

ARE04A Contract (Addendum 01)					
S. No.	Part	Section	Clause No.	Original Bid Condition	Revised Bid Condition
1	Part 1	Section II (BDS)	ITB 37.1	The currency that shall be used for Bid evaluation and comparison purposes to convert all Bid Prices expressed in various currencies into a single currency is: Indian Rupees (INR)The source of exchange rate shall be: Reserve Bank of India (RBI) / Financial Benchmarks India Pvt. Ltd (FBIL) as delegated by the Reserve Bank of India vide their order no. RBI / 2018-19 / 34DBR. Ret. BC. No. 01 / 12.01.001 / 2018-19 dated August 02, 2018. In case such rates are not available in the source identified above, any other publicly available source acceptable to the Employer shall be used for the evaluation. Any error in determining the exchange rates may be corrected by the Employer. The date for the exchange rate shall be: 28 days before last date of submission of the Bid.	The currency that shall be used for Bid evaluation and comparison purposes to convert all Bid Prices expressed in various currencies into a single currency is: Indian Rupees (INR)The source of exchange rate shall be: Reserve Bank of India (RBI) / Financial Benchmarks India Pvt. Ltd (FBIL) as delegated by the Reserve Bank of India vide their order no. RBI / 2018-19 / 34DBR. Ret. BC. No. 01 / 12.01.001 / 2018-19 dated August 02, 2018. In case such rates are not available in the source identified above, any other publicly available source acceptable to the Employer shall be used for the evaluation. Any error in determining the exchange rates may be corrected by the Employer. The date for the exchange rate shall be: 28 days before last date of submission of the Bid. If the date that is 28 days prior to the stipulated date of submission happens to fall on a public holiday, then the rate of Exchange at the close of business of FBIL's website on the previous working day shall be considered for the conversion of Foreign Currency to Indian Rupees.
2	Part 1	Section II (BDS)	ITB 18	"and Discounts" deleted.	Deleted.
3	Part 1	Section II (BDS)	ITB 18.4	Replace Sub-clause 18.4 with the following: The price to be offered in the Letter of Bid, in accordance with ITB 12.1, shall be the total price of the Bid	Replace Sub-clause 18.4 with the following: The price to be offered in the Letter of Bid, in accordance with ITB 12.1, shall be the total price of the Bid after Discount.
4	Part 1	Section IV (BF)	3.2.7	Price Adjustment towards RS-CMC is not applicable on Foreign Currencies (JPY & FC) portions.	Price Adjustment towards RS-CMC is not applicable on Foreign Currency opted by the bidder.
5	Part 1	Section IV (BF)	4.2 4.3 4.4	All section of 4.2, 4.3 & 4.4	All of Section 4.2, Section 4.3 & Section 4.4 is replaced by:- Annexure (01) to ARE04A Addendum (01).
6	Part 1	Section IV (BF)	5.15	Note : The bidder shall submit their declaration in Technical Bid submission. Within 10 days of last date of bid submission date details requested under Form Minimum Local Content shall be submitted to CMRL.	Deleted.
7	Part 2	Section VI-A (ERTS)	2.2.23	The complete brake system shall be of similar performance to EN 13452-1 and EN 13452-2	The complete brake system shall be of similar performance to UIC 544-1 , EN 13452-1 and EN 13452-2
8	Part 2	Section VI-A (ERTS)	2.14.3.1	The Contractor shall submit design calculations for the safe braking distances and Emergency braking distances for both dry and wet conditions as per EN 13452-1 & EN 13452 -2 and design basis for wet condition.	The Contractor shall submit design calculations for the safe braking distances and Emergency braking distances for both dry and wet conditions as per UIC 544-1, EN 14531-1 , EN 13452-1 & EN 13452 -2 and design basis for wet condition.
9	Part 2	Section VI-A (ERTS)	2.15.8.15	The complete brake system shall be of similar performance to EN 13452-1.	The complete brake system shall be of similar performance to UIC 544-1 , EN 13452-1 and EN 13452-2
10	Part 2	Section VI-A (ERTS)	2.15.9.3	The system shall be designed to be Fail Safe to ensure that any failure of the system shall not render it ineffective for friction brake control. If a failure of the slide protection system occurs while braking, the system shall not reduce the level of braking below the commanded level not more than THREE (3) seconds. Alternatively, the Contractor must demonstrate fail safe proven design to CMRL	The system shall be designed to be Fail Safe to ensure that any failure of the system shall not render it ineffective for friction brake control. If a failure of the slide protection system occurs while braking, the system shall not reduce the level of braking below the commanded level not more than TEN (10) seconds. Alternatively, the Contractor must demonstrate fail safe proven design to CMRL
11	Part 2	Section VI-A (ERTS)	2.15.10.10	The associated EP brake unit shall be of the energize-to-release type and shall contain all the pneumatic items necessary to control all applications of the friction service brakes and emergency brakes.	The associated EP brake unit shall be of the energize-to-release type during Emergency Brake and energize-to-apply for other friction brakes and shall contain all the pneumatic items necessary to control all applications and release of the friction service brakes and emergency brakes on that car.
12	Part 2	Section VI-A (ERTS)	2.18.9.1	Rolling stock shall comply with following or equivalent Standards: EN 50121-2.	Rolling stock shall comply with all applicable requirements in the following Standards: EN 50121-1, EN 50121-2, EN 50121-3 & EN 50121-4.
13	Part 2	Section VI-A (ERTS)	2.25.10 (a) iv	Loading conditions: <input type="checkbox"/> For Combined test bed: AW4 loading condition. <input type="checkbox"/> For Field Trial: AW4 loading condition.	Loading conditions: <input type="checkbox"/> For Combined test bed: AW3 loading condition. <input type="checkbox"/> For Field Trial: AW3 loading condition.
14	Part 2	Section VI-A (ERTS)	2.25.10 (a) vi	Train loaded: AW4	Train loaded: AW3
15	Part 2	Section VI-A (ERTS)	2.26.4.2	The Contractor shall prepare a Fire Safety Design Report for review and acceptance by CMRL. This shall be submitted within 2 months of the Commencement Date and shall be further revised and updated at each design stage. Both the design as well as materials used in the cars shall conform to fire safety requirements of EN 45545 Parts 1 to 7 (Category 4-A, Hazard level HL3) or later edition if superseded	The Contractor shall prepare a Fire Safety Design Report for review and acceptance by CMRL. This shall be submitted during PFDR stage and shall be further revised and updated in FDR stage. Both the design as well as materials used in the cars shall conform to fire safety requirements of EN 45545 Parts 1 to 7 (Category 4-A, Hazard level HL3) or later edition if superseded
16	Part 2	Section VI-A (ERTS)	3.2.11	Carbody and its sub-assemblies shall be manufactured conforming to NF F31-101 tolerance class B.	Carbody and its sub-assemblies shall be manufactured conforming to NF F31-101 tolerance class B or ISO 13920 or any other International Standard.
17	Part 2	Section VI-A (ERTS)	3.3.7	Non-stainless steel surfaces below the floor of the carbody shall be primed with epoxy coating and then finish painted with two coats of an approved polyurethane paint.	Non-stainless steel surfaces below the floor of the carbody shall be primed with epoxy coating and then finish painted with two coats of an approved polyurethane paint of minimum 60 micron.
18	Part 2	Section VI-A (ERTS)	3.14.10.2 (a)	Collision Scenario: • One 3-car trainset (loading condition as mentioned in EN 15227) on level tangent track and moving at velocity V, impacts a similar, 3-car trainset loaded to AW2 stationary trainset which has all friction brake systems applied with a wheel/rail coefficient of friction of 0.3.	Collision Scenario: • One 3-car trainset (loading condition as mentioned in EN 15227) on level tangent track and moving at velocity V, impacts a similar, 3-car trainset loaded to AW2 stationary trainset which has all friction brake systems applied with a wheel/rail coefficient of friction of 0.3.

