500.0	571.0	1118.4
3817	1624.1	990.9	2164.0	539.9	1173.1
4055	1250.2	577.5	1944.0	693.8	1366.5

LEGEND

	COACH STATIC PROFILE - NORMAL CONDITION
	COACH STATIC PROFILE - DERAILED CONDITION
	KINEMATIC ENVELOPE OF COACH

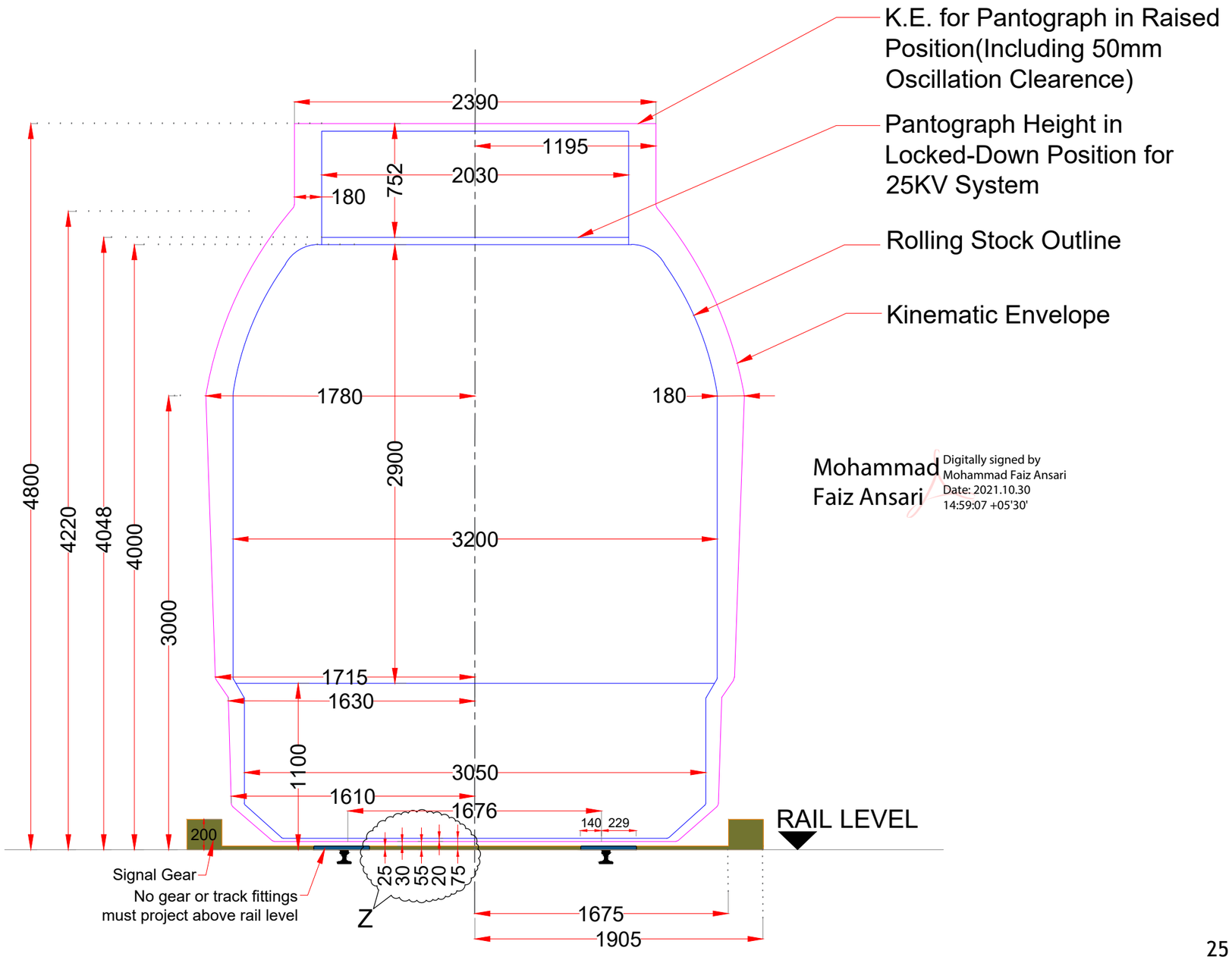
Fig 17 B: Derailment inside the curve



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Fig. 18: Third Rail Current Collection System

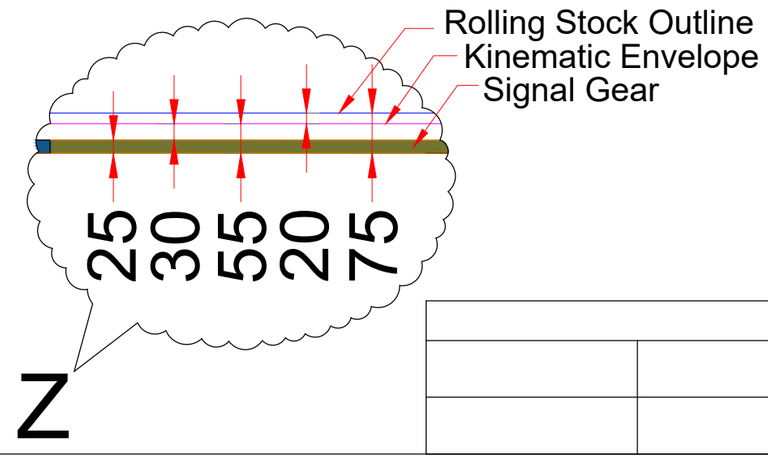


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NOTE:-

1. ALL DIMENSIONS ARE IN mm.
2. KINEMATIC ENVELOPE (of 3200mm maximum coach width) IS CALCULATED FOR WIND SPEED OF 70 kmph, COACH SPEED OF 90 kmph, TRACK DEFECT / CLEARANCE (gauge tolerance + alignment tolerance + cross level error + track alignment error + vertical un-evenness) OF 32mm (for ballasted track) 22mm (for ballast-less track), COACH CLEARANCES (wheel wear + flange wear + bolster to bogie body clearance+ bogie body to axle box clearance, etc.,) OF 43mm, (For bolsterless bogie 32 mm) CENTER BETWEEN BOGIE OF 15000mm AND TOTAL END-TO-END COACH LENGTH OF 21740mm.
3. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVE (including vertical curve) AND CANT SHALL BE EXTRA.
4. KINEMATIC ENVELOPE IS VALID FOR VEHICLE WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.

THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM

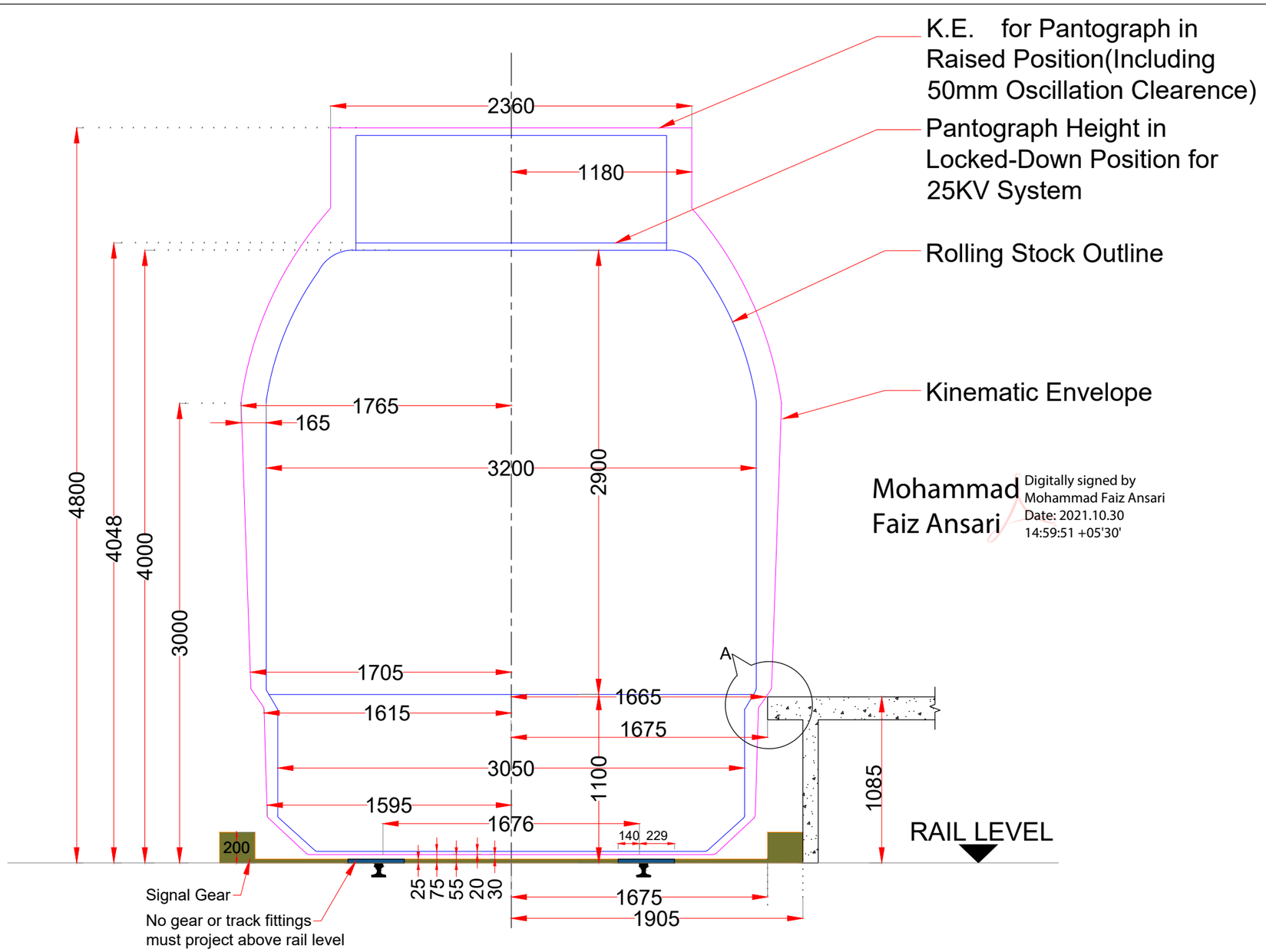


Note :

1. MINIMUM ELECTRICAL CLARENCE - 270mm
2. REGIONAL WIND SPEED kmph
3. MAXIMUM WIND SPEED kmph
4. OPERATION IS AS PER IS-875 (latest)
5. DESIGN SPEED OF ROLLING STOCK - 90 kmph

25 KV A.C. TRACTION

NAME OF WORK :	KINEMATIC ENVELOPE FOR AT-GRADE AND ELEVATED SECTIONS ON LEVEL OR CONSTANT GRADE TANGENT TRACK
DRG. No :	Fig.1
SCALE :	NTS



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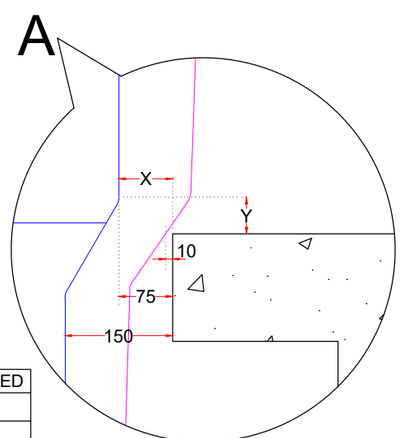
NOTE:-

1. ALL DIMENSIONS ARE IN mm.
2. KINEMATIC ENVELOPE (of 3200mm maximum coach width) IS CALCULATED FOR WIND SPEED OF 70 kmph, COACH SPEED OF 70 kmph, TRACK DEFECT / CLEARANCE (gauge tolerance + alignment tolerance + cross level error + track alignment error + vertical un-evenness) OF 32mm (for ballasted track) 22mm (for ballast-less track), COACH CLEARANCES (wheel wear + flange wear + bolster to bogie body clearance+ bogie body to axle box clearance, etc.,) OF 43mm, (For bolsterless bogie 32 mm) CENTER BETWEEN BOGIE OF 15000mm AND TOTAL END-TO-END COACH LENGTH OF 21740mm.
3. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVE (including vertical curve) AND CANT SHALL BE EXTRA.
4. KINEMATIC ENVELOPE IS VALID FOR VEHICLE WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.

THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM

HEIGHT OF PASSENGER PLATFORM:

1. MAX. FOR BALLASTED TRACK - 1085
2. MAX. FOR BALLASTLESS TRACK - 1095
3. MIN. FOR BALLASTED TRACK - 1075
4. MIN. FOR BALLASTLESS TRACK - 1085



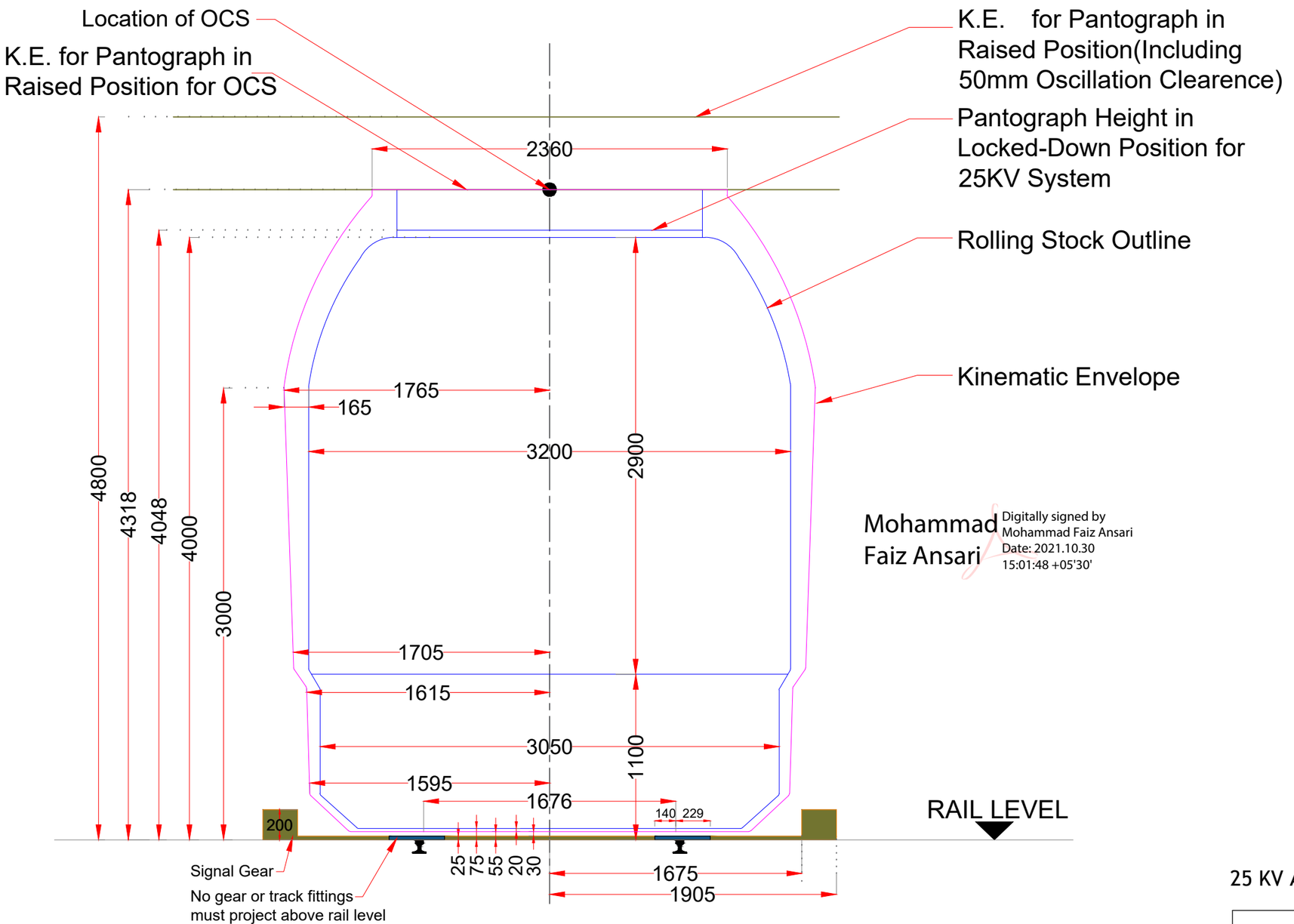
Note :

1. MINIMUM ELECTRICAL CLARENCE - 270mm
2. REGIONAL WIND SPEED kmph
3. MAXIMUM WIND SPEED kmph
4. OPERATION IS AS PER IS - 875 (latest)
5. DESIGN SPEED OF ROLLING STOCK - 90 kmph

CONDITION	UNLOADED	LOADED
X	75	75
Y	50	20

25 KV A.C. TRACTION

NAME OF WORK :	KINEMATIC ENVELOPE FOR AT-GRADE AND ELEVATED SECTIONS ON LEVEL OR CONSTANT GRADE TANGENT TRACK AT PLATFORM
DRG. No :	Fig. 2
SCALE :	NTS :



NOTE:-

1. ALL DIMENSIONS ARE IN mm.
2. KINEMATIC ENVELOPE (of 3200mm maximum coach width) IS CALCULATED FOR WIND SPEED OF 42 kmph, COACH SPEED OF 90 kmph, TRACK DEFECT / CLEARANCE (gauge tolerance + alignment tolerance + cross level error + track alignment error + vertical un-evenness) OF 32mm (for ballasted track) 22mm (for ballast-less track), COACH CLEARANCES (wheel wear + flange wear + bolster to bogie body clearance+ bogie body to axle box clearance, etc.,) OF 43mm, (For bolsterless bogie 32 mm) CENTER BETWEEN BOGIE OF 15000mm AND TOTAL END-TO-END COACH LENGTH OF 21740mm.
3. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVE (including vertical curve) AND CANT SHALL BE EXTRA.
4. KINEMATIC ENVELOPE IS VALID FOR VEHICLE WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.

THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM

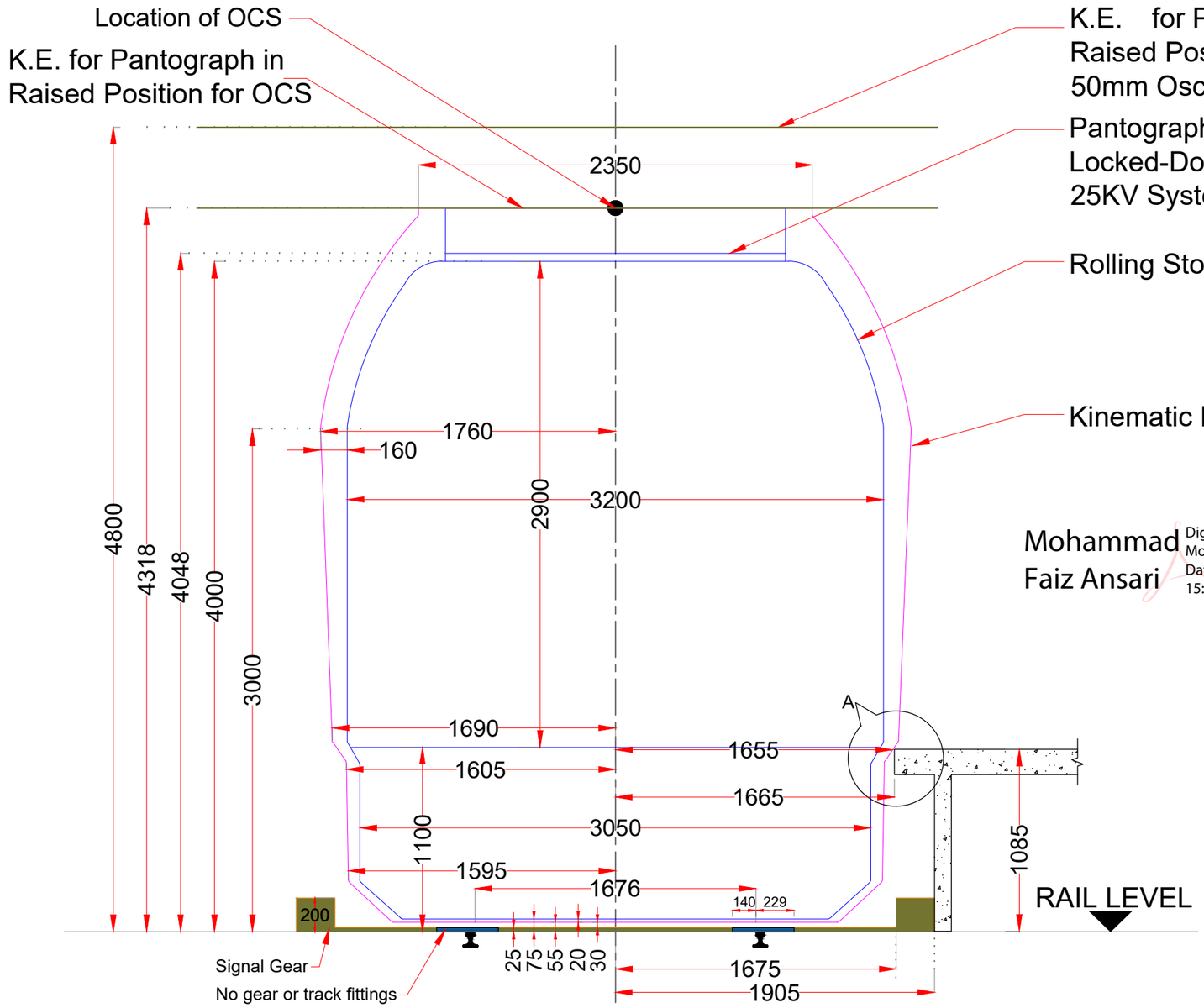
Mohammad Faiz Ansari
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Date: 2021.10.30 15:01:48 +05'30'

Note :

1. MINIMUM ELECTRICAL CLARENCE - 270mm
2. REGIONAL WIND SPEED kmph
3. MAXIMUM WIND SPEED kmph
4. OPERATION IS AS PER IS - 875 (latest)
5. DESIGN SPEED OF ROLLING STOCK - 90 kmph

25 KV A.C. TRACTION

NAME OF WORK :	KINEMATIC ENVELOPE FOR CUT AND COVER SECTION OF UNDERGROUND (TUNNELS) ON LEVEL OR CONSTANT GRADE TANGENT TRACK
DRG. No :	Fig. 3
SCALE :	NTS



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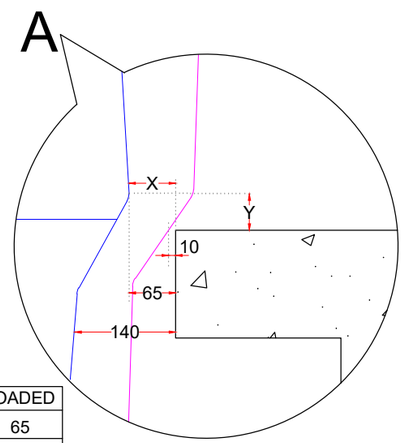
NOTE:-

1. ALL DIMENSIONS ARE IN mm.
2. KINEMATIC ENVELOPE (of 3200mm maximum coach width) IS CALCULATED FOR WIND SPEED OF 42 kmph, COACH SPEED OF 70 kmph, TRACK DEFECT / CLEARANCE (gauge tolerance + alignment tolerance + cross level error + track alignment error + vertical un-evenness) OF 32mm (for ballasted track) 22mm (for ballast-less track), COACH CLEARANCES (wheel wear + flange wear + bolster to bogie body clearance+ bogie body to axle box clearance, etc.,) OF 43mm, (For bolsterless bogie 32 mm) CENTER BETWEEN BOGIE OF 15000mm AND TOTAL END-TO-END COACH LENGTH OF 21740mm.
3. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVE (including vertical curve) AND CANT SHALL BE EXTRA.
4. KINEMATIC ENVELOPE IS VALID FOR VEHICLE WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.

THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM

HEIGHT OF PASSENGER PLATFORM:

1. MAX. FOR BALLASTED TRACK - 1085
2. MAX. FOR BALLASTLESS TRACK - 1095
3. MIN. FOR BALLASTED TRACK - 1075
4. MIN. FOR BALLASTLESS TRACK - 1085



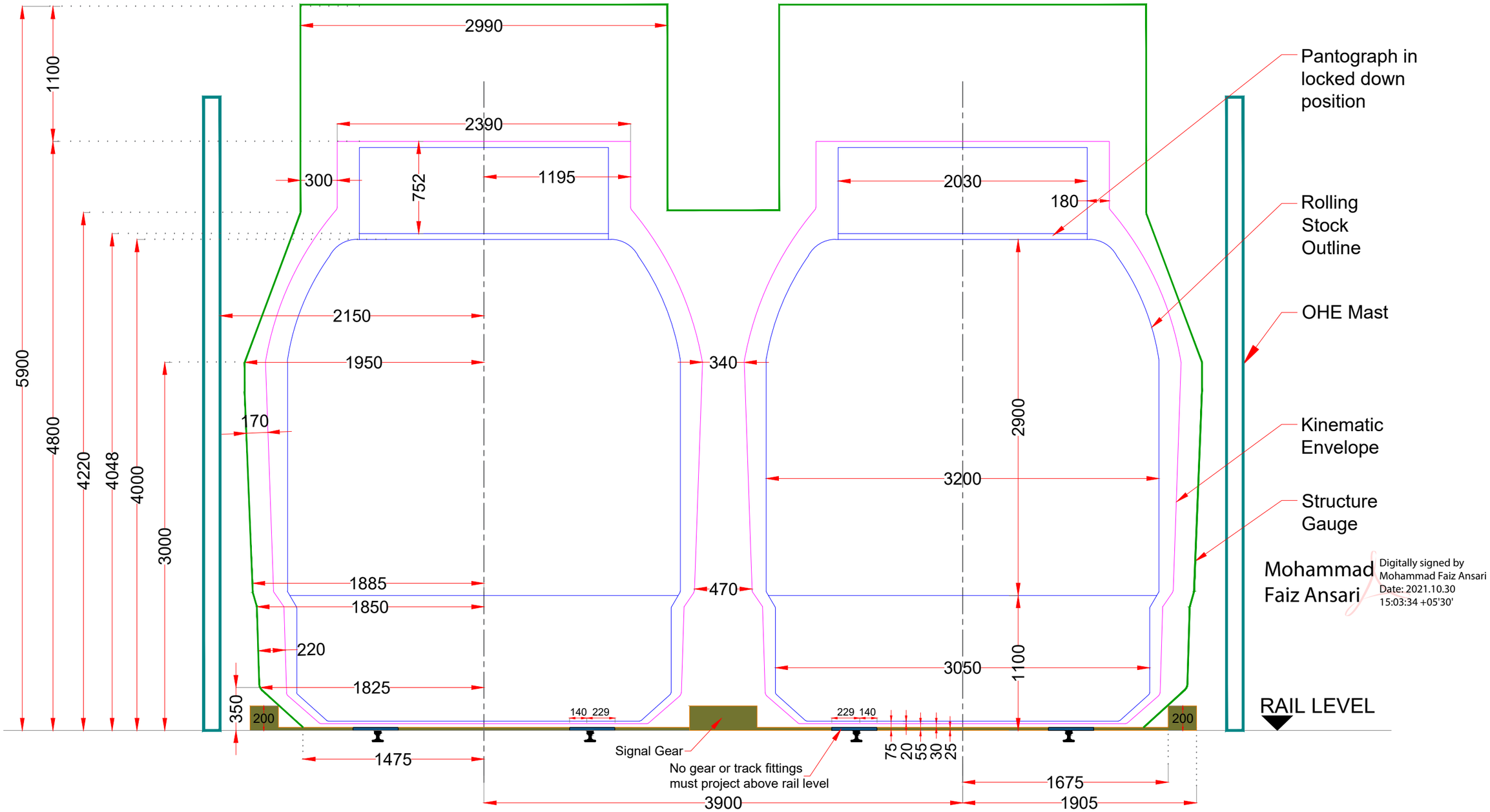
Note :

1. MINIMUM ELECTRICAL CLARENCE - 270mm
2. REGIONAL WIND SPEED kmph
3. MAXIMUM WIND SPEED kmph
4. OPERATION IS AS PER IS - 875 (latest)
5. DESIGN SPEED OF ROLLING STOCK - 90 kmph

CONDITION	UNLOADED	LOADED
X	65	65
Y	50	20

25 KV A.C. TRACTION

NAME OF WORK :	KINEMATIC ENVELOPE FOR CUT AND COVER SECTION OF UNDERGROUND (TUNNELS) ON LEVEL OR CONSTANT GRADE TANGENT TRACK AT PLATFORM
DRG. No :	Fig. 4
SCALE :	NTS



Mohammad Faiz Ansari

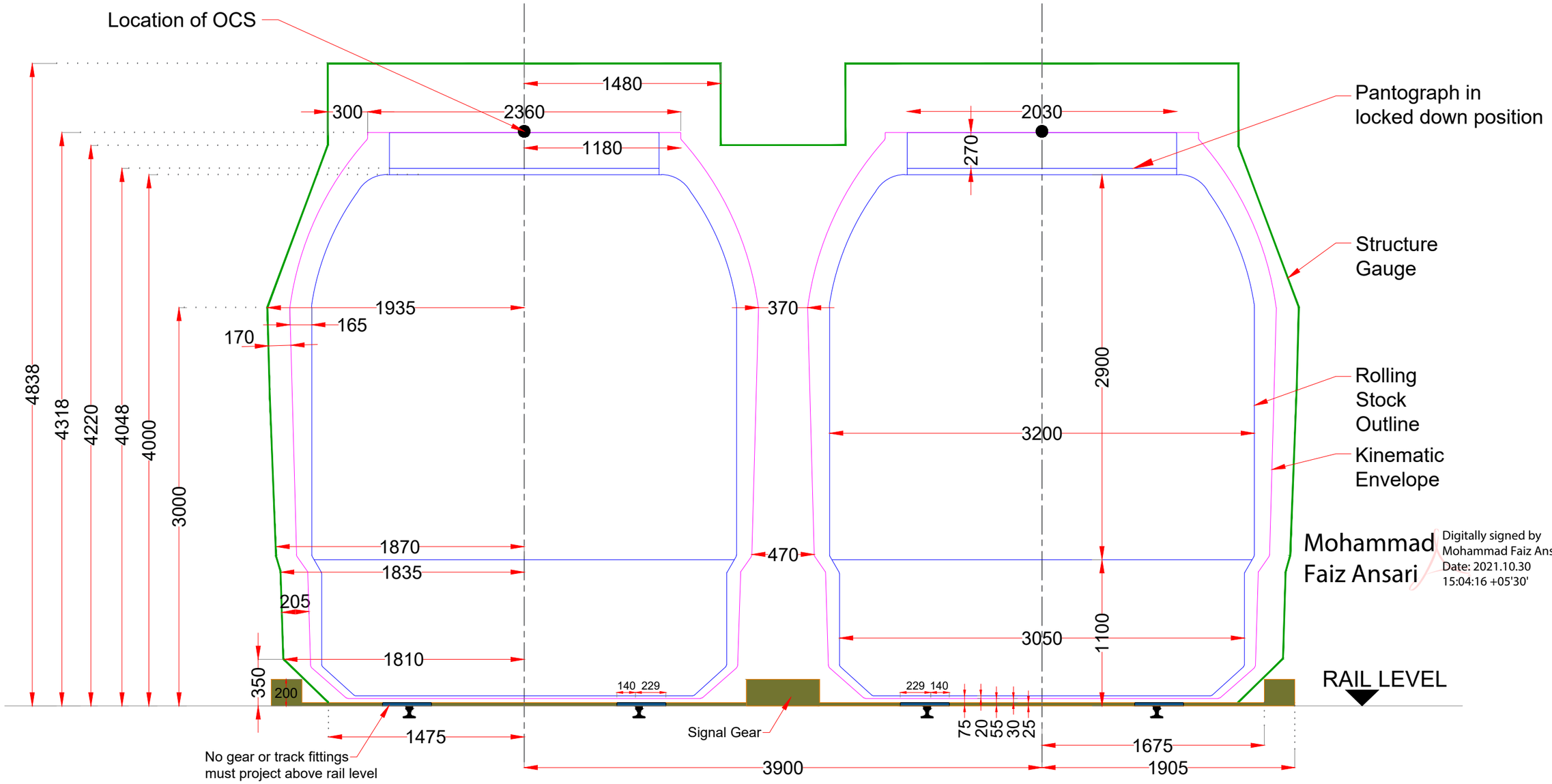
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Date: 2021.10.30 15:03:34 +05'30'

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. TRACK CENTRES / STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
3. ALLOWANCE FOR HORIZONTAL AND VERTICAL CURVES AND CANT SHALL BE EXTRA.
4. FOR KINEMATIC ENVELOPE , REFER TO FIGURE NO._____

25 KV A.C. TRACTION

NAME OF WORK :	STRUCTURE GAUGE FOR AT-GRADE AND ELEVATED SECTIONS ON LEVEL OR CONSTANT GRADE TANGENT TRACK
DRG. No :	Fig. 5
SCALE :	NTS



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NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. TRACK CENTRES / STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
3. ALLOWANCE FOR HORIZONTAL AND VERTICAL CURVES AND CANT SHALL BE EXTRA.
4. FOR KINEMATIC ENVELOPE , REFER TO FIGURE NO. _____

25 KV A.C. TRACTION

NAME OF WORK :	STRUCTURE GAUGE FOR CUT AND COVER SECTION OF UNDERGROUND (TUNNELS) ON LEVEL OR CONSTANT GRADE TANGENT TRACK
DRG. No :	Fig. 6
SCALE :	NTS

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

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

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

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

Chord $c_1 c_2 = 2x[(r-D_1)/\sin\theta) \times (\sin\alpha/2)]$

$X = c_1 c_2 \times \cos(90-\theta-\alpha/2)$

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

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

Where 'r' is internal radius of tunnel.