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19	Part 2	Section VI-A (ERTS)	3.14.10.2 (a)	<ul style="list-style-type: none"> One 6-car trainset (loading condition as mentioned in EN 15227) on level tangent track and moving at velocity V, impacts a similar, 6-car trainset loaded to AW2 stationary trainset which has all friction brake systems applied with a wheel/rail coefficient of friction of 0.3. (Trainsets configuration defined as per clause 2.2.12) 	<ul style="list-style-type: none"> One 6-car trainset (loading condition as mentioned in EN 15227) on level tangent track and moving at velocity V, impacts a similar, 6-car trainset loaded to AW2 stationary trainset which has all friction brake systems applied with a wheel/rail coefficient of friction of 0.3. (Trainsets configuration defined as per clause 2.2.12)
20	Part 2	Section VI-A (ERTS)	3.4.1.4.1	All underfloor piping and conduit shall be stainless steel.	All Underfloor piping shall be Seamless Stainless Pipe and Conduits shall be HDPE or equivalent.
21	Part 2	Section VI-A (ERTS)	3.11.5.4	The Contractor shall ensure adequate water drainage from the roof, such that no water shall be discharged into the vicinity of the passenger doorways. The water shall not accumulate in the rain gutters and shall be easily discharged through adequate sized pipes at levels below the floor level and sufficiently away from the track. Hose/Rubber fittings are not preferred in the discharge pipe and Stainless steel pipe fittings shall be preferred. In case, rubber pipe connections are unavoidable due to tolerance clearance issues, they can be used only at one location provided the life of rubber used shall be more than 15 years and suitable window arrangement on the carbody for its replacement shall be available.	The Contractor shall ensure adequate water drainage from the roof, such that no water shall be discharged into the vicinity of the passenger doorways. The water shall not accumulate in the rain gutters and shall be easily discharged through adequate sized pipes at levels below the floor level and sufficiently away from the track. Hose/Rubber fittings are not preferred in the discharge pipe and Stainless steel pipe fittings shall be preferred. In case, rubber pipe connections are unavoidable due to tolerance clearance issues, they can be used only at one location provided the life of rubber used shall be more than 12 years and suitable window arrangement on the carbody for its replacement shall be available.
22	Not Used.	Not Used.	Not Used.	Not Used.	Not Used.
23	Part 2	Section VI-A (ERTS)	7.3.9	All compressors within the VAC units shall be inverter controlled variable voltage variable frequency (VVVF) type motors. If DC motors are proposed for Evaporator fans, they must be of a Brushless type.	The Contractor shall propose a compressor design which ensures the highest possible energy efficiency is achieved on an annualised basis. If DC motors are proposed for Evaporator fans, they must be of a Brushless type.
24	Not Used.	Not Used.	Not Used.	Not Used.	Not Used.
25	Part 2	Section VI-A (ERTS)	7.4.5.6	In the event of Smoke or fire being present outside the train, arrangements shall be made to prevent the products of combustion being introduced into the saloon and emergency operator's desk areas by shutting off the fresh air inlets and operate in a 100% re-circulation mode. Irrespective of any smoke, in the event that there is a total loss of 110 V dc power supply to the VAC modules (and therefore no emergency ventilation) the ducting devices shall default to this condition of 100% re-circulation.	In the event of Smoke or fire being present outside the train, arrangements shall be made to prevent the products of combustion being introduced into the saloon and emergency operator's desk areas by shutting off the fresh air inlets and operate in a 100% re-circulation mode. In the event that there is a total loss of 110 Vdc power supply to the VAC modules the dampers shall default to the fully closed position.
25	Part 2	Section VI-A (ERTS)	7.4.6.2	The outside fresh air intake in this mode shall not be less than 2.5 litres / sec / passenger @ AW4 load.	The outside fresh air intake in this mode shall not be less than 2.2 litres / sec / passenger @ AW4 load.
26	Part 2	Section VI-A (ERTS)	8.3.1	The interior lighting system shall comprise of "Dimmable" type LEDs with a minimum of six (6) step lighting control, conforming to EN13272. The following requirements shall also apply:	The interior lighting system shall comprise of "Dimmable" type LEDs with (OFF, 25%, 50%, 75%, 100% & Automatic) step lighting control, conforming to EN13272. The following requirements shall also apply:
27	Part 2	Section VI-A (ERTS)	9.2.2	The auxiliary power supply distribution scheme shall be so configured that each 3 car trainset (DMC + TC + DMC) has two sets of auxiliary power supply equipment in a single box. When either operator's cab is activated, both auxiliary converter inverters shall be operated and equally share the entire 100% auxiliary load of a 3 car train.	The auxiliary power supply distribution scheme shall be so configured that each 3 car trainset (DMC + TC + DMC) has two sets of auxiliary power supply equipment in a single box. When either operator's cab is activated, both auxiliary converter inverters shall be operated and equally share the entire 100% auxiliary load of a 3 car train.
28	Part 2	Section VI-A (ERTS)	10.3.4	A pantograph auto-drop function shall be provided to drop the pantograph automatically when excessive height is detected (to be finalised during design stage, but shall be a minimum of 5,900mm from top of rail height). An indication shall be provided to the train operator and RSC consoles of OCC, BCC & DCC when this function has been triggered. During pantograph entanglement with OHE catenary, there shall be an indication to the train operator and RSC consoles of OCC, BCC & DCC	A pantograph auto-drop function shall be provided to drop the pantograph automatically when excessive height is detected. (to be finalised during design stage, but shall be a minimum of 5,500 mm from top of rail height). During design stage, the Contractor shall propose a suitable height at which the ADD shall be activated based on a review of the OHE height at all locations including the mainline, depots and stabling locations. An indication shall be provided to the train operator and RSC consoles of OCC, BCC & DCC when this function has been triggered. During pantograph entanglement with OHE catenary, there shall be an indication to the train operator and RSC consoles of OCC, BCC & DCC
29	Part 2	Section VI-A (ERTS)	10.11.15	Four (4) trains shall be instrumented (in accordance with EN 50463) with separate Power Quality measuring instruments, data acquisition systems and power analyser (with provision for permanent installation and shall have necessary in-built software / analysis tool) to measure, record and analyse the power quality parameters. This instrument shall also have memory storage for minimum 15 days of testing data. The measurement with these instruments shall include but not limited to Time, kW, kVAR, kVA, THD, TDD, Total pf and Displacement pf. The instruments supplied shall have the adequate capability of measuring and data acquisition to analyse higher order harmonics (up to 50th) and measure power quality parameters mentioned above with minimum accuracy of 0.1% and sampling rate of 100 kHz. Details of instruments shall be finalized during design stage. Other trains shall also have necessary provisions (suitable space, wiring etc.) for installation and recording power quality parameters as per above.	Four (4) trains shall be instrumented (in accordance with EN 50463) with separate Power Quality measuring instruments, data acquisition systems and power analyser (with provision for permanent installation and shall have necessary in-built software / analysis tool) to measure, record and analyse the power quality parameters. This instrument shall also have memory storage for minimum 15 days of testing data. The measurement with these instruments shall include but not limited to Time, kW, kVAR, kVA, THD, TDD, Total pf and Displacement pf. The instruments supplied shall have the adequate capability of measuring and data acquisition to analyse higher order harmonics (up to 50th) and measure power quality parameters mentioned above with minimum accuracy of 0.1% and sampling rate of 100 kHz. Details of instruments shall be finalized during design stage. Other trains shall also have necessary provisions (suitable space, wiring etc.) for installation and recording power quality parameters as per above. In the event that this Contract is awarded to the same Contractor that was previously awarded the ARE03A or ARE02A Contract(s) then, requirement for Four (4) trains instrumentation is not required.

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30	Part 2	Section VI-A (ERTS)	11.2.4	Bogie assemblies shall have a service life of 35 years without structural repairs, rebuilding, strengthening under standard maintenance practices and service. Elastomeric elements, dampers and other consumable bogie mounted components, with the exception of items like brake pads, shall have a minimum service life of 5 years.	Bogie assemblies shall have a service life of 35 years without structural repairs, rebuilding, strengthening under standard maintenance practices and service. Elastomeric elements, dampers and other consumable bogie mounted components, with the exception of items like brake pads, shall have a minimum service life of 5 years.
31	Part 2	Section VI-A (ERTS)	11.4.11 (d)	Hydraulic dampers of suitable capacity shall be provided symmetrically to control and limit the vertical and lateral oscillation of the car body. The damping factors are to satisfy this provision. The damping factor in vertical mode, by wedge test, when tested using a wedge of 18 mm thickness should be between 0.20 and 0.25. The damping factor in lateral mode when measured by quick release side pull test should be between 0.30 and 0.40. Suspension will not be considered acceptable if maximum acceleration and spring displacements do not decay within 2-3 cycles. No leakages of any kind shall be permitted. The design life of the dampers shall be minimum 10 years.	Hydraulic dampers of suitable capacity shall be provided symmetrically to control and limit the vertical and lateral oscillation of the car body. The damping factors are to satisfy this provision. The damping factor in vertical mode, by wedge test, when tested using a wedge of 18 mm thickness should be between 0.20 and 0.25. The damping factor in lateral mode when measured by quick release side pull test should be between 0.30 and 0.40. Suspension will not be considered acceptable if maximum acceleration and spring displacements do not decay within 2-3 cycles. No leakages of any kind shall be permitted. The design life of the dampers shall be minimum 10 years.
32	Part 2	Part 2 Section VIA (ERTS – RS)	11.5.1 (f)	Longitudinal forces between car body and bogies shall be considered according to the rules in UIC 615-1, clause 4.2, or JIS E 4207. The bogie frames including vehicle body-bogie connecting gear shall be able to withstand a longitudinal shock load of 5g without failure. This shall be taken as occurring simultaneously with the fully laden vertical load. The Contractor shall validate these requirements by test.	Longitudinal forces between car body and bogies shall be considered according to the rules in UIC 615-1, clause 4.2, or JIS E 4207 or EN13749. The bogie frames including vehicle body-bogie connecting gear shall be able to withstand a longitudinal shock load of 3g for Motor Bogie & 5g for the Trailer Bogie as per EN13749 without failure, implies Ultimate Strength as acceptance criteria. This shall be taken as occurring simultaneously with the fully laden vertical load. The Contractor shall validate these requirements by test.
33	Part 2	Section VI-A (ERTS)	11.12.4	The Contractor shall submit the methodology of detection, detailed calculation of design proof load, installation arrangement, safety against derailment, energy absorbing capabilities etc. conforming to Table 3 — Obstacle deflector performance requirements of EN 15227 / Section 4.5 of GM RT 2100 and EN 12663-1 / EN 13749 during detailed design for CMRL review and approval. Provisions shall be made to avoid false detection.	The Contractor shall submit the methodology of detection, detailed calculation of design proof load, installation arrangement, safety against derailment, energy absorbing capabilities etc. conforming to Table 3 — Obstacle deflector performance requirements of EN 15227 / Section 4.5 of GM RT 2100 and EN 12663-1 and EN 13749 during detailed design for CMRL review and approval. Provisions shall be made to avoid false detection.
34	Part 2	Section VI-A (ERTS)	12.2.3 (g)	Wheel slip and slide protection	Wheel Slide Protection.
35	Part 2	Section VI-A (ERTS)	12.2.7	The brake system shall comply to UIC 544-1 regarding Braking Performances.	The brakes system shall comply to UIC 544-1, EN 13452-1 & EN 13452-2.
36	Part 2	Section VI-A (ERTS)	12.2.10 (h)	Under conditions of a dragging parking brake for a minimum distance of 3 kilometers at a speed of 10 kmph, no damage shall be caused to the braking system or any bogie component, with the exception of abnormal shoe wear. Detailed figures to be provided during preliminary design stage.	Under conditions of a dragging parking brake (occurring on no more than one (1) bogie) for a minimum distance of 3 kilometers at a speed of 10 kmph, no damage shall be caused to the braking system or any bogie component, with the exception of abnormal shoe wear. Detailed figures to be provided during preliminary design stage.
37	Part 2	Section VI-A (ERTS)	12.2.10 (i)	The Spring Applied Parking Brake (SAPB) shall be an integral part of the friction brake actuation system. Brake actuators shall be sufficient to permit push-through without any wheel damage.	The Spring Applied Parking Brake (SAPB) shall be an integral part of the friction brake actuation system. Brake actuators shall be sufficient to permit push-through without any wheel damage.
38	Part 2	Section VI-A (ERTS)	12.3.2	All piping shall be of stainless-steel conforming to the requirements of JIS3459, ISO 9329-4 and ISO 9330-6 or equivalent preferably of grade SUS316LTP conforming to JIS3459 with flared compression fittings. Alternatively, the pipe fittings shall conform to the requirements of DIN 2353 or approved equal.	All piping shall be of stainless-steel conforming to the requirements of JIS3459 (Grade SUS316LTP), ISO 9329-4 and ISO 9330-6 or equivalent preferably of grade SUS316LTP conforming to JIS3459 with flared compression fittings. Alternatively, the pipe fittings shall conform to the requirements of DIN 2353 or approved equal.
39	Part 2	Section VI-A (ERTS)	12.3.15	The Contractor shall ensure that the pressure leakage from the train under static condition shall not exceed 1 bar / hour. This function shall be tested at contactor's manufacturing facility. The contractor shall ensure this requirement is met throughout the entire design life. Any trends of deterioration of pneumatic integrity shall be remedied by the Contractor through an appropriate modification.	The Contractor shall ensure that the pressure leakage from the train under static condition shall not exceed 0.5 bar / 15 minutes from main reservoir setting. This function shall be tested at contactor's manufacturing facility. The contractor shall ensure this requirement is met throughout the entire design life. Any trends of deterioration of pneumatic integrity shall be remedied by the Contractor through an appropriate modification.
40	Part 2	Section VI-A (ERTS)	12.4.5	A pressure governor for each compressor shall be provided, which shall be capable of withstanding a pressure not less than the 'open' pressure of the safety valve without damage or deterioration. TCMS shall control cut in and cut out of the compressors based on the feedback of a pressure transducer / governor fitted to the MR pipe. Pressure transducers, switches and governors shall be of proven reliability that was demonstrated in previous EMU metro operations. The Contractor shall furnish the reliability figures during the design stage.	A pressure governor for each compressor shall be provided, which shall be capable of withstanding a pressure not less than the 'open' pressure of the safety valve without damage or deterioration. TCMS shall monitor cut in and cut out of the compressors based on the feedback of a pressure transducer / governor fitted in MR pipe. Pressure transducers, switches and governors shall be of proven reliability that was demonstrated in previous EMU metro operations. The Contractor shall furnish the reliability figures during the design stage.
41	Part 2	Section VI-A (ERTS)	12.6.8.3	The electric regenerative brake shall be independent for each Motor Car and faults on one car shall not adversely affect the braking performance on the other car. Each Bogie of the rake shall have independent Brake Electronics with independent Electro Pneumatic brake control. Detection of Wheel slip & Wheel slide and its protection control shall be per individual axle based.	The electric regenerative brake shall be independent for each Motor Car and faults on one car shall not adversely affect the braking performance on the other car. Each Bogie of the rake shall have independent Brake Electronics with independent Electro Pneumatic brake control. Detection of Wheel slip & Wheel slide and its protection control shall be per individual axle based.
42	Part 2	Section VI-A (ERTS)	12.8.5	The parking brake force on individual axles shall not be so large as to inhibit emergency rake recovery or to give rise to locked wheels during recovery. The maximum wheel / rail adhesion level to be assumed for the "push-out" requirement shall be 0.16	Deleted.

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43	Part 2	Section VI-A (ERTS)	12.15.5	The Contractor shall interface with ARE03a / ARE04 Contractor(s) to ensure that full compatibility of train rescue functionality is achieved. The same shall be demonstrated during at type test stage	The Contractor shall interface with ARE03a / ARE02A Contractor(s) to ensure that full compatibility of train rescue functionality is achieved. The same shall be demonstrated during at type test stage																																																						
44	Part 2	Section VI-A (ERTS)	12.16.1	It shall be possible to rescue a sick train (Eg., Defective, Immobilized, No battery power or in a shutdown condition) using only an air connection from the rescue train. The emergency brake application of the dead train shall be possible by its operator. The detailed scheme shall be subject to CMRL review during design finalization.	A single MR pipe connection (via the auto-coupler) shall (in combination with the brake control requirements described in Clause 12.15) be all that is required to facilitate the rescue of sick trains in all foreseeable modes (E.g. Defective, Immobilized, No battery power or in a shutdown condition). Detailed schematics shall be subject to CMRL review during design finalization.																																																						
45	Part 2	Section VI-A (ERTS)	12.16.2	During the rescue operation (of an energized) the train pushing / pulling of a defective train with a healthy train shall ensure simultaneous brake application in both the healthy and defective train consists. Release of parking brake / holding brake of the defective train shall be possible from healthy train after mechanical, electrical and pneumatic couplings has been achieved. Release of an individual trains holding brake shall also be possible from TCMS.	Simultaneous brake application in both the healthy and defective train consists shall always be achieved during train rescue; regardless of whether the sick train is powered on or shutdown.																																																						
46	Part 2	Section VI-A (ERTS)	12.16.3	To facilitate the rescue of a defective train which has a burst MR pipe (or total loss of pneumatic integrity); the rescuing train shall be able to push-out a failed train in a condition where the MR pipe is isolated at the auto coupler, service brakes are isolated on the defective train and its parking brakes are applied (as defined in clause 2.14.2.3).	To facilitate the rescue of a defective train which has a burst MR pipe (or total loss of pneumatic integrity); the rescuing train shall be able to push-out a failed train in a condition where the MR pipe is isolated at the auto coupler, service brakes are isolated on the defective train and its parking brakes are applied (as defined in clause 2.14.2.3).																																																						
47	Not Used.	Not Used.	Not Used.	Not Used.	Not Used.																																																						
48	Part 2	Section VI-A (ERTS)	13.13.6	All the interior and exterior cameras shall support for a video resolution of minimum 1920x1080 HD and minimum 30 frames per second, minimum illumination of 0.3 lux (color), iris control, minimum 90 dB wide dynamic range (WDR) and Power Over Ethernet (POE) compliant. Cameras shall be of proven design in railway applications. The recordings from these cameras must be clear in dark, daytime, night-time and in all hours of operation even in case of nonavailability of any exterior lighting. All the train cameras shall be Infra-red type or latest better type. Camera and Recorder shall comply CCTV Industry standards like onvif. The Visual images from each camera shall be recorded in non-volatile memory without any limitation of repetitive writing of the data. Each camera shall have recording capacity for at least 7 days. The records shall be easily downloadable.	All the interior and exterior cameras shall support for a video resolution of minimum 1920x1080 HD and minimum 30 frames per second, minimum illumination of 0.3 lux (color), iris control, minimum 90 dB wide dynamic range (WDR) and Power Over Ethernet (POE) compliant. Cameras shall be of proven design in railway applications. The recordings from these cameras must be clear in dark, daytime, night-time and in all hours of operation even in case of nonavailability of any exterior lighting. All the Exterior train cameras shall be Infra-red type or latest better type. Camera and Recorder shall comply CCTV Industry standards like onvif. The Visual images from each camera shall be recorded in non-volatile memory without any limitation of repetitive writing of the data. Each camera shall have recording capacity for at least 7 days. The records shall be easily downloadable.																																																						
49	Part 2	Section VI-A (ERTS)	17.5.2.16 (b)	The test shall be started with the unit at room temperature 30 to 40°C. A fan or other device may be provided so that in-service airflow conditions are simulated. The temperature rise measured in the oil sump shall not exceed the gear oil supplier's recommendations for maximum temperature consistent with the life between oil changes, as called out in the Contractor's maintenance manuals. The direction of rotation shall be reversed every 8 hours, until the 100 hour test is completed.	The test shall be started with the unit at room temperature 55°C . A fan or other device may be provided so that in-service airflow conditions are simulated. The temperature rise measured in the oil sump shall not exceed the gear oil supplier's recommendations for maximum temperature consistent with the life between oil changes, as called out in the Contractor's maintenance manuals. The direction of rotation shall be reversed every 8 hours, until the 100 hour test is completed.																																																						
50	Part 2	Section VI-A (ERTS)	17.5.4.8.10	Parking Brake Test A parking brake system test shall be performed on one three car rake. Design compliance with Chapter 2 shall be demonstrated by measuring the force required to move the train with the parking brake applied. The test shall be performed with bedded-in brake shoes. Push out test shall be performed in dry condition to prove clause 12.8.5. During this test, all wheels should rotate and shall not slide.	Parking Brake Test A parking brake system test shall be performed on one three car rake. Design compliance with Chapter 2 shall be demonstrated by measuring the force required to move the train with the parking brake applied (occurring on no more than one (1) bogie) . The test shall be performed with bedded-in brake shoes. Push out test shall be performed in dry condition to prove clause 12.8.5. During this test, all wheels should rotate and shall not slide.																																																						
51	Part 2	Section VI-A (ERTS)	18.6.6.1	<table border="1"> <caption>Table 18-2: Requirements for Reliability Demonstration (RD):</caption> <thead> <tr> <th rowspan="2">RD Period</th> <th colspan="3">Criteria for Evaluation of Fleet Reliability Demonstration</th> <th rowspan="2">MDBF Target (For Type-1 Failures)</th> <th rowspan="2">Duration of Rolling Evaluation Period</th> </tr> <tr> <th>RD Evaluation Period Starts</th> <th>Reporting Submission Start Date</th> <th>Criteria to Complete RD Period</th> </tr> </thead> <tbody> <tr> <td>Stabilisation</td> <td>1st Train RID</td> <td>1st Train RID +1 Month (Informal Reporting Only)</td> <td>1st Train RID + 6 Months</td> <td>No Target / Reporting Only</td> <td>1 Month</td> </tr> <tr> <td>Level 1</td> <td>1st Train RID + 6 Months</td> <td>1st Train RID +13 Months</td> <td>MDBF Target met for 18 Reporting Months (accumulated)</td> <td>80,000 Km</td> <td>6 Months</td> </tr> <tr> <td>Level 2</td> <td>1st Train RID + 6 Months</td> <td>1st Train RID +19 Months</td> <td>MDBF Target met for 12 Reporting Months (accumulated)</td> <td>1,25,000 Km</td> <td>12 Months</td> </tr> </tbody> </table>	RD Period	Criteria for Evaluation of Fleet Reliability Demonstration			MDBF Target (For Type-1 Failures)	Duration of Rolling Evaluation Period	RD Evaluation Period Starts	Reporting Submission Start Date	Criteria to Complete RD Period	Stabilisation	1 st Train RID	1 st Train RID +1 Month (Informal Reporting Only)	1 st Train RID + 6 Months	No Target / Reporting Only	1 Month	Level 1	1 st Train RID + 6 Months	1 st Train RID +13 Months	MDBF Target met for 18 Reporting Months (accumulated)	80,000 Km	6 Months	Level 2	1 st Train RID + 6 Months	1 st Train RID +19 Months	MDBF Target met for 12 Reporting Months (accumulated)	1,25,000 Km	12 Months	<p>Table 18-2 is replaced by the following (error corrected version). The Level-2 MDBF Target (for Type-1 Failures) is 1,25,000.</p> <table border="1"> <caption>Table 18-2: Requirements for Reliability Demonstration (RD):</caption> <thead> <tr> <th rowspan="2">RD Period</th> <th colspan="3">Criteria for Evaluation of Fleet Reliability Demonstration</th> <th rowspan="2">MDBF Target (For Type-1 Failures)</th> <th rowspan="2">Duration of Rolling Evaluation Period</th> </tr> <tr> <th>RD Evaluation Period Starts</th> <th>Reporting Submission Start Date</th> <th>Criteria to Complete RD Period</th> </tr> </thead> <tbody> <tr> <td>Stabilisation</td> <td>1st Train RID</td> <td>1st Train RID +1 Month (Informal Reporting Only)</td> <td>1st Train RID + 6 Months</td> <td>No Target / Reporting Only</td> <td>1 Month</td> </tr> <tr> <td>Level 1</td> <td>1st Train RID + 6 Months</td> <td>1st Train RID +13 Months</td> <td>MDBF Target met for 18 Reporting Months (accumulated)</td> <td>80,000 Km</td> <td>6 Months</td> </tr> <tr> <td>Level 2</td> <td>1st Train RID + 6 Months</td> <td>1st Train RID +19 Months</td> <td>MDBF Target met for 12 Reporting Months (accumulated)</td> <td>1,25,000 Km</td> <td>12 Months</td> </tr> </tbody> </table>	RD Period	Criteria for Evaluation of Fleet Reliability Demonstration			MDBF Target (For Type-1 Failures)	Duration of Rolling Evaluation Period	RD Evaluation Period Starts	Reporting Submission Start Date	Criteria to Complete RD Period	Stabilisation	1 st Train RID	1 st Train RID +1 Month (Informal Reporting Only)	1 st Train RID + 6 Months	No Target / Reporting Only	1 Month	Level 1	1 st Train RID + 6 Months	1 st Train RID +13 Months	MDBF Target met for 18 Reporting Months (accumulated)	80,000 Km	6 Months	Level 2	1 st Train RID + 6 Months	1 st Train RID +19 Months	MDBF Target met for 12 Reporting Months (accumulated)	1,25,000 Km	12 Months
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52	Not Used.	Not Used.	Not Used.	Not Used.	Not Used.																																																						
53	Part 2	Section VI-A (ERTS)	18.13.2.2	The Contractor shall arrange its own furnishing, security etc. Charges for the electricity consumption shall be payable by the Contractor at the prescribed rates.	The Contractor shall arrange its own furnishing, security etc. Charges for the electricity consumption (for the site office area only) shall be payable by the Contractor at the prescribed rates.																																																						
54	Part 2	Section VI-A (ERTS)	18.13.2.8	The Contractor shall arrange at his own cost all Site services necessary and appropriate for the assembly, testing and commissioning of trains, which shall include, but not necessarily be limited to: (i) Electricity at site area (other than traction and inside the shed). (ii) Compressed air. (iii) Communication facilities and (iv) Instrumentation	The Contractor shall arrange at his own cost all Site services necessary and appropriate for the assembly, testing and commissioning of trains, which shall include, but not necessarily be limited to: (i) Electricity (for the site office area only) (ii) Compressed air. (iii) Communication facilities (for the site office area only) (iv) Instrumentation																																																						
55	Not Used.	Not Used.	Not Used.	Not Used.	Not Used.																																																						
56	Part 2	Section VI-A (ERTS)	19.36.13	Fire resistant cables shall be proposed for circuits, which should survive for long periods during fire, as per applicable international standards. As a minimum, the cables and wires for Public Address System, emergency lighting, door opening and warning systems shall be fire resistant in compliant to EN 50200 PH15 & EN 50200 PH90.	Fire resistant cables shall be proposed for circuits which should survive for long periods during fire, as per applicable international standards. As a minimum, the cables and wires for Battery Circuit , Public Address System, CCTV system , emergency lighting, door system , any other circuit related to Passenger Safety and warning systems shall be fire resistant in compliant to EN-50200-PH15 & EN 50200 PH90.																																																						