D_1= depth from rail level to invert of tunnel

g= distance between centres of rails

= 1510mm

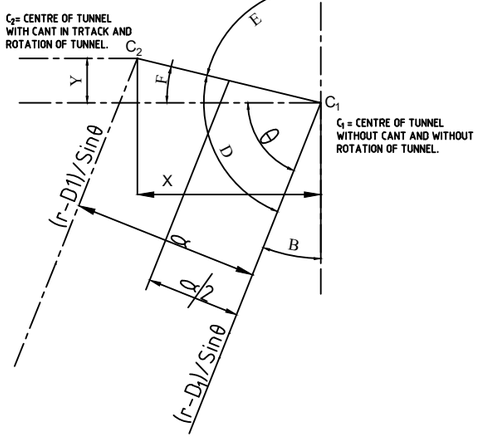
DETAIL AT CENTRE OF TUNNEL

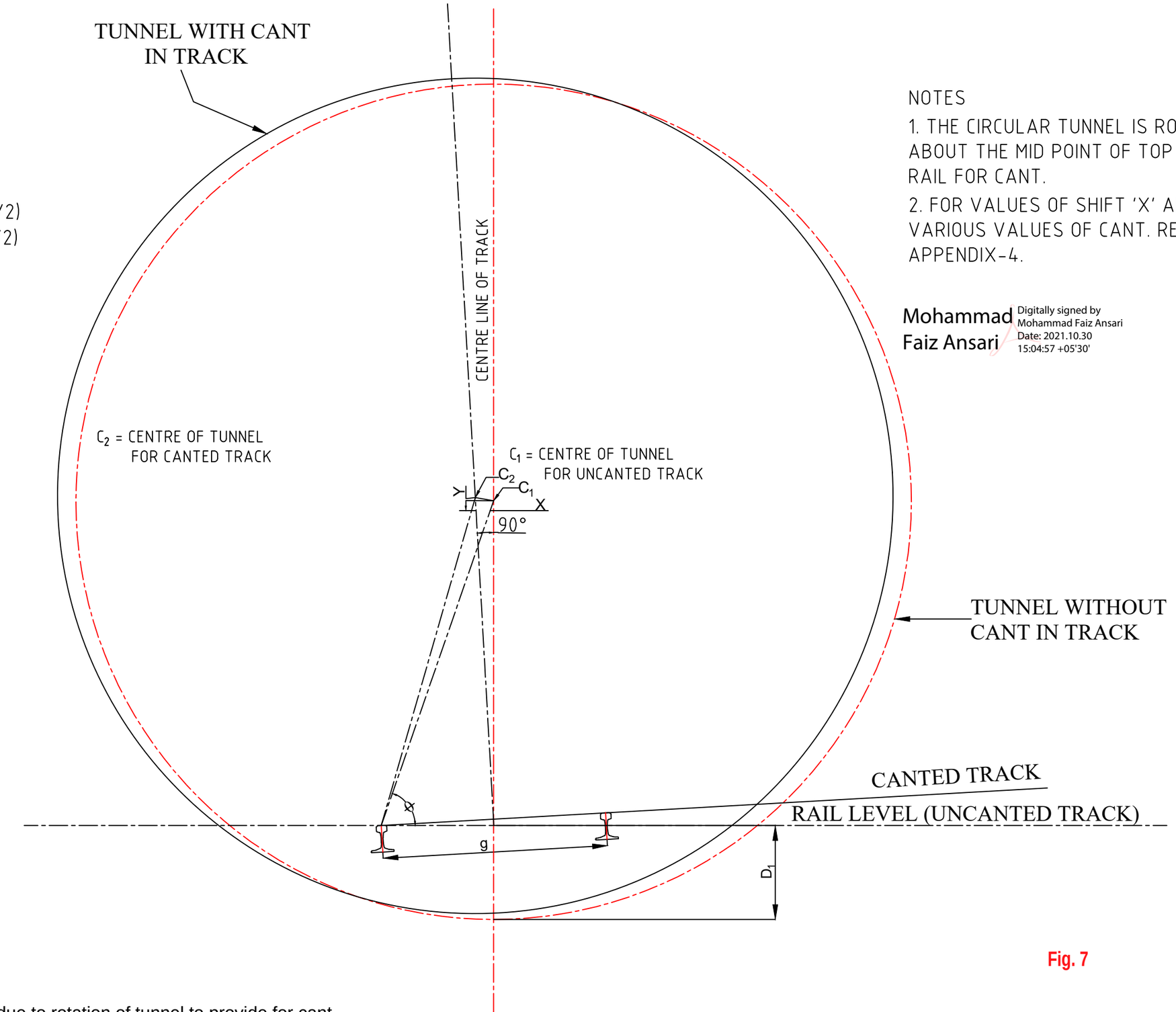
Angle B = $(90-\theta)$

Angle D = $(90-\alpha/2)$

Angle E = $(\theta+\alpha/2)$

Angle F = $(90-\theta-\alpha/2)$





NOTES

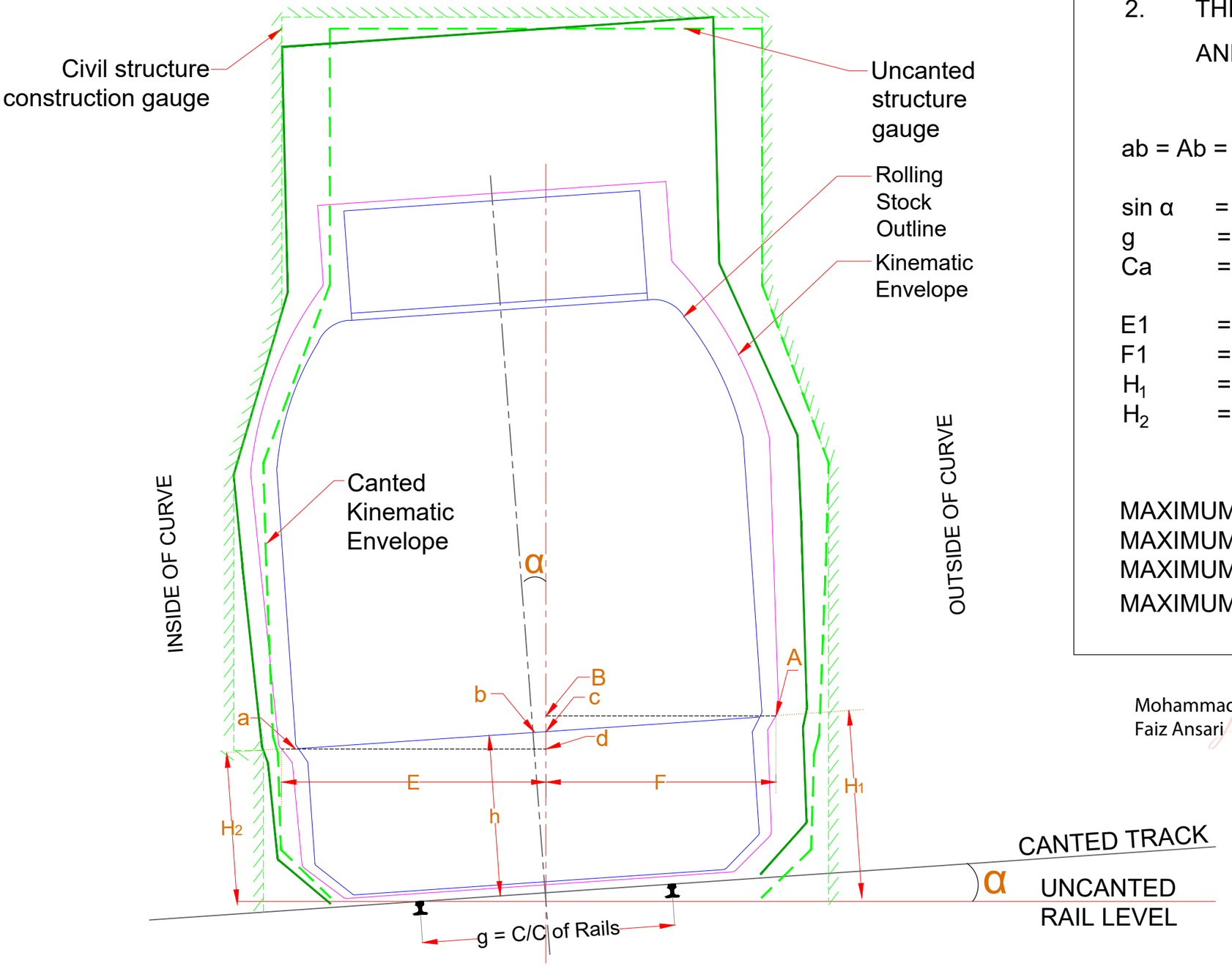
1. THE CIRCULAR TUNNEL IS ROTATED ABOUT THE MID POINT OF TOP OF INNER RAIL FOR CANT.
2. FOR VALUES OF SHIFT 'X' AND 'Y' FOR VARIOUS VALUES OF CANT. REFER TO APPENDIX-4.

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Fig. 7

Fig 7: Shift of the centre of circular tunnel due to rotation of tunnel to provide for cant



Note :

1. ALL DIMENSIONS ARE IN mm
2. THIS DOES NOT INCLUDE CURVATURE EFFECT AND ALLOWANCE FOR VERTICAL CURVE

ab = Ab = Distance from centerline of track to Structure Gauge for level tangent track at any height 'h'
sin α = cant / g
g = 1750 mm for Broad Gauge
Ca = Cant applied

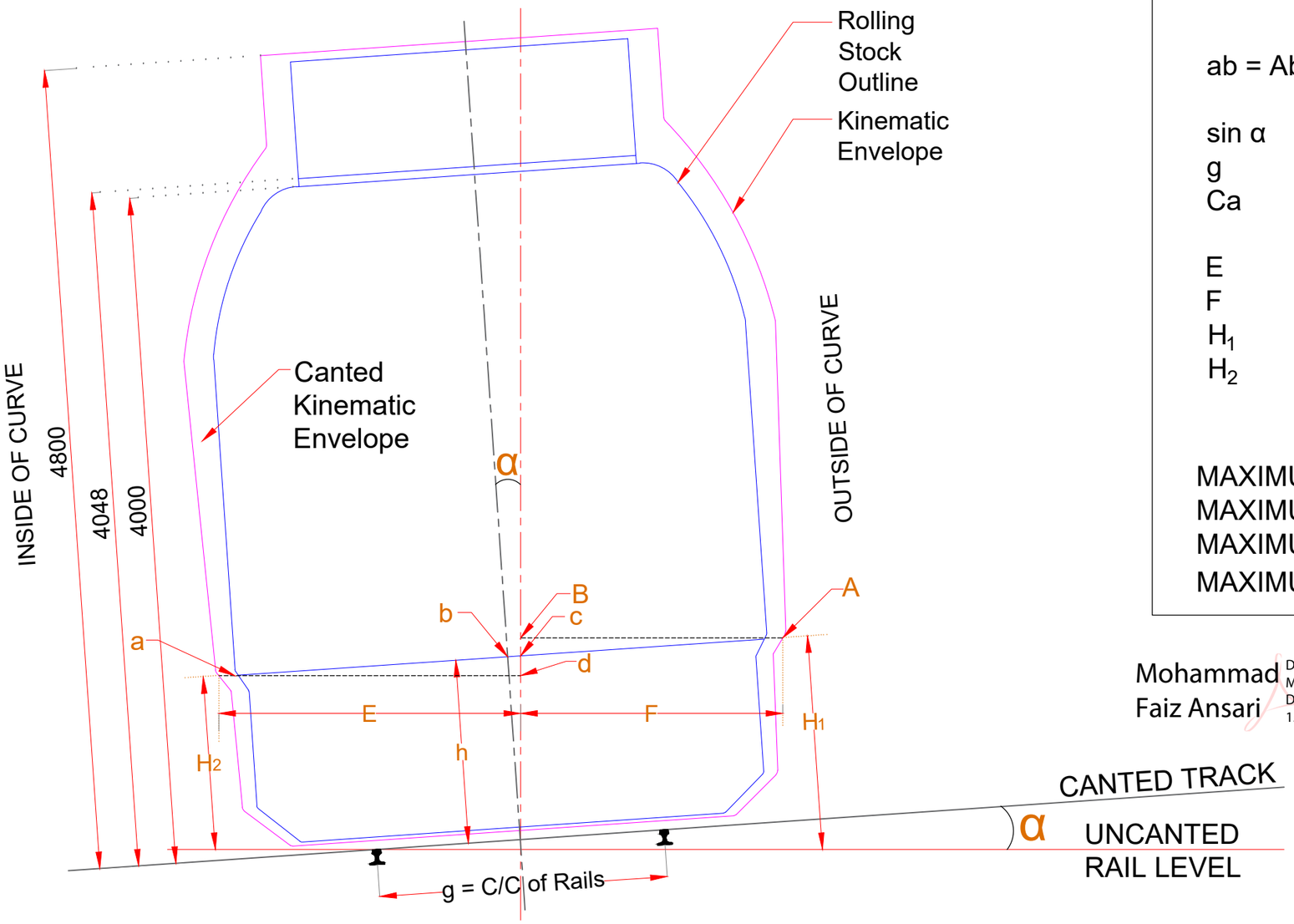
E1 = [ab+(h x tan α)] x cos α
F1 = [Ab- (h x tan α)] x cos α
H_1 = (Ca / 2) + (h / cos α) + (Ab - h x tan α) x sin α
H_2 = (Ca / 2) + (h / cos α) - (ab + h x tan α) x sin α

MAXIMUM CANT - 120
MAXIMUM CANT DEFICIENCY - 85
MAXIMUM CANT EXCESS - 75
MAXIMUM 'α' - 3.931°

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25 KV A.C. TRACTION

NAME OF WORK :	EFFECT OF CANT ON STRUCTURE GAUGE AT ATGRADE SECTION
DRG. No :	Fig. 8
SCALE :	NTS



Note :

1. ALL DIMENSIONS ARE IN mm
2. THIS DOES NOT INCLUDE CURVATURE EFFECT AND ALLOWANCE FOR VERTICAL CURVE

ab = Ab = Distance from centerline of track to Structure Gauge for level tangent track at any height 'h'
sin α = cant / g
g = 1750 mm for Broad Gauge
Ca = Cant applied

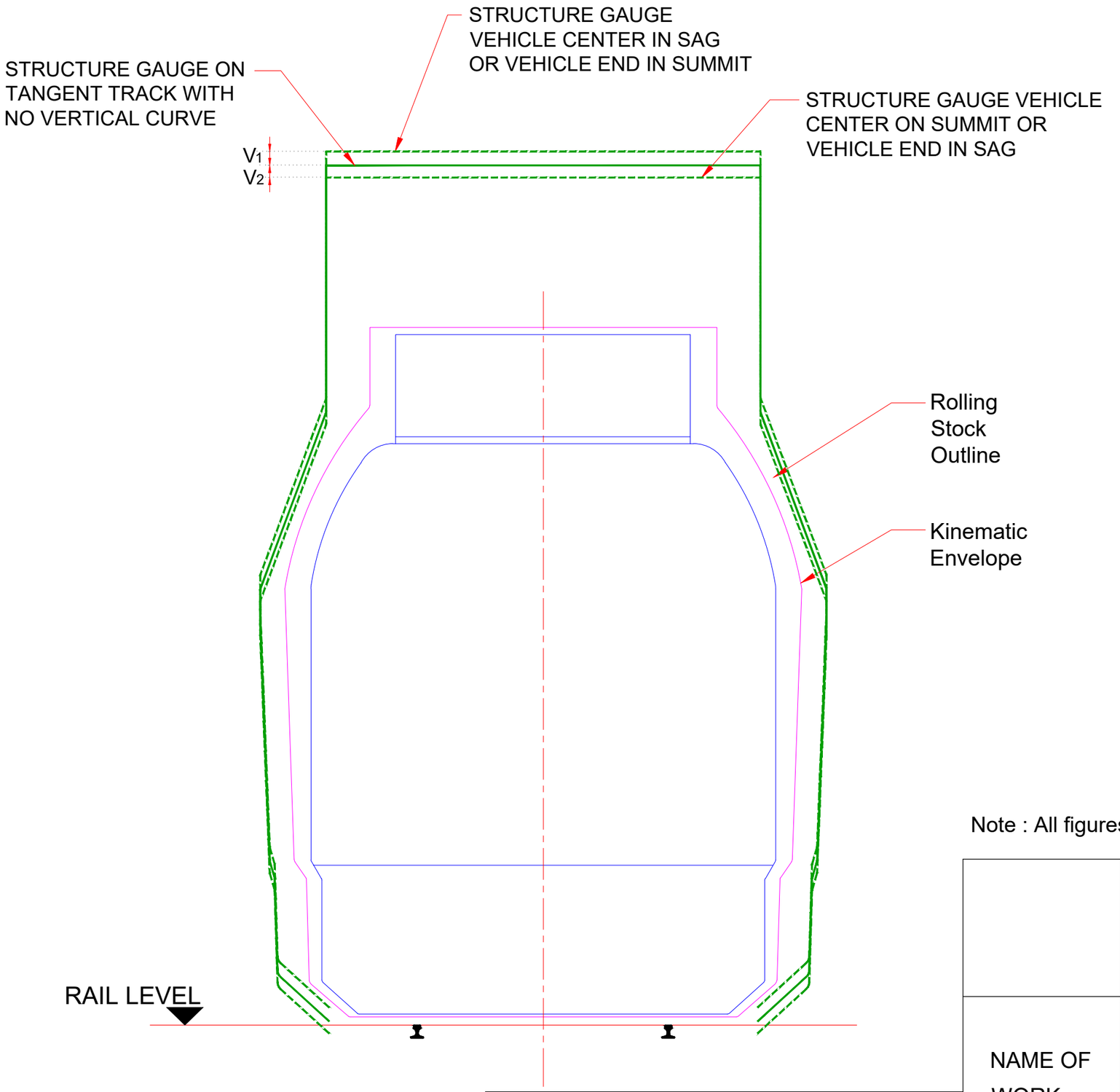
E = [ab+(h x tan α)] x cos α
F = [Ab- (h x tan α)] x cos α
H_1 = (Ca / 2) + (h / cos α) + (Ab - h x tan α) x sin α
H_2 = (Ca / 2) + (h / cos α) - (ab + h x tan α) x sin α

MAXIMUM CANT	- 120
MAXIMUM CANT DEFICIENCY	- 85
MAXIMUM CANT EXCESS	- 75
MAXIMUM 'α'	- 3.931°

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25 KV A.C. TRACTION

NAME OF WORK :	EFFECT OF CANT ON KINEMATIC ENVELOPE AT ATGRADE & ELEVATED SECTION
DRG. No :	Fig. 9
SCALE :	NTS

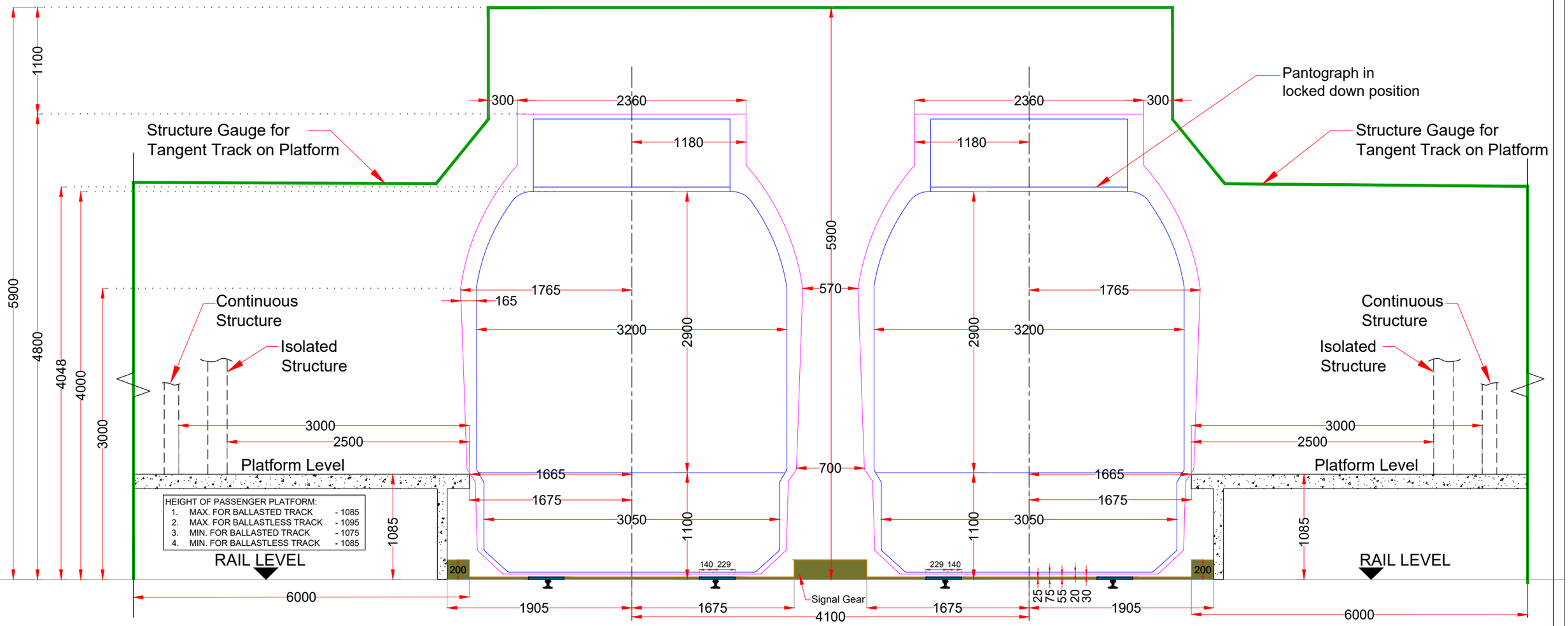


RADIUS OF VERTICAL CURVE(M)	V_1 / V_2 mm
1500	24
1600	22
1700	21
1800	20
1900	19
2000	18
2100	17
2200	16
2300	16
2400	15
2500	15
2600	14
2700	14
2800	13
2900	13
3000	12

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Note : All figures are in mm

NAME OF WORK :	EFFECT OF VERTICAL CURVE ON STRUCTURE GAUGE
DRG. No :	Fig. 10
SCALE :	NTS



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NOTE:

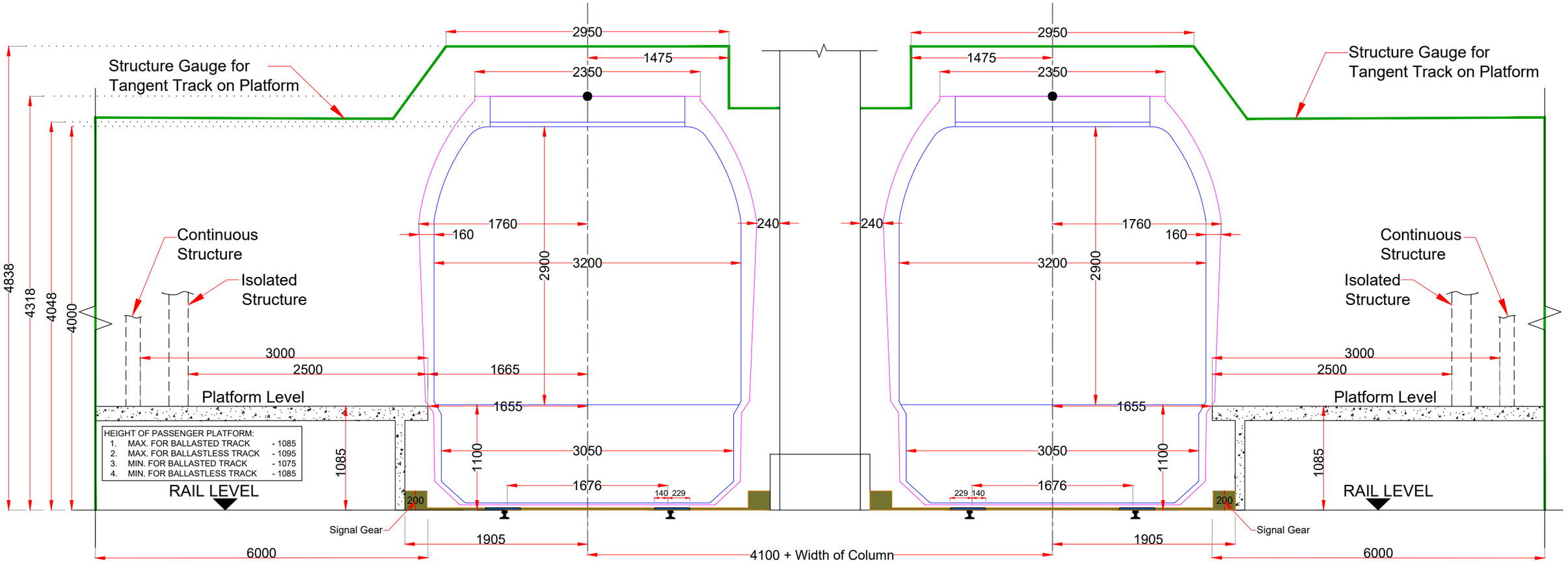
TYPICAL FOR 6000 mm WIDE, SIDE PLATFORMS.

1. ALL DIMENSIONS ARE IN mm.
2. ALLOWANCE FOR CURVE / CANT SHALL BE EXTRA. HOWEVER THE TRACK SPACING OF 4100 mm WILL NOT INCREASE FOR CURVE OF RADIUS 1000 m AND FLATTER.
3. VERTICAL THROW DUE TO VERTICAL CURVE SHALL BE EXTRA.
4. TRACK CENTERS / STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
5. FOR MAINTENANCE OF ANY OF THE OHE LINES, BOTH THE LINES SHALL BE SHUT DOWN.
6. THE OHE IS PROPOSED TO BE SUPPORTED FROM CEILING BY DROP ARM.
7. Refer K.E. _____

THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM AND PLATFORM COPING EDGE DISTANCE FROM CENTRE OF THE TRACK TO BE REDUCED TO 1670.

25 KV A.C. TRACTION

NAME OF WORK :	STRUCTURE GAUGE FOR AT-GRADE AND ELEVATED SECTIONS ON LEVEL OR CONSTANT GRADE TANGENT TRACK FOR SINGLE-END PLATFORM
DRG. No :	Fig. 11
SCALE :	NTS