ARE04A Contract (Addendum 01)						
S. No.	Part	Section	Clause No.	Original Bid Condition		Revised Bid Condition
57	Part 2	Section VI-A (ERTS)	19.43.1 (a)	For wire sizes 1.5 mm ² Cross sectional area of conductor and larger, the insulation shall be silicone rubber in accordance with AAR S-503, 110oC irradiated cross-linked polyolefin, or abrasion-resistant extruded PTFE (polytetrafluoroethylene) Teflon meeting MIL-W-22759/6B. All cables shall be fire retardant and shall comply with EN 50306-1 to -4, EN 50264-1, EN 50267-2-1. Cables used for Emergency circuits and fire survival circuits shall comply with EN50200.		For wire sizes 1.5 mm ² Cross sectional area of conductor and larger, the insulation shall be silicone rubber in accordance with AAR S-503, 110oC irradiated cross-linked polyolefin, or abrasion-resistant extruded PTFE (polytetrafluoroethylene) Teflon meeting MIL-W-22759/6B. All cables shall be fire retardant and shall comply with EN 50306-1 to -4, EN 50264-1, EN 50267-2-1. Cables used for Emergency circuits and fire survival circuits shall comply with EN50200.
58	Part 2	Section VI-A (Interface Appendix-C)	2.4.40	Ground based hot axle box detection for monitoring of axle box temperature shall be provided in mainline by Rolling Stock Contractor and shall be installed specific to each corridor. The ground equipment shall be provided by RS Contractor. The server for storage of the information shall be placed by RS Contractor at the nearest station's Telecom Equipment Room. This ground based hot axle detection system shall be integrated with RTR-DMS by the RS Contractor. The communication network path from the station server to the OCC shall be provided by the STC Contractor. The power from UPS as well as network cabling from the equipment to the Signalling network switch is the responsibility of the RS Contractor		Deleted.
59	Part 2	Section VI-A (Interface Appendix-C)	6.4.3 (Table S/N 11)	11	Wayside Equipment: Hot Axle Box detection system The RS Contractor shall provide detailed drawings of way side equipment to be installed in the track slab/track plinth to the TRW Contractors if any provision is required within the track slab.	TRW Contractors shall accommodate the required design requirements in the track slab/track plinth to facilitate for the installation by the RS Deleted.
60	Part 2	Section VI-A (Appendix-D1)	Schedule of Dimensions (SOD)			All of Section Appendix D1 is replaced by:- Annexure (02) to ARE04A Addendum (01).
61	Not Used.	Not Used.	Not Used.	Not Used.		Not Used.
62	Not Used.	Not Used.	Not Used.	Not Used.		Not Used.
63	Part 2	Section VI-C (ERTS-CMC)	1.15.9 (New)			CMRL will procure initial Operations and Maintenance training under the DM250 Contract covering all the items listed in Clause 1.15.1. This training shall be provided for the initial batch of staff nominated by the ARE04A Contractor. Any further training sessions that are required will need to be arranged and funded by the ARE04A Contractor.
64	Part 2	Section VI-C (ERTS-CMC)	1.7.12 (d) (New)			Point (d) as worded below is added to Clause 1.7.12:- (d) Cost attribution for Unscheduled Maintenance arising on a CMC Asset on account of accident or vandalism shall (without prejudice to Part-2 Section VI-C ERTS -CMC of RS and DM&P Clause 1.7.18) be apportioned to CMRL if the root cause investigation reveals that the incident occurred whilst the train was under the control and custody of CMRL Operations (E.g. on the mainline or stabled in UTO zones of the Designated Depots). Whereas, costs will be apportioned to the Contractor, if the root cause investigation reveals that the incident occurred whilst the train was under the control and custody of the Contractor during its undertaking of CMC Works, or it arose as a result of an omission of maintenance or technical defect with the CMC Asset.
65	Part 2	Section VI-C (ERTS-CMC)	1.8.2	The PREB team shall consist of at least 10 fully trained staff per shift who shall be strategically located throughout the network, so as to always ensure that incidents will be attended by PREB staff within 30mins of receiving a request to attend an incident.		The PREB team shall consist of an adequate number of fully trained staff per shift who shall be strategically located throughout the network, so as to always ensure that incidents will be attended by PREB staff within 30 mins of receiving a request to attend an incident. The Contractor shall provide a deployment plan for CMRL review and acceptance.
66	Part 2	Section VI-C (ERTS-CMC)	1.15.3	Any additional Depot M&P Assets required for the ARE04A Contractor to perform its CMC Works on the rolling stock fleet, shall be procured by the ARE04A Contractor and the cost is deemed to have been included in the price quoted in the CMC-RS Price Centre. A provisional list of these items will have been provided by the Contractor during bidding stage (Part-1, Section IV Bidding Form Clause 4.4.13).		Any additional Depot M&P Assets required for the ARE04A Contractor to perform its CMC Works on the rolling stock fleet, shall be procured by the ARE04A Contractor and the cost is deemed to have been included in the lumpsum price . A provisional list of these items will have been provided by the Contractor during bidding stage (Part-1, Section IV Bidding Form Clause 4.4.13).
67	Not Used.	Not Used.	Not Used.	Not Used.		Not Used.
68	Part 2	Section VI-C (ERTS-CMC)	1.15.5	The Depot M&P Contract (DM250), shall include an Optional Service Contract defined as a "Technical Services and Spares Supply Agreement" (TSSSA).		The Depot M&P Contract (DM250), shall include an Optional Service Contract defined as a "Technical Services Support and Spares Supply Agreement" (TSSSA).
69	Part 2	Section VI-C (ERTS-CMC)	3.3.1 (f)	$\% \text{Availability} = 1 - \left(\left(\frac{DT(SC) + DT(OPM) + DT(CM)}{\text{Total Time}} \right) * 100 \right)$		$\% \text{Availability} = \left(1 - \left(\frac{DT(SC) + DT(OPM) + DT(CM)}{\text{Total Time}} \right) \right) * 100$
70	Part 2	Section VI-C (ERTS-CMC)	3.4.2	The Contractor's Operational staff shall be available at the premises of the designated Depot(s) round the clock. The price towards the operation of Depot Machinery & Plant is deemed to have been included in quoted price.		The Contractor's Operational staff shall be available at the premises of the RS Maintenance Depot round the clock. The price towards the operation of Depot Machinery & Plant is deemed to have been included in quoted price.
71	Part 2	Section VI-C (ERTS-CMC)	5.2.2(ii)	The Contractor shall also interface with the Signalling and Telecoms Contractors for transfer of TCMS and wayside Hot Axle measuring system data through their network to the AMMS server.		The Contractor shall also interface with the Signalling and Telecoms Contractors for transfer of TCMS and wayside Hot Axle measuring system data through their network to the AMMS server.