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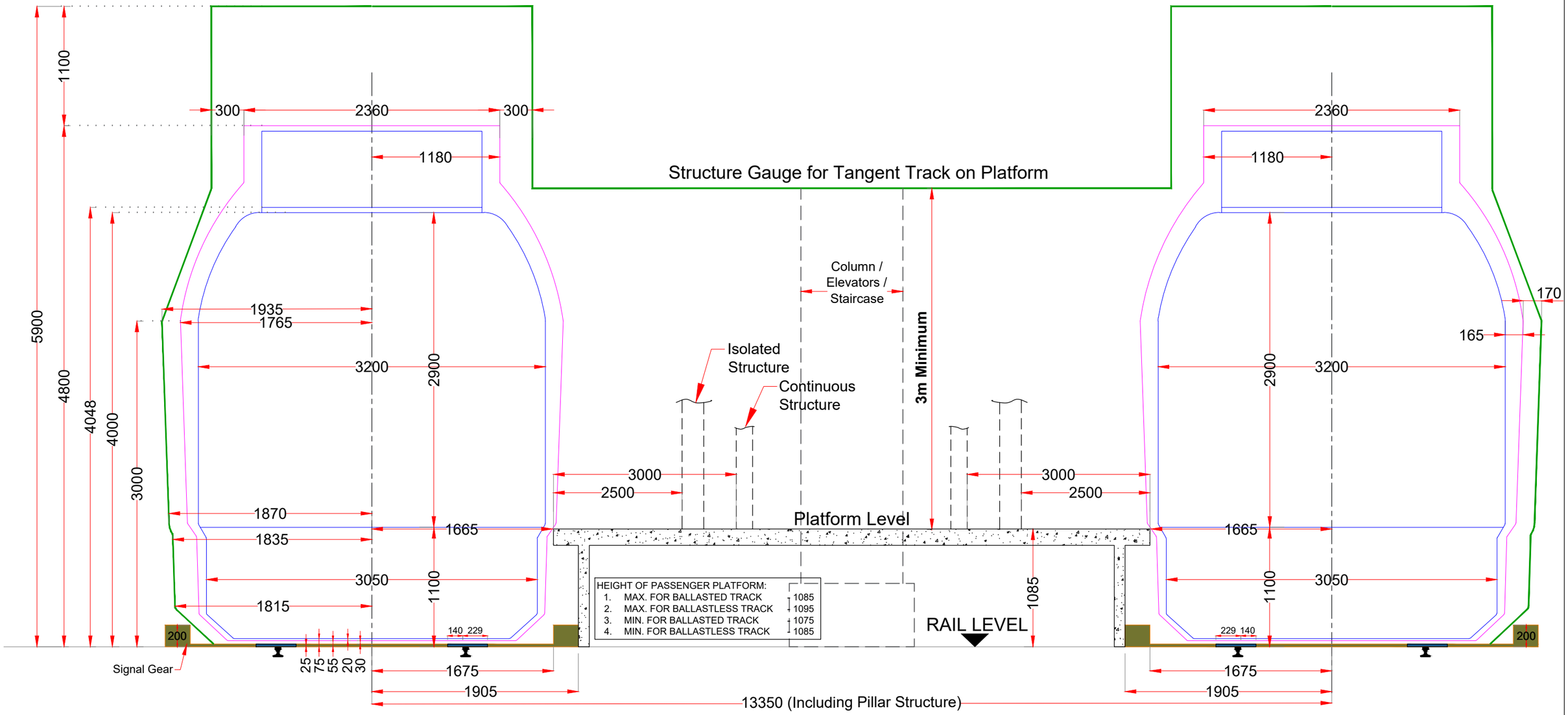
NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. TRACK CENTRES / STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
3. ALLOWANCE FOR HORIZONTAL AND VERTICAL CURVES AND CANT SHALL BE EXTRA.
4. FOR KINEMATIC ENVELOPE , REFER TO FIGURE NO. _____

THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM AND PLATFORM COPING EDGE DISTANCE FROM CENTRE OF THE TRACK TO BE REDUCED TO 1660.

25 KV A.C. TRACTION

NAME OF WORK :	STRUCTURE GAUGE FOR CUT AND COVER SECTION OF UNDERGROUND (TUNNELS) ON LEVEL OR CONSTANT GRADE TANGENT TRACK FOR SINGLE-END PLATFORM
DRG. No :	Fig. 12
SCALE :	NTS



NOTE:

TYPICAL FOR 6000 mm WIDE, ISLND PLATFORMS.

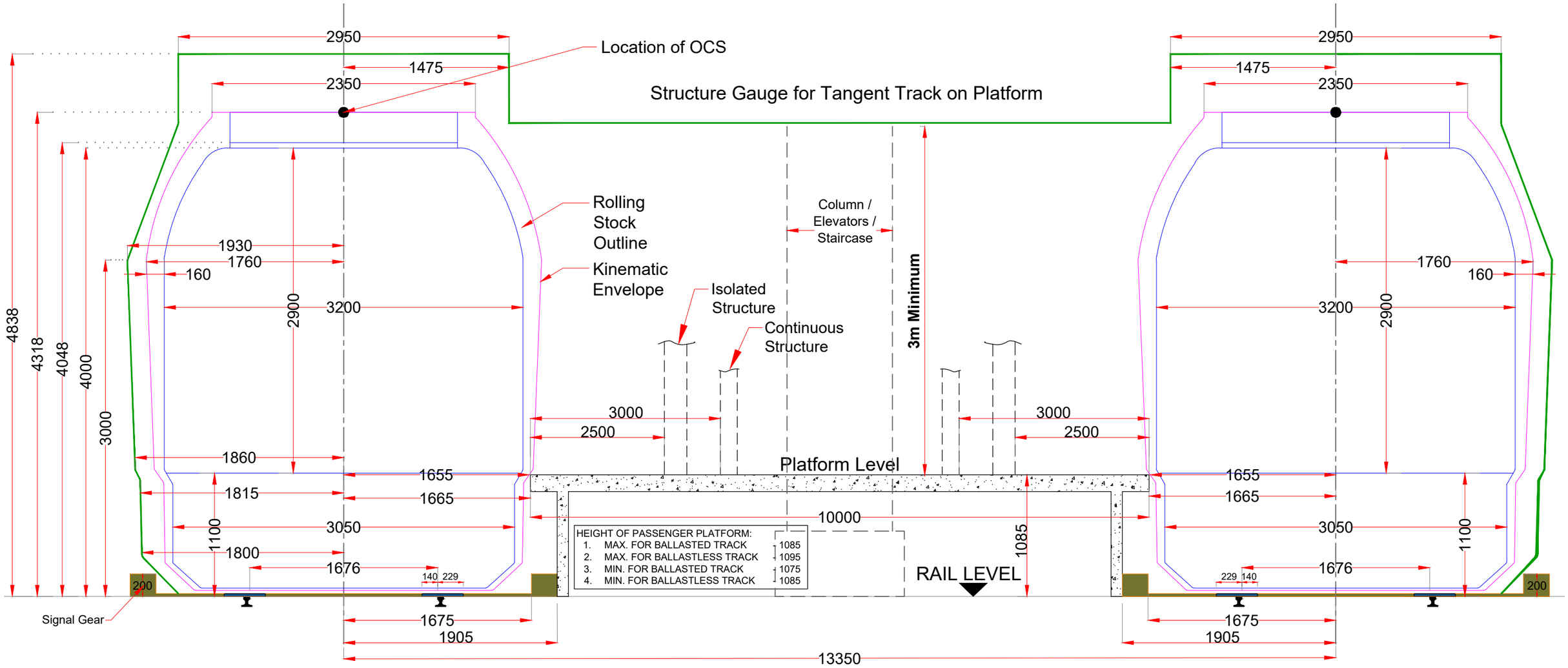
1. ALL DIMENSIONS ARE IN mm.
2. ALLOWANCE FOR CURVE / CANT SHALL BE EXTRA. HOWEVER THE TRACK SPACING OF 4100 mm WILL NOT INCREASE FOR CURVE OF RADIUS 1000 m AND FLATTER.
3. VERTICAL THROW DUE TO VERTICAL CURVE SHALL BE EXTRA.
4. TRACK CENTRES / STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
5. FOR MAINTENANCE OF ANY OF THE OHE LINES, BOTH THE LINES SHALL BE SHUT DOWN.
6. THE OHE IS PROPOSED TO BE SUPPORTED FROM CEILING BY DROP ARM.
7. PLATFORM WIDTH IS NOT TO SCALE.
8. Refer K.E._____

THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM AND PLATFORM COPING EDGE DISTANCE FROM CENTRE OF THE TRACK TO BE REDUCED TO 1670.

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25 KV A.C. TRACTION

NAME OF WORK :	STRUCTURE GAUGE FOR AT-GRADE AND ELEVATED SECTIONS ON LEVEL OR CONSTANT GRADE TANGENT TRACK FOR ISLAND PLATFORM
DRG. No :	Fig. 13
SCALE :	NTS



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NOTE:

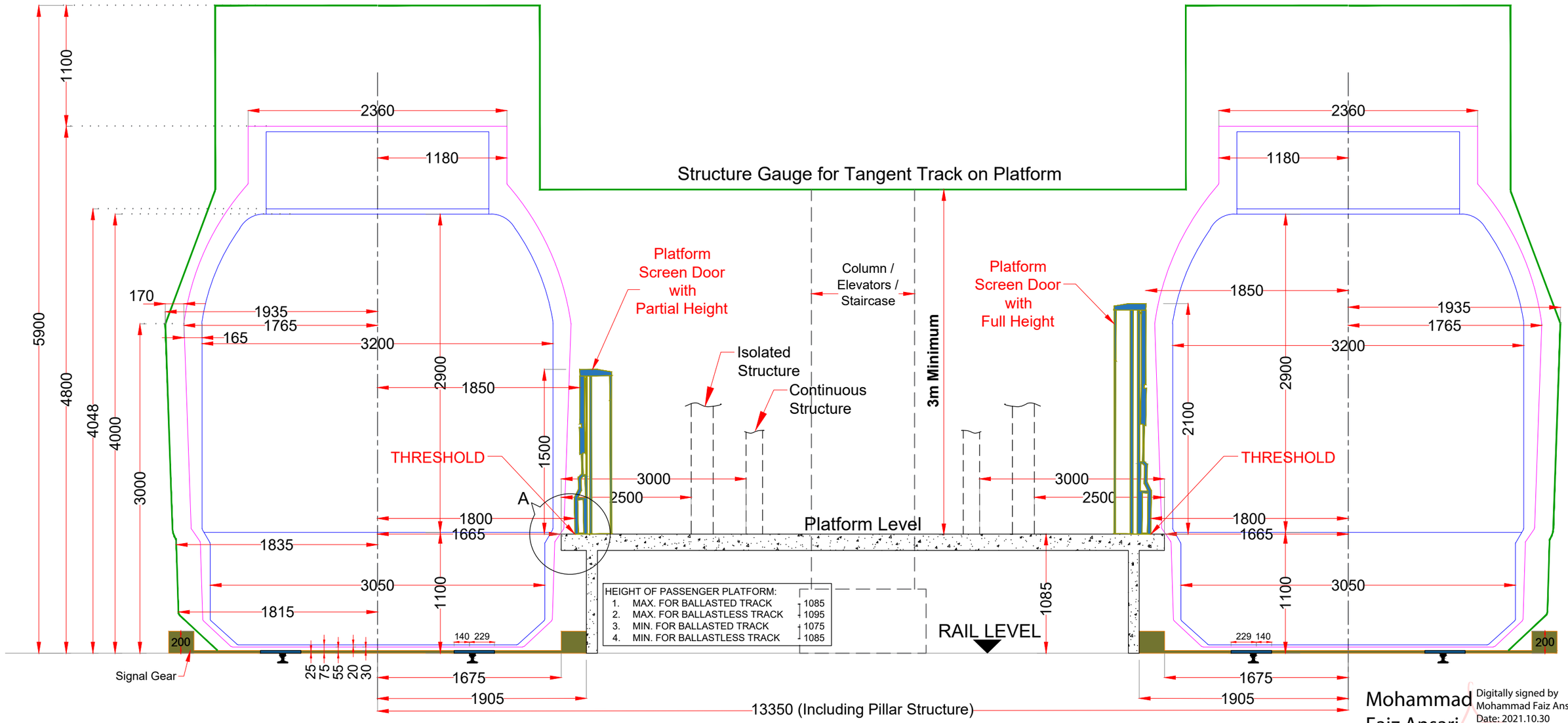
1. ALL DIMENSIONS ARE IN mm.
2. TRACK CENTRES / STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
3. ALLOWANCE FOR HORIZONTAL AND VERTICAL CURVES AND CANT SHALL BE EXTRA.
4. PLATFORM WIDTH IS NOT TO SCALE.
5. FOR KINEMATIC ENVELOPE , REFER TO FIGURE NO. _____

THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM AND PLATFORM COPING EDGE DISTANCE FROM CENTRE OF THE TRACK TO BE REDUCED TO 1660.

25 KV A.C. TRACTION

NAME OF WORK :	STRUCTURE GAUGE FOR CUT AND COVER SECTION OF UNDERGROUND (TUNNELS) ON LEVEL OR CONSTANT GRADE TANGENT TRACK FOR ISLAND PLATFORM
DRG. No :	Fig. 14
SCALE :	NTS

Structure Gauge for Tangent Track on Platform



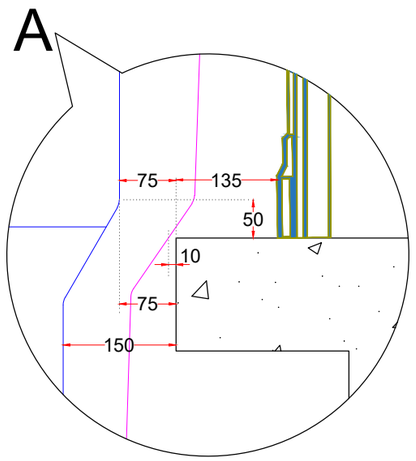
Mohammad Faiz Ansari
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Date: 2021.10.30 15:12:37 +05'30'

NOTE:

TYPICAL FOR 6000 mm WIDE, ISLAND PLATFORMS.