ARE04A Contract (Addendum 01)					
S. No.	Part	Section	Clause No.	Original Bid Condition	Revised Bid Condition
72	Part 3	Section VIII Particular Conditions (Part-A: Contract Data)	S No. 18 (GCC 14.2)	Interest bearing Mobilization Advance to a maximum of 10% of the Accepted Contract Amount (Excluding Provisional Sum) excluding taxes & duties is payable in INR only. The Rate of Interest shall be 13.5% per annum. Mobilization advance shall be paid in two equal instalments.	Interest free Mobilization Advance to a maximum of 10% of the Accepted Contract Amount (Excluding Taxes & Duties, Provisional Sum and Price Centre 'RS-CMC') is payable in INR only. Mobilization advance shall be paid in two equal instalments.
73	Part 3	Section VIII Particular Conditions Part-B	Si No 21 (NEW)	4.1.4 CMC Obligations: The Contractor's obligation under this Contract shall also include 'Comprehensive Maintenance Contract' (CMC) for Rolling Stock and Depot Plant & Machinery as defined under Part 2, Section VI C, ERTSCMC RS and DM&P & PC 4.25 of Part 3-PCC.	The text shown in Bold is added to Sub-Clause 4.1.4 (All other subclauses added though Si No 21 remain) 4.1.4 CMC Obligations: The Contractor's obligation under this Contract shall also include 'Comprehensive Maintenance Contract' (CMC) for Rolling Stock and Depot Plant & Machinery as defined under Part 2, Section VI C, ERTSCMC RS and DM&P & PC 4.25 of Part 3-PCC. Further, it is clarified that all maintenance activities falling due from the time of delivery of the trainsets, until completion of the CMC Period shall be completed by the Contractor. Such Works is deemed to have been included in the quoted Lumpsum Price.
74	Part 3	Section VIII Particular Conditions Part-B	Si No 22 (GCC 4.2)	Add the following to the end of Sub-Clause 4.2: CMC - Rolling Stock: 28 days before the completion of Rolling Stock (Train level) DNP, the Contractor shall furnish CMC Performance Security for the deliverables defined in the CMC Period; in the form of a Bank Guarantee from a public sector bank (PSB) of India or Scheduled Commercial Banks in India, for an amount of 10% of Price Centre RS-CMC in the same currency(ies). The Performance Bank Guarantee for CMC shall be valid until 210 days beyond the scheduled expiry of the Rolling Stock CMC period. The Employer shall, however, permit the Contractor to reduce the CMC Performance Security at every three (3) year intervals provided the following two (2) conditions are satisfied: - i. The Contractor has obtained a CMC Performance Certificate from the Employer for the preceding 3-year period. ii. The Contractor has provided a replacement Bank Guarantee (same expiry date) for the reduced value amount for CMC Performance Security amount in accordance with the following schedule:	The first Paragraph of additional text added at the end of Sub-Clause 4.2 is changed as follows (All other Paragraphs remain same): CMC - Rolling Stock : 28 days before the completion of Rolling Stock (Train level) DLP / DNP, the Contractor shall furnish CMC Performance Security for the deliverables defined in the CMC Period; in the form of a Bank Guarantee from a public sector bank (PSB) of India or Scheduled Commercial Banks in India for an amount of 10% of Price Centre RS-CMC in the same currency(ies). A Performance Bank Guarantee (PBG) shall always been in place throughout the full duration of the CMC Period. In case the Contractor needs multiple CMC PBGs to cover the full duration, then the duration of each CMC PBG that is furnished shall not less than 4 years. The Employer shall also permit the Contractor to reduce the value of the CMC Performance Security at every three (3) year intervals provided the following two (2) conditions are satisfied: i. The Contractor has achieved satisfactory CMC Performance for the preceding 3 year period. ii. The Contractor has provided a replacement Bank Guarantee (either valid for a fresh 4 year period, or valid until 210 days beyond the end of the CMC Period; whichever is earlier) for the reduced value amount for CMC Performance Security amount in accordance with the following schedule:
75	Part 3	Section VIII Particular Conditions Part-B	Si No 45 (GCC 10.1)	Add the following at the end of sub-clause 10.1: All the Works or Section shall be handed over to Employer duly cleaned using suitable agents." The Defect Notification Period shall begin with Taking-Over of the Project Works except for parts and/or systems / subsystems of the Project Works, which may require further corrective action or design change. In such scenarios, the Defect Notification Period for those respective systems/subsystems shall recommence only after completion of the corrective action to the full satisfaction of the Engineer / Employer.	Add the following at the end of sub-clause 10.1: All the Works or Section shall be handed over to Employer duly cleaned using suitable agents." The DNP / DLP shall be followed as per GCC clause 11.1 and PCC to GCC clause 11.1. Further, the DLP / DNP for parts and/or systems / subsystems of the Project Works, which may require further corrective action or design change, the DNP / DLP for those respective systems / subsystems shall recommence only after completion of the corrective action to the full satisfaction of the Engineer / Employer.
76	Part 3	Section IX Annex to Particular Conditions- Contract Forms	2 Contract Agreement Sl. No. 2	The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement along with schedules shall prevail over all other Contract documents. a) The Letter of Acceptance (LoA) vide CMRL letter No. [insert Letter No.] dated [insert letter dated]. b) The Letter of Acceptance (LoA) accepted by the Contractor. c) Post bid clarification and responses. d) Letter of Technical Bid and Letter of Price Bid. e) Addendum / Corrigendum to Tender. f) Pre-bid queries and responses. g) the Particular Conditions – Part A (Contract Data). h) the Particular Conditions – Part B (Specific Provisions). i) the General Conditions. j) Employer's Requirements – Technical Specifications. k) Pricing Document & Financial Bid. l) Instruction to Bidders (ITB), Bid Data Sheet (BDS), Bidding Procedures and other Forms. m) Any other documents forming part of the contract.	The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement along with Schedules shall prevail over all other Contract documents. (a) the Contract Agreement along with Schedules. (b) the Letter of Acceptance (LoA). (c) Addendum / Corrigendum to Tender. (d) Reply to Bidder Queries issued by the Employer / Engineer. (e) the Particular Conditions – Part A (Contract Data). (f) the Particular Conditions – Part B (Specific Provisions). (g) the General Conditions. (h) Not Used. (i) Employer's Requirements Technical Specifications – Rolling Stock, and Employer's Requirements Technical Specifications – Comprehensive Maintenance Contract of Rolling Stock and Depot Plant & Machinery. (j) Pricing Document & Financial Bid. (k) Letter of Technical Bid and Letter of Price Bid. (l) Part 1 : Bidding Procedures. (m) The Contractor's proposal and any other documents forming part of the Contract.

ARE04A Contract (Addendum 01)											
S. No.	Part	Section	Clause No.	Original Bid Condition		Revised Bid Condition					
77	Part 3	Section VIII Particular Conditions Part-B	Si No 13 (GCC 1.5)	<p>Replace Sub-Clause 1.5 with the following: The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:</p> <p>(a) the Contract Agreement along with schedules, (b) the Letter of Acceptance (LoA), (c) Letter of Technical Bid and Letter of Price Bid (d) Addendum / Corrigendum to Tender (e) the Particular Conditions – Part A (Contract Data) (f) the Particular Conditions – Part B (Specific Provisions) (g) the General Conditions (h) Pre-bid Clarifications issued by the Employer / Engineer (i) Employer's Requirements Technical Specifications – Rolling Stock, Employer's Requirements Technical Specifications – Depot Machinery & Plant and Employer's Requirements Technical Specifications – Comprehensive Maintenance Contract (j) Pricing Document & Financial Bid (k) Acknowledgement of Compliance with Guidelines for Procurement under Japanese ODA Loan (l) Part 1 : Bidding Procedures. (m) The Contractor's proposal and any other documents forming part of the Contract</p>		<p>Replace Sub-Clause 1.5 with the following: The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:</p> <p>(a) the Contract Agreement along with Schedules. (b) the Letter of Acceptance (LoA). (c) Addendum / Corrigendum to Tender. (d) Reply to Bidder Queries issued by the Employer / Engineer. (e) the Particular Conditions – Part A (Contract Data). (f) the Particular Conditions – Part B (Specific Provisions). (g) the General Conditions. (h) Not Used. (i) Employer's Requirements Technical Specifications – Rolling Stock, and Employer's Requirements Technical Specifications – Comprehensive Maintenance Contract of Rolling Stock and Depot Plant & Machinery. (j) Pricing Document & Financial Bid. (k) Letter of Technical Bid and Letter of Price Bid. (l) Part 1 : Bidding Procedures. (m) The Contractor's proposal and any other documents forming part of the Contract.</p>					
78	Part 1	Section II (BDS)	18.8	Deleted.		Bidders wishing to offer any unconditional discount shall specify in BOQ offered discounts and the manner in which price discounts will apply.					
79	Part 2	Section VI-A (ERTS-RS)	12.6.9.5	Wheel slide protection shall be available during emergency braking. (Except when the command is initiated by the Operator's Emergency Pushbutton available on the Operator Emergency Driver desk or by RSC consoles of OCC, BCC & DCCs in case of UTO mode of operation.)		Wheel slide protection shall be available during emergency braking. (Except when the command is initiated by the Operator's Emergency Pushbutton available on the Operator Emergency Driver desk or by RSC consoles of OCC, BCC & DCCs in case of UTO mode of operation.)					
80	Part-2	Section VI C	1.16 1.17 1.18 1.19 1.20			All of Section 1.16, Section 1.17, Section 1.18, Section 1.19 & Section 1.20 are modified and attached as "Annexure (03) to ARE04A Addendum (01).					
81	Part 2	Section VI C	Table 3-4	<table border="1"> <tr> <td>4</td> <td>≤ 90%</td> <td>If availability AD₀ is ≤ 90% consecutively for 3 (three) times, the CMC Works is liable for termination as per the provisions of GCC.</td> </tr> </table>	4	≤ 90%	If availability AD ₀ is ≤ 90% consecutively for 3 (three) times, the CMC Works is liable for termination as per the provisions of GCC.	<table border="1"> <tr> <td>4</td> <td>≤ 90%</td> <td>2% Penalty on the respective quarter Price Center RS-CMC apportioned amount. If availability AD₀ is ≤ 90% consecutively for 3 (three) times, the CMC Works is liable for termination as per the provisions of GCC.</td> </tr> </table>	4	≤ 90%	2% Penalty on the respective quarter Price Center RS-CMC apportioned amount. If availability AD ₀ is ≤ 90% consecutively for 3 (three) times, the CMC Works is liable for termination as per the provisions of GCC.
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82	Part 3	Section VI C	3.3.6 (New)			Section 3.3.6 (New Clause): Refer Annexure (04) to ARE04A Addendum (01).					
83	Part 1	Section IV	4.1.8	Amounts payable for Price Centers RS-A, RS-CST, RS-FAI, RS-CPT, RS-C, RS-E, RS-F, RS-H and RS-CMC are capped by the Allowable Apportionment shown in Table 4.2 Pricing Summary, which is expressed as a percentage of the lumpsum price. Further Allowable Apportionment limits are also applied to each respective Milestone. Bidders shall ensure that the prices filled throughout submitted Pricing Tables do not exceed the Allowable Apportionment limits.		Amounts declared by the bidder for Price Centers RS-A, RS-CST, RS-FAI, RS-CPT, RS-C, RS-E, RS-F, RS-H and RS-CMC are capped by the Allowable Apportionment shown in Table 4.2 Pricing Summary, which is expressed as a percentage of the lumpsum price. Bidders shall ensure that the prices filled throughout submitted Pricing Tables do not exceed the Allowable Apportionment limits. The Bidder may offer discount for each Price Centres (except RS-CMC) and this amount will be calculated for the Lumpsum Price (after Discount). The individual Price centre (after Discount) will be taken as the basis for determining the allowable Apportionment limits for the respective Price centres (RS-A, RS-CST, RS-FAI, RS-CPT, RS-C, RS-E, RS-F, RS-H), which are then applied to each Milestone.					
84	Part 2	Section VI-A (ERTS)	11.9.23	<p>The car axle (including AW0 unbalanced weight) shall not be more than 16T Under AW4 load condition of car, weight shall comply to IEC 61133 standard. The Contractor shall also comply with the following weight distribution requirements</p> <p>(i) Measured load on the line of wheels on one side does not differ by more than ± 4% from the average of the measured loads on both sides of the wheels.</p> <p>(ii) For a given axle, the measured load per wheel does not differ by more than ± 4% from the average load per wheel on this axle.</p> <p>(iii) For the load on each axle does not differ by more than ± 2% compared to the average value of the loads on axles.</p>		<p>The car axle (including AW0 unbalanced weight) shall not be more than 16T Under AW4 load condition of car, weight shall comply to IEC 61133 standard. The measured load per axle shall not exceed the above-mentioned figure by more than 2% according to IEC 61133:1992.</p> <p>The Contractor shall also comply with the following weight distribution requirements</p> <p>(i) Measured load on the line of wheels on one side does not differ by more than ± 4% from the average of the measured loads on both sides of the wheels.</p> <p>(ii) For a given axle, the measured load per wheel does not differ by more than ± 4% from the average load per wheel on this axle.</p> <p>(iii) For the load on each axle does not differ by more than ± 2% compared to the average value of the loads on axles.</p>					
85	Part 2	Section VI-A (ERTS)	2.12.3	The rake shall not exceed an axle loading of 16 tonnes under AW4 conditions.		The rake shall not exceed an axle loading of 16 tonnes under AW4 conditions. The measured load per axle shall not exceed the above-mentioned figure by more than 2% according to IEC 61133:1992.					

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S. No.	Part	Section	Clause No.	Original Bid Condition	Revised Bid Condition
86	Part 2	Section VI-A (ERTS)	17.5.3.1 vi	<p>vi. Cooling capacity tests (with doors opening every 2 minutes for 30 sec) including pre-cooling from steady state environmental condition. These tests shall be conducted inside a Climate Chamber for judging the cooling and dehumidification performances of the VAC system for Summer, Monsoon, high ambient, low ambient, high humidity and any other ambient conditions as per EN 14750 or any other equivalent standard. Heating and humidifying equipment shall be provided in the car for test purposes. Testing shall be done for different passenger loads for:</p> <ul style="list-style-type: none"> •Pre-cooling (with full passenger occupancy heat load) – Set temperature should be achieved in 30 minutes. •Regulation (doors closed) - Cooling capacity of VACs shall be sufficiently high to demonstrate 3 complete regulation cycles during the regulation test. •Doors open-close - It should be done for door open-close cycles for complete to-and-fro route run. •Any other tests deemed by CMRL as required by the Contractor shall also be carried out at no additional cost. •Measurements of thermal conductivity (K factor) and cooling capacities shall also be done as per EN 14750-2. •Fresh air flow rate shall also be verified by using dummy passengers as per full passenger load and measuring interior CO2 levels with doors closed and doors open-close situation in all different types of cars. •Parameters to be Measured : Temperature, humidity, pressure, current, voltage, power etc. at various locations of the VACs, test car, climate chamber and equipment used for creating the ambient and interior heat load conditions. Each parameter shall be recorded on a digital data logger. 	<p>vi. Cooling capacity tests (with doors opening every 2 minutes for 30 sec) including pre-cooling from steady state environmental condition. These tests shall be conducted inside a Climate Chamber for judging the cooling and dehumidification performances of the VAC system for Summer, Monsoon, high ambient, low ambient, high humidity and any other ambient conditions as per EN 14750 or any other equivalent standard. Heating and humidifying equipment shall be provided in the car for test purposes. Testing shall be done for different passenger loads for:</p> <ul style="list-style-type: none"> •Pre-cooling (with full passenger occupancy without passenger heat load) – Set temperature should be achieved in 30 minutes. •Regulation (doors closed) - Cooling capacity of VACs shall be sufficiently high to demonstrate 3 complete regulation cycles during the regulation test. •Doors open-close - It should be done for door open-close cycles for complete to-and-fro route run. •Any other tests deemed by CMRL as required by the Contractor shall also be carried out at no additional cost. •Measurements of thermal conductivity (K factor) and cooling capacities shall also be done as per EN 14750-2. •Fresh air flow rate shall also be verified by using dummy passengers as per full passenger load and measuring interior CO2 levels with doors closed and doors open-close situation in all different types of cars. •Parameters to be Measured : Temperature, humidity, pressure, current, voltage, power etc. at various locations of the VACs, test car, climate chamber and equipment used for creating the ambient and interior heat load conditions. Each parameter shall be recorded on a digital data logger.
87	Part 2	Section VI-A (ERTS)	10.8.4	The main transformer design shall be "Hermetically Sealed" type forced cooled or naturally cooled design is proposed. Components shall be modular in construction, complete with oil pump, oil pump motor, radiator with blower fans (if adopted), conservator (if adopted) and protection equipment (e.g. over pressure, over temperature, Buchholz Relay, etc.) all assembled as a single module.	The main transformer shall be Forced cooled or Naturally cooled design. Components shall be modular in construction, complete with oil pump, oil pump motor, radiator with blower fans (if adopted), conservator (if adopted) and protection equipment (e.g. over pressure, over temperature, Buchholz Relay, etc.) all assembled as a single module.
88	Part 2	Section VI-A (ERTS)	2.14.1	<p>The acceleration and braking requirements given below are minimums for actual performance with new wheels on level track in still air. Performance shall be verified by empty car acceptance tests done on all cars, as well as loaded car engineering tests done on the first rake. Design calculations shall be based on the Davis Formulae for rolling resistance given below.</p> <p>Resistance to motion (formula, curve, starting resistance) $TR = 21.96 + 0.4222V + 0.00876V^2$ N/t for Underground Section. $TR = 14.01 + 0.264V + 0.00191V^2$ N/t for Elevated/At grade Section. (Were V in kmph) Curve resistance is 500 / r kg/ton (where r is radius of curve in meter) Starting resistance is 5 kg/ton</p> <p>To facilitate testing, equivalent performance criteria shall be developed, for approval by CMRL. While the specified acceleration and service braking rates are desired and are believed by CMRL to be based upon capabilities of existing apparatus designs, alternate rates may be proposed in the Technical Proposal if the benefits of the revised rates can be documented. The balancing speed for the 3 and 6 car rakes on level tangent track under AW4 conditions in still air shall be a minimum of 80 kmph and the maximum motor, gear unit and bogie safe speed, with minimum wheel diameter, shall be a minimum of 90 kmph. Each car shall be capable of continuously operating in service at all sustained speeds up to 80 kmph, with repeated acceleration and braking, without degradation or damage to any part of the car.</p>	<p>The acceleration and braking requirements given below are minimums for actual performance with new wheels on level track in still air. Performance shall be verified by empty car acceptance tests done on all cars, as well as loaded car engineering tests done on the first rake. Design calculations shall be based on the Davis Formulae for rolling resistance (in both elevated and under-ground) or approved equivalent for a configuration with new wheels. for rolling resistance given below.</p> <p>Resistance to motion (formula, curve, starting resistance) $TR = 21.96 + 0.4222V + 0.00876V^2$ N/t for Underground Section. $TR = 14.01 + 0.264V + 0.00191V^2$ N/t for Elevated/At grade Section. (Were V in kmph) Curve resistance is 500 / r kg/ton (where r is radius of curve in meter) Starting resistance is 5 kg/ton</p> <p>To facilitate testing, equivalent performance criteria shall be developed, for approval by CMRL. While the specified acceleration and service braking rates are desired and are believed by CMRL to be based upon capabilities of existing apparatus designs, alternate rates may be proposed in the Technical Proposal if the benefits of the revised rates can be documented. The balancing speed for the 3 and 6 car rakes on level tangent track under AW4 conditions in still air shall be a minimum of 80 kmph and the maximum motor, gear unit and bogie safe speed, with minimum wheel diameter, shall be a minimum of 90 kmph. Each car shall be capable of continuously operating in service at all sustained speeds up to 80 kmph, with repeated acceleration and braking, without degradation or damage to any part of the car.</p>
89	Part 2	Section VI A: ERTS – Rolling Stock	Appendix D – Guidelines and Drawings		<p>Appendix No. D8 (New addition)</p> <p>Layout drawings of Madhavaram Depot</p>
90	Part 2	Section VI A: ERTS – Rolling Stock	19.52.13 (a)	The Contractor shall provide two no. of portable Relay Testing Kit in each of the two Depots under quoted cost as per GA5 list to quickly identify the relay condition. It shall be capable of testing instantaneous and timer relays on correct functionality (no jammed contacts), minimum operating voltage, contact quality, operating time and delay time.	The Contractor shall provide two (02) Portable Relay Testing Kit to quickly identify the relay condition in RS Maintenance Depot . It shall be capable of testing instantaneous and timer relays on correct functionality (no jammed contacts), minimum operating voltage, contact quality, operating time and delay time.
91	Part 2	Section VI A: ERTS – Rolling Stock	19.52.14 (a)	The Contractor shall provide two no. of tools in each of the two Depots under quoted cost as per GA5 list for extension of each type relay base (i.e. duplicating all the relay pins) for unattended system monitoring (measurement of current and voltage) without affecting the train electrical system in any way.	The Contractor shall provide two (02) tools in RS Maintenance Depot, for extension of each type relay base (i.e. duplicating all the relay pins) for unattended system monitoring (measurement of current and voltage) without affecting the train electrical system in any way.
92	Part 2	Section VI A: ERTS – Rolling Stock	19.52.15 (b)	under quoted cost as per GA5 list for testing, commissioning and faultfinding purpose. The Plug-in test switch shall be able to simulate relay operation in an electrical installation, with latchable manual	For testing, commissioning and faultfinding purpose, Plug-in test switch shall be able to simulate relay operation in an electrical installation, with latchable manual.