1. ALL DIMENSIONS ARE IN mm.
2. ALLOWANCE FOR CURVE / CANT SHALL BE EXTRA. HOWEVER THE TRACK SPACING OF 4100 mm WILL NOT INCREASE FOR CURVE OF RADIUS 1000 m AND FLATTER.
3. VERTICAL THROW DUE TO VERTICAL CURVE SHALL BE EXTRA.
4. TRACK CENTRES / STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
5. FOR MAINTENANCE OF ANY OF THE OHE LINES, BOTH THE LINES SHALL BE SHUT DOWN.
6. THE OHE IS PROPOSED TO BE SUPPORTED FROM CEILING BY DROP ARM.
7. PLATFORM WIDTH IS NOT TO SCALE.
8. FOR KINEMATIC ENVELOPE , REFER TO FIGURE NO._____

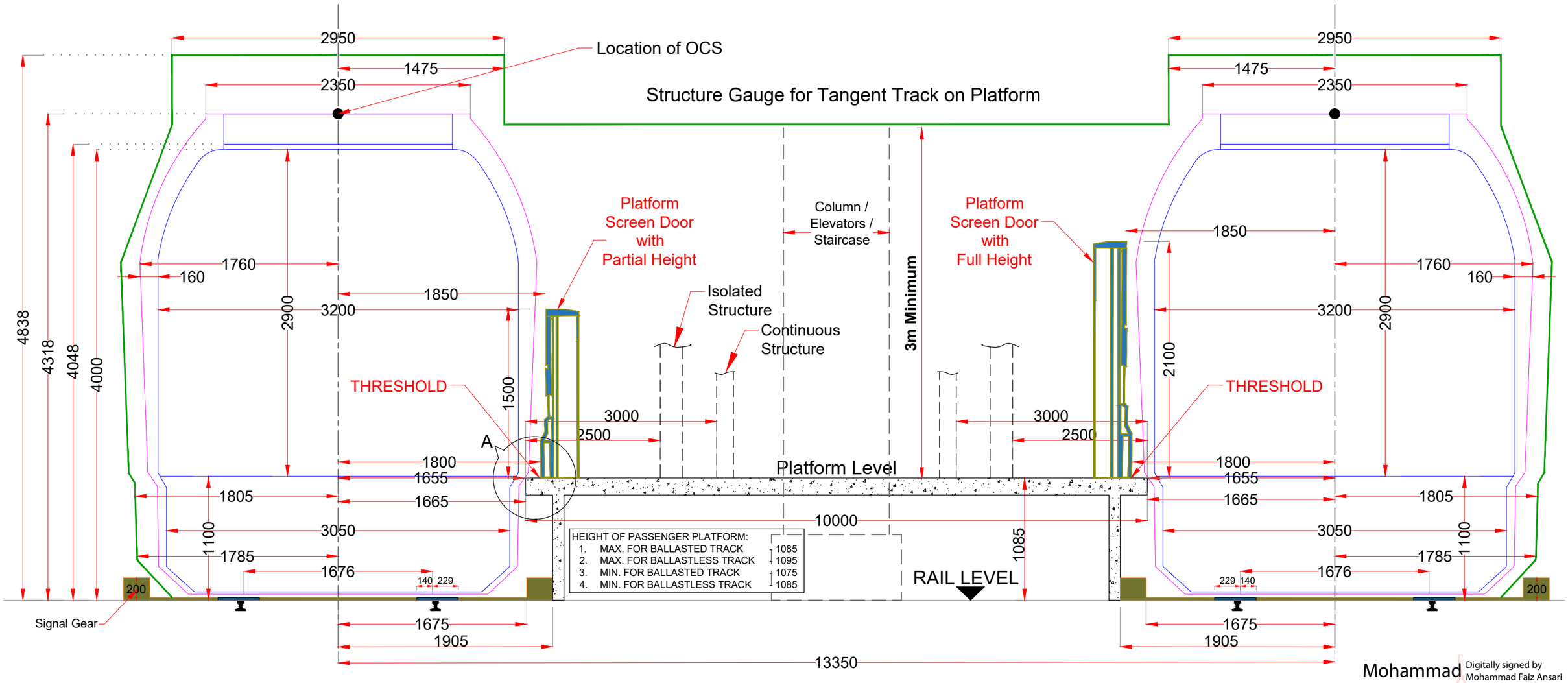
THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM AND PLATFORM COPING EDGE DISTANCE FROM CENTRE OF THE TRACK TO BE REDUCED TO 1670.



25 KV A.C. TRACTION

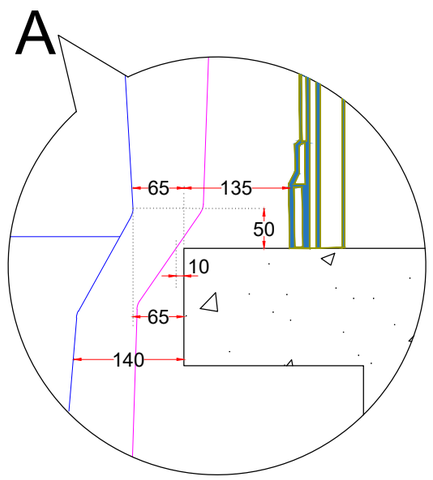
NAME OF WORK :	**Platform gate – Elevated / at grade platform on level or constant grade tangent track**
DRG. No :	Fig. 15
SCALE :	NTS

Structure Gauge for Tangent Track on Platform



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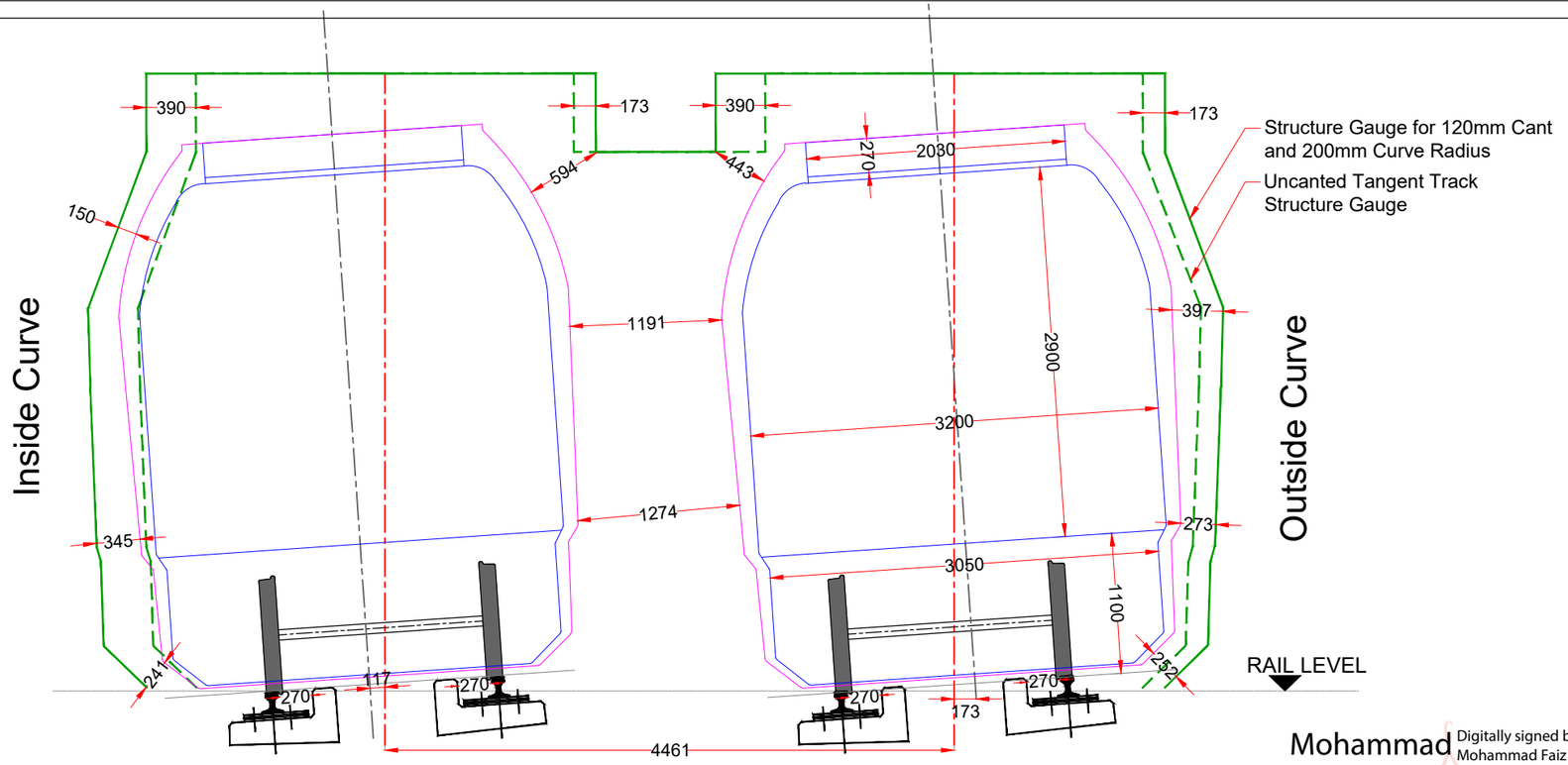
NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. TRACK CENTRES / STRUCTURE GAUGE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
3. ALLOWANCE FOR HORIZONTAL AND VERTICAL CURVES AND CANT SHALL BE EXTRA.
4. FOR KINEMATIC ENVELOPE , REFER TO FIGURE NO. _____

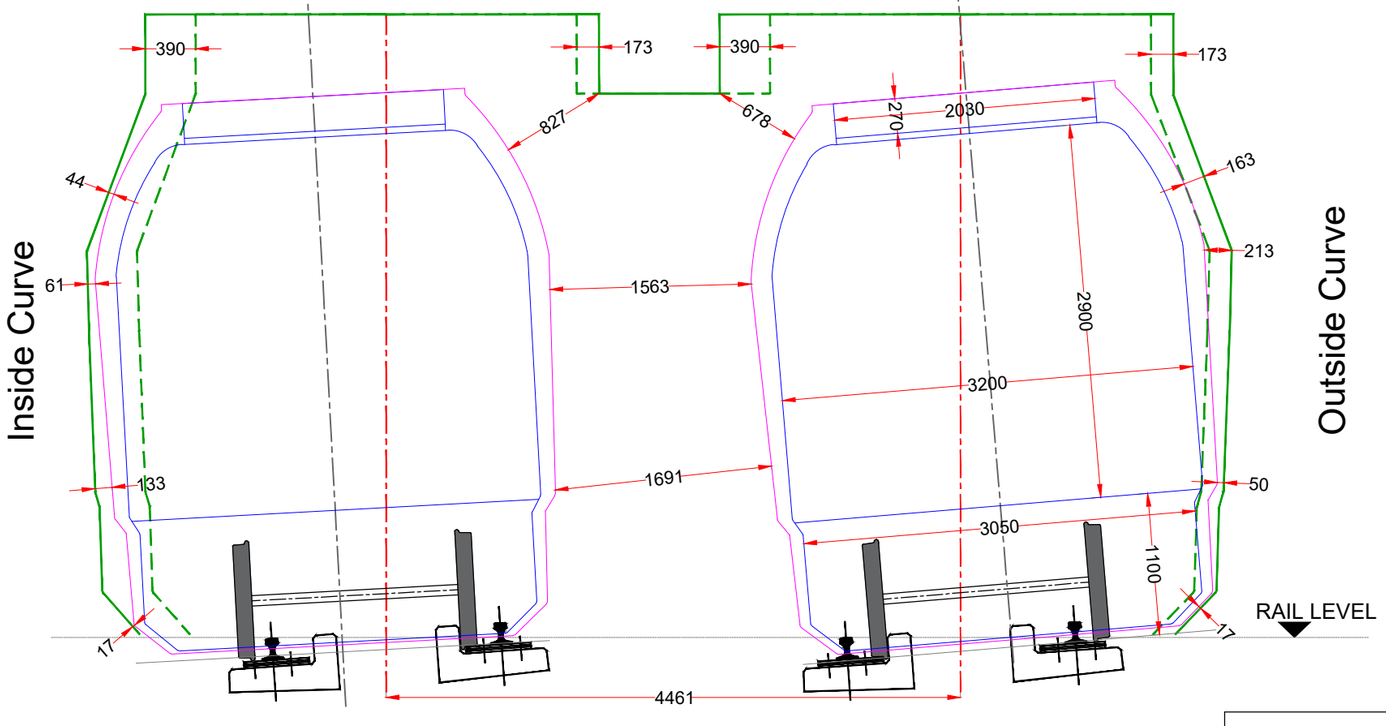
THIS SECTION IS FOR BALLASTED TRACK. IN CASE OF BALLASTLESS TRACK, DECREASE KINEMATIC ENVELOPE BY 10MM AND PLATFORM COPING EDGE DISTANCE FROM CENTRE OF THE TRACK TO BE REDUCED TO 1660.