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4.2 Pricing Summary (BID TOTAL)

The bidder may quote his offer in any of the following currencies or in any combination: **Indian Rupees (INR)** and in **TWO freely convertible foreign currency (FC)**.

The offer should be submitted in the proforma as given in Price Bid Form of e-procurement portal:

S. No	Description	Total Amount with taxes			Allowable apportionment			
		INR	FC1	FC2				
I	Lumpsum Price (Rolling Stock Before Discount)	AMOUNT NOT TO BE FILLED HERE. KINDLY FILL THE PRICE BID FORM AVAILABLE IN CPP PORTAL			100 %			
1.	Price Centre RS-A: <i>Preliminaries, General Requirements, Design of Rolling Stock, and Provision of 3D Virtual models.</i>							5.60 %
	<i>Discount Offered by the Bidder</i>							
	Price Centre RS-A (After Discount)							
2.	Price Centre RS-CST: <i>'Car shell structural qualification testing' as per ERTS-RS and the Scope of Works covered in Part-2</i>							2.10 %
	<i>Discount Offered by the Bidder</i>							
	Price Centre RS-CST (After Discount)							
3.	Price Centre RS-FAI: <i>'First Article Inspections' as per ERTS-RS and the Scope of Works covered in Part-2</i>							4.90 %
	<i>Discount Offered by the Bidder</i>							
	Price Centre RS-FAI (After Discount)							
4.	Price Centre RS-CPT: <i>'Car Performance tests (Prototype train)' as per ERTS-RS and the Scope of Works covered in Part-2</i>							2.10 %
	<i>Discount Offered by the Bidder</i>							
	Price Centre RS-CPT (After Discount)							
5.	Price Centre RS-C: <i>Indigenous Manufacture, Factory Testing, Inspection and Dispatch, transit insurance from factory to Depot Site. Inland Transportation of Indigenous manufactured trains within India including handling charges at depot or at any other place, and all other incidental costs, receipt of cars in depot.</i>							44.45 %
	<i>Discount Offered by the Bidder</i>							
	Price Centre RS-C (After Discount)							
6.	Price Centre RS-E: <i>Formation of Indigenous manufactured trains, satisfactory completion of tests and running of train in the depot.</i>							5.60 %
	<i>Discount Offered by the Bidder</i>							
	Price Centre RS-E (After Discount)							

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S. No	Description	Total Amount with taxes			Allowable apportionment			
		INR	FC1	FC2				
7.	Price Centre RS-F: <i>Integrated testing and commissioning of trains and service trials.</i>	AMOUNT NOT TO BE FILLED HERE. KINDLY FILL THE PRICE BID FORM AVAILABLE IN CPP PORTAL			4.90 %			
	<i>Discount Offered by the Bidder</i>							
	<i>Price Centre RS-F (After Discount)</i>							
8.	Price Centre RS-H: <i>Training, operation and maintenance manuals</i>						0.35 %	
	<i>Discount Offered by the Bidder</i>							
	<i>Price Centre RS-H (After Discount)</i>							
9.	Price Centre RS-CMC: <i>Comprehensive Maintenance Contract of Rolling Stock (32 Train Sets of 3-car configuration) and Depot Plant & Machinery for 15 years.</i>						30.00 %	
10.	Lumpsum Price (Rolling Stock After Discount) = Price Centre (RS-A + RS-CST + RS-FAI + RS-CPT + RS-C + RS-E + RS-F + RS-H) After Discount + RS-CMC							
11.	Provisional Sum				INR 2 Crore (DB Charges)			

Notes:

- (i) The Bidder shall quote his Lumpsum Bid price in INR and/or in any two freely convertible foreign Currency.
- (ii) Price centres 'RS_CMC' shall be quoted in Indian Rupees (INR) and/or in any one freely convertible foreign Currency.
- (iii) Payment of the Contract Price shall be made in the currency or currencies in which the Bid Price is expressed in the Bid of the successful Bidder.
- (iv) Bidders shall quote for the above Price Centres including all taxes and duties including GST, Customs Duty, levies and fees.
- (v) The 'Price centre total' mentioned above, shall be converted into Indian Rupees (INR) if other currencies are used and the exchange rates(s) shall be as published by the Reserve Bank of India selling rates of exchange / FBIL reference rates at the close of business hours of Financial Benchmarks India Pvt Ltd (FBIL) as delegated by the Reserve Bank of India vide their order no. RBI / 2018-19 / 34 DBR.Ret.BC.No.01 / 12.01.001 / 2018-19 dated August 02, 2018, 28 days prior to submission of the Bid. *If the date that is 28 days prior to the stipulated date of submission happens to fall on a public holiday, then the rate of Exchange at the close of business of FBIL's website on the previous working day shall be considered for the conversion of Foreign Currency to Indian Rupees.* The Bid Total (III Price Centre Total) mentioned above shall be considered in INR equivalent for bid evaluation.
- (vi) Provisional Sum shall not be considered during evaluation.
- (vii) The bidder shall be responsible to ensure that their quoted price towards individual Price Centres in various currencies (if any), converted into INR equivalent as above, comply with the apportionment percentage ratio indicated against each Price Centre. In case of any deviation in the quoted price towards individual Price Centres with respect to its allowable apportionment percentage, the Employer will readjust the prices and taxes & duties table among the Price Centres without altering the Total Bid Price, before entering into the Contract agreement.
- (viii) Amounts declared by the bidder for Price Centers RS-A, RS-CST, RS-FAI, RS-CPT, RS-C, RS-E, RS-F, RS-H and RS-CMC are capped by the Allowable Apportionment shown in Table 4.2 Pricing Summary, which is expressed as a percentage of the lumpsum price. Bidders shall ensure that the prices filled throughout submitted Pricing Tables do not exceed the Allowable Apportionment limits. The Bidder may offer discount for each Price Centres (except RS-CMC) and this amount will be calculated for the Lumpsum Price (after Discount). The individual Price centre (after Discount) will be taken as the basis for determining the allowable Apportionment

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limits for the respective Price centres (RS-A, RS-CST, RS-FAI, RS-CPT, RS-C, RS-E, RS-F, RS-H), which are then applied to each Milestone.

- (ix) Any additional Depot M&P Assets (including, but not limited to the items mentioned by the bidder in the tables in 4.4.13) the tables required for the ARE04A Contractor to perform its CMC Works on the Rolling Stock fleet, shall be procured by the ARE04A Contractor and the cost is deemed to have been included in the price quoted in the lumpsum price.

4.3 DETAILS OF TAXES / DUTIES / LEVIES ETC. INCLUDED IN THE LUMP SUM PRICE AFTER DISCOUNT (PRICE CENTRE WISE)

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

Table 4.3.1: Taxes, Duties, Levies, etc.

Price Centre	Taxes, Duties, Levies etc. (In INR)																			
	Customs Duty						Goods and Services Tax						Any other taxes /duties / levies		Total Amount All taxes, duties, levies, cess etc.					
	Basic Custom Duty		IGST		Social Welfare Surcharges		CGST		SGST		IGST									
	Rate (%)	Amount	Rate (%)	Amount	Rate (%)	Amount	Rate (%)	Amount	Rate (%)	Amount	Rate (%)	Amount	Rate (%)	Amount	Amount					
RS-A	NOT APPLICABLE																			
RS-CST																				
RS-FAI																				
RS-CPT																				
RS-C																				
RS-E	NOT APPLICABLE																			
RS-F																				
RS-H																				
RS-CMC																				
Total																				

Table 4.3.2: Overview of Contract Price

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

Price Centre	Contract Price without taxes & duties			Customs duty	GST	Any other taxes/duties	Contract Price with taxes & duties			
	INR	FC1	FC2	INR	INR	INR	INR	FC1	FC2	
RS-A				NOT APPLICABLE						
RS-CST										
RS-FAI										
RS-CPT										
RS-C										

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RS-E				NOT APPLICABLE					
RS-F									
RS-H									
RS-CMC									
Total									

Table Filling Instructions:

1. Bidders' are required to submit the duly filled in tables along with the Letter of Price Bid.
2. Goods and Services Tax (GST) amounts shall only be filled for indigenously manufactured complete / finished Trainsets, Depot Machinery & Plant and for CMC Price Centres.
3. Customs Duty is only applicable for Price Centres RS-C & RS-CMC.
 - a) The Contractor shall fill the data based on their own estimation of the quantity of goods that will be imported to fulfil the Works and shall serve as the ceiling amounts considered for reimbursement.
 - b) The successful bidder shall then submit a detailed breakdown list (in a format that is approved by the Engineer & the Employer) by NTP + 330 days showing values for all Equipment / Sub-assemblies / Components that will be imported. Reimbursement of Customs Duty by CMRL shall be in accordance with the detailed breakdown list (supported by evidence of actual duties incurred and utilisation during manufacturing) but will be capped at the ceiling amounts declared in accordance with 3(a).

Notes on Taxes / Duties / Levies:

The following shall apply to ALL tables which indicates Taxes, Duties or Levies:

4. Wherever Customs Duty has been blocked out as "Not Applicable" within the pricing table it is clarified that the Contractor will not be eligible to claim any reimbursement, nor can the Contractor make any adjustment claims whatsoever in the event of any future changes in law / legislation (GCC 13.7) which may affect Customs Duty rates.
5. All Customs Duty, GST, levies, etc. indicated in the above table are considered to be included in the lumpsum price (Price centre wise) i.e. Bid Total in INR currency. Reimbursement of Customs Duty, GST, levies, etc. indicated in the above table by the Employer shall be in INR only, upon submission of proof of discharge of Contractor's liability subject to the ceiling of the amounts indicated in the above table.
6. Increases in Taxes / Duties / Levies incurred by the Contractor due to currency fluctuations (or for any currency hedging) are deemed to have been included in the Lumpsum Price. Ceiling limits shall not be adjusted on this account.
7. Ceiling limit(s) shall be proportionately increased or decreased in the event that the Option Quantity Variation is exercised or other Variation to the Works is awarded by the Employer during the Contract period.
8. In case the customs duty rate is increased, decreased or abolished due to a change in tax law, the customs duty ceiling amount applied to any reimbursement (Defined in Note-3b) shall be proportionately increased / decreased by a corresponding amount.
9. If any rates of taxes and duties are increased or decreased, a new tax is introduced or an existing tax is abolished during the course of performance of the Contract, an equitable adjustment of the

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Contract Price shall be applied to fully take into account any such change by addition to the Contract Price or deduction therefrom, as the case may be.