25 KV A.C. TRACTION

NAME OF WORK :	**Platform gate – underground platform on level or constant grade tangent track**
DRG. No :	Fig. 16
SCALE :	NTS



COACH POSITION IN NORMAL CONDITION



COACH POSITION IN DERAILED CONDITION (OUTWARD)
SECTION A - A

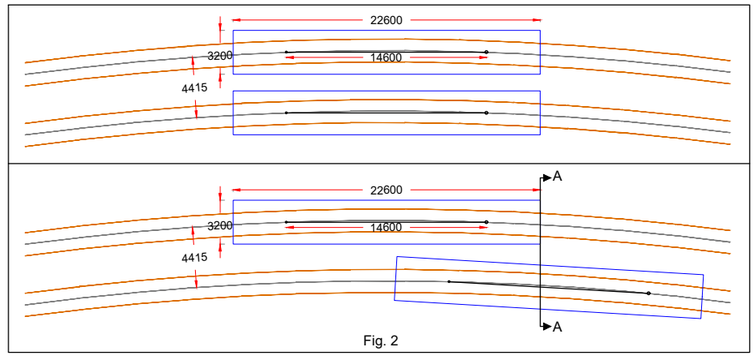


Fig. 2

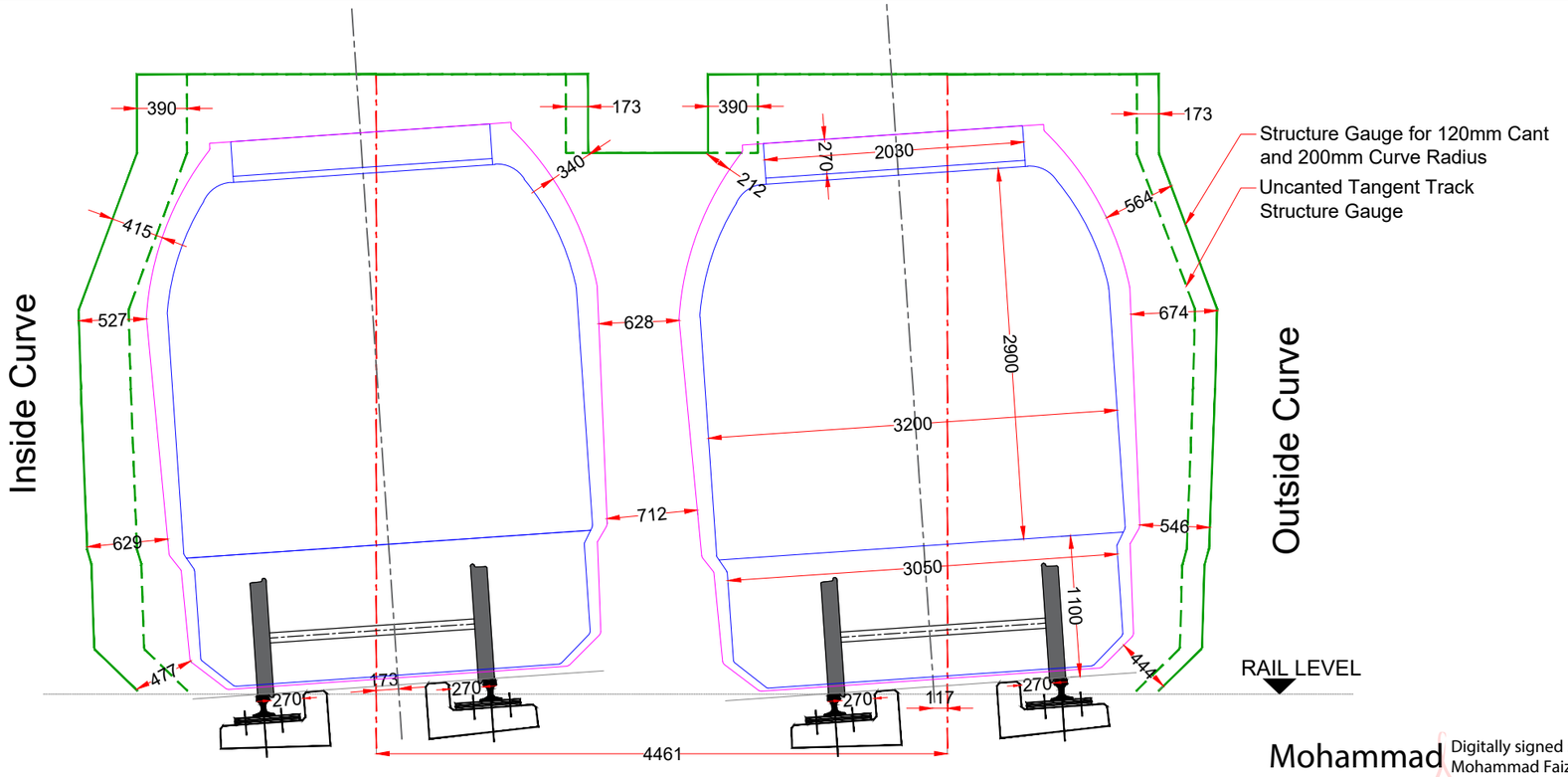
Mohammad Faiz Ansari
Digitally signed by Mohammad Faiz Ansari
Date: 2021.10.30 15:14:15 +05'30'

NOTE:

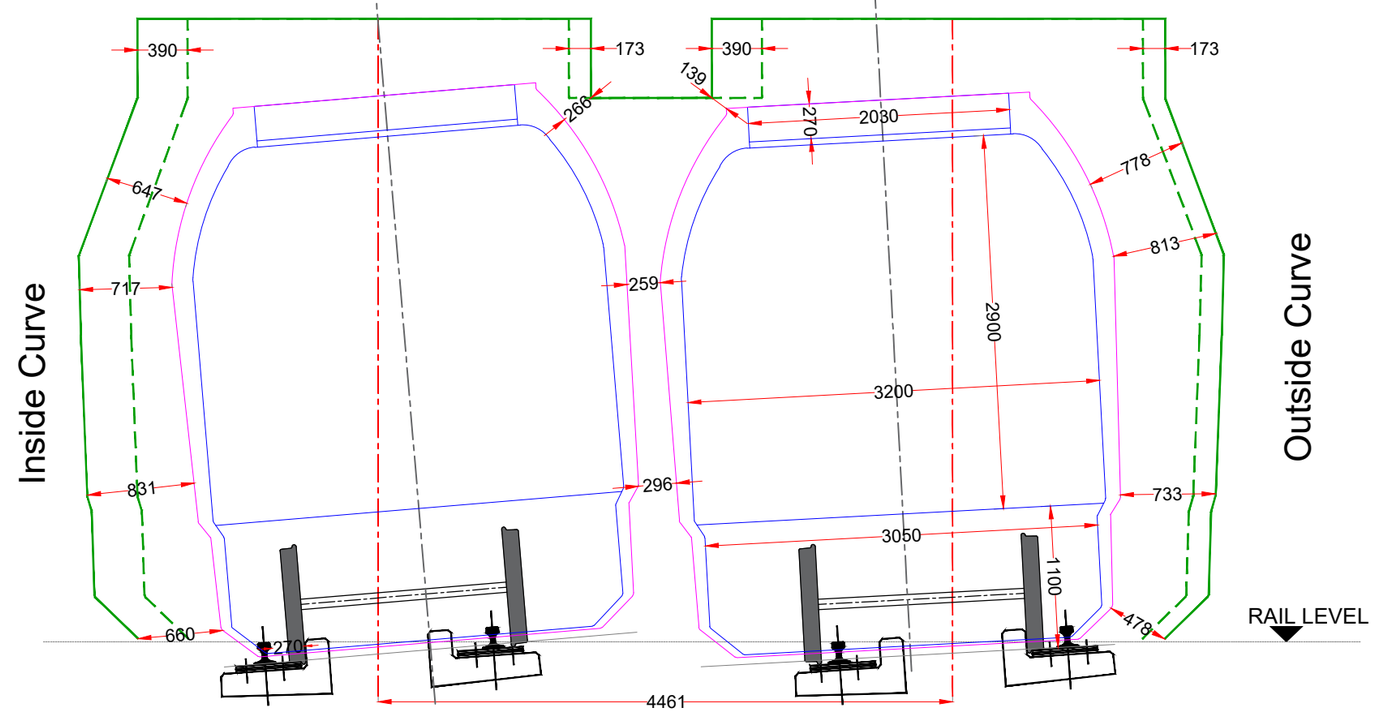
1. ALL DIMENSIONS ARE IN mm.
2. TRACK CENTRES IS EQUAL TO SUM OF E+F+T1+T2. FOR 200M RADIUS AND CANT OF 120MM, TRACK CENTER IS 4461 (2210+1661+173+117+300)
3. STRUCTURE GAUGE HAS BEEN MOVED AWAY FROM CENTRE LINE BY (273MM FOR 120MM CANT + 117MM FOR MID THROW) 390MM TOWARDS INSIDE OF THE CURVE.
4. STRUCTURE GAUGE HAS BEEN MOVED AWAY FROM CENTRE LINE BY (173MM FOR END THROW, SINCE CANT EFFECT WAS NEGATIVE, IT WAS IGNORED) 173MM TOWARDS OUTSIDE OF THE CURVE.
5. DERAILMENT GAURD IS PLACED AT 250 ± 20 (WORST CONDITION IS 250+20 = 270MM)
6. WORST CONDITION OF DERAILMENT IS MENTIONED IN ABOVE FIGURE (Fig. 2)

25 KV A.C. TRACTION

NAME OF WORK :	CHECK FOR DERAILMENT CONDITION FOR CUT AND COVER SECTION WITH SHARPEST CURVE AND MAXIMUM CANT (OUTWARD) (DOUBLE TUNNEL) (270 mm)
DRG. No :	Fig. 17A
SCALE :	NTS



COACH POSITION IN NORMAL CONDITION



COACH POSITION IN DERAILED CONDITION (INWARD)

SECTION A - A

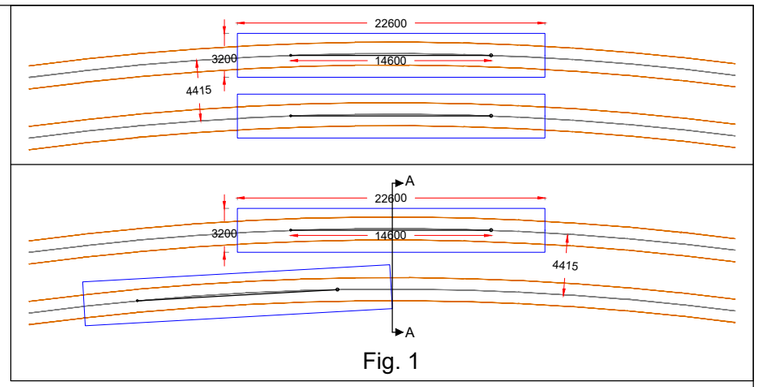


Fig. 1

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. TRACK CENTRES IS EQUAL TO SUM OF E+F+T1+T2. FOR 200M RADIUS AND CANT OF 120MM, TRACK CENTER IS 4461 (2210+1661+173+117+300)
3. STRUCTURE GAUGE HAS BEEN MOVED AWAY FROM CENTRE LINE BY (273MM FOR 120MM CANT + 117MM FOR MID THROW) 390MM TOWARDS INSIDE OF THE CURVE.
4. STRUCTURE GAUGE HAS BEEN MOVED AWAY FROM CENTRE LINE BY (173MM FOR END THROW, SINCE CANT EFFECT WAS NEGATIVE, IT WAS IGNORED) 173MM TOWARDS OUTSIDE OF THE CURVE.
5. DERAILMENT GAURD IS PLACED AT 250 ± 20 (WORST CONDITION IS 250+20 = 270MM)
6. WORST CONDITION OF DERAILMENT IS MENTIONED IN ABOVE FIGURE (Fig. 1)

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25 KV A.C. TRACTION

NAME OF WORK :	CHECK FOR DERAILMENT CONDITION FOR CUT AND COVER SECTION WITH SHARPEST CURVE AND MAXIMUM CANT (INWARD) (DOUBLE TUNNEL) (270 mm)
DRG. No :	Fig. 17 B
SCALE :	NTS