10. If the extension of the contract period is on account of contractor's fault, no compensation shall be made towards upward revision towards "Change in Taxes and Duty". Any benefit on account of downward revision towards "Change in Taxes and Duty", during the original contract period or extended contract period shall be on Employer's account.

4.4 SCHEDULE OF PAYMENTS

4.4.1 PRICE CENTRE 'RS-A' – PRELIMINARIES, GENERAL REQUIREMENTS, DESIGN OF ROLLING STOCK AND PROVISION OF 3D VIRTUAL MODELS.

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

MILESTONE NUMBER	WORK DESCRIPTION	INR	FC1	FC2	PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE (QUANTITY)	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-A) %
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
Obtain the "No Objection With Comments (NOWC)" / "Notice of No Objection (NONO)" from the Employer / Engineer for:						
RS-A1	Submission of Preliminary Design Documents (PDR) and obtain NOWC / NONO approval from the Employer / Engineer.				NTP + 240	18.00 %
RS-A2	Acceptance of 3D view of prototype train model to allow issue of NONO / NOWC by the Employer / Engineer.				NTP + 280	1.00 %
RS-A3	Submission of Pre-Final Design Documents (PFDR), and obtain NOWC / NONO approval from the Employer / Engineer.				NTP + 480	27.00 %
RS-A4	Submission of Final Design Documents (FDR), and obtain NOWC / NONO approval from the Employer / Engineer.				NTP + 600	27.00 %
RS-A5	Submission of Test Reports, and obtain NOWC / NONO approval from the Employer / Engineer.				NTP + 1190	18.00 %
RS-A6	Submission of As Built Drawing & Manufacturing Drawing obtain NOWC / NONO approval from the Employer / Engineer.				NTP + 240	8.00 %
RS-A7	Submission of Compliance Matrix (for all Works) obtain				NTP + 28	1.00 %

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MILESTONE NUMBER	WORK DESCRIPTION	INR	FC1	FC2	PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE (QUANTITY)	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-A) %
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
	NOWC / NONO approval from the Employer / Engineer.					
RS-A : PRICE CENTRE TOTAL (RS-A1 ~ RS-A7)		Carried over from Price Centre 'RS-A' (After Discount)			X	100 %

Note : 1. Bidders shall quote for the above Price Centres including all taxes and duties.

2. In the event that the values entered in above table mismatch with the BOQ values submitted by the bidder; the BOQ values shall be considered.

4.4.2 PRICE CENTRE 'RS-CST' – CAR SHELL STRUCTURAL QUALIFICATION TESTING

This Price Centre comprises of all requirements/ activities associated with the successful completion of the Car Shell Qualification Test as specified in ERTS - RS, Section 17.5.2.3

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

MILESTONE NUMBER	WORK DESCRIPTION	INR	FC1	FC2	PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE (QUANTITY)	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-CST) %
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
Obtain the "No Objection With Comments (NOWC)" / "Notice of No Objection (NONO)" from the Employer / Engineer for:						
RS-CST1	Car Shell Structural Qualification Test. 'Car shell structural qualification testing' as per ERTS-RS and the Scope of Works covered in Part-2				NTP + 480	100 %
RS-CST : PRICE CENTRE TOTAL		Carried over from Price Centre 'RS-CST' (After Discount)			X	100 %

Note : 1. Bidders shall quote for the above Price Centres including all taxes and duties.

2. In the event that the values entered in above table mismatch with the BOQ values submitted by the bidder; the BOQ values shall be considered.

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4.4.3 PRICE CENTRE 'RS-FAI' – FIRST ARTICLE INSPECTIONS

This Price Centre comprises of all requirements/ activities associated with the successful completion of the First Article Inspections as specified in ERTS - RS, Section 18.9.7

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

MILESTONE NUMBER	WORK DESCRIPTION	INR	FC1	FC2	PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE (QUANTITY)	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-FAI) %
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
Obtain the "No Objection With Comments (NOWC)" / "Notice of No Objection (NONO)" from the Employer / Engineer for:						
RS-FAI1	Completion and Approval of First Article Inspections. 'First Article Inspections' as per ERTS-RS and the Scope of Works covered in Part-2				NTP + 540	100 %
RS-FAI : PRICE CENTRE TOTAL		Carried over from Price Centre 'RS-FAI' (After Discount)				100 %

Note : 1. Bidders shall quote for the above Price Centres including all taxes and duties.

2. In the event that the values entered in above table mismatch with the BOQ values submitted by the bidder; the BOQ values shall be considered.

4.4.4 PRICE CENTRE 'RS-CPT' – CAR PERFORMANCE TESTS

This Price Centre comprises of all requirements/ activities associated with the successful completion of the Car Performance tests as specified in ERTS - RS, Section 17.5.4.8

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

MILESTONE NUMBER	WORK DESCRIPTION	INR	FC1	FC2	PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE (QUANTITY)	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-CPT) %
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
Obtain the "No Objection With Comments (NOWC)" / "Notice of No Objection (NONO)" from the Employer / Engineer for:						
RS-CPT1	Car Performance test (Prototype cars on site). 'Car Performance tests (Prototype train)' as per ERTS-RS and the Scope of Works covered in Part-2				NTP + 900	100 %
RS-CPT : PRICE CENTRE TOTAL		Carried over from Price Centre 'RS-CPT' (After Discount)				100 %

Note : 1. Bidders shall quote for the above Price Centres including all taxes and duties.

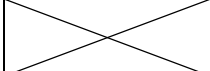
Annexure (1) of Addendum (01):

2. In the event that the values entered in above table mismatch with the BOQ values submitted by the bidder; the BOQ values shall be considered.

4.4.5 **Not Used.**

4.4.6 **PRICE CENTRE 'RS-C' – INDIGENOUS MANUFACTURE, TESTING, INSPECTION, TRANSPORTATION AND DELIVERY TO CMRL DEPOT**

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

MILESTONE NUMBER	WORK DESCRIPTION	APPORTIONED AMOUNT			PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE (QUANTITY)	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-C) %
		INR	FC1	FC2		
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
Obtain the "No Objection With Comments (NOWC)" / "Notice of No Objection (NONO)" from the Employer / Engineer for:						
a. Issue of Inspection/ clearance Certificate on satisfactory completion of all Factory Tests;						
b. Transit Insurance;						
c. Dispatch documents						
d. Delivery of cars to CMRL's property.						
RS-C1	First 3 car rake (Prototype Rake)				NTP + 630	3.125 %
RS-C2	Obtain as above for first 6 train sets				NTP + 840	18.750 %
RS-C3	Obtain as above for next 6 train sets				NTP + 900	18.750 %
RS-C4	Obtain as above for next 6 train sets				NTP + 960	18.750 %
RS-C5	Obtain as above for next 6 train sets				NTP + 1020	18.750 %
RS-C6	Obtain as above for next 7 train sets				NTP + 1090	21.875 %
RS-C : PRICE CENTRE TOTAL (RS-C1 ~ RS-C6)		Carried over from Price Centre 'RS-C' (After Discount)				100 %

Notes:


1. The apportioned amounts (both foreign currency and local currency) in the above Table shall in proportion to the number of trains in all Milestones relevant to the Price Centre.
2. Specify 'Not Applicable' against each of the rows which are not applicable under this milestone.
3. Bidders shall quote for the above Price Centres including all taxes and duties.

4.4.7 **Not Used.**

Annexure (1) of Addendum (01):

4.4.8 PRICE CENTRE 'RS-E' – FORMATION, TESTING IN THE DEPOT FOR INDIGENOUSLY MANUFACTURED TRAINS

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

MILESTONE NUMBER	WORK DESCRIPTION	APPORTIONED AMOUNT			PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE (QUANTITY)	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-E) %
		INR	FC1	FC2		
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
Obtain the "No Objection With Comments (NOWC)" / "Notice of No Objection (NONO)" from the Employer / Engineer for:						
a) Formation of train, obtaining certificate of satisfactory completion of functional tests and running of train in the Depot, train static and dynamic test in mainline.						
RS-E1	First 3 car rake (Prototype Rake)				NTP + 900	3.125 %
RS-E2	Obtain as above for first 6 train sets				NTP + 930	18.750 %
RS-E3	Obtain as above for next 6 train sets				NTP + 990	18.750 %
RS-E4	Obtain as above for next 6 train sets				NTP + 1050	18.750 %
RS-E5	Obtain as above for next 6 train sets				NTP + 1110	18.750 %
RS-E6	Obtain as above for next 6 train sets				NTP + 1195	21.875 %
RS-E: PRICE CENTRE TOTAL (RS-E1 ~ RS-E6)		Carried over from Price Centre 'RS-E' (After Discount)				100 %

Notes:

1. The apportioned amounts (both foreign currency and local currency) in the above Table shall in proportion to the number of trains in all Milestones relevant to the Price Centre.
2. Specify 'Not Applicable' against each of the rows which are not applicable under this milestone.
3. Bidders shall quote for the above Price Centres including all taxes and duties.

Annexure (1) of Addendum (01):

4.4.9 PRICE CENTRE 'RS-F' – INTEGRATED TESTING AND COMMISSIONING OF TRAINS AND SERVICE TRIALS

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

MILESTONE NUMBER	WORK DESCRIPTION	APPORTIONED AMOUNT			PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE (QUANTITY)	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-F) %
		INR	FC1	FC2		
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
Obtain the "No Objection With Comments (NOWC)" / "Notice of No Objection (NONO)" from the Employer / Engineer for:						
a. Completion of Integrated Testing and Commissioning in the Depot;						
b. Completion of Integrated testing and Commissioning on the section in conjunction with Designated Contractors;						
c. Instrumentation Tests of First train, conducting oscillation trials as per requirement of Statutory Authorities, compilation of test Results, obtaining sanction of Statutory Authorities for fitness of train for carriage of passengers in respect of Prototype Trains only.						
d. Service Trials, for;						
RS-F1	First 3 car rake (Prototype Rake)				NTP + 1050	3.125 %
RS-F2	Obtain as above for first 6 train sets				NTP + 1050	18.750 %
RS-F3	Obtain as above for next 6 train sets				NTP + 1110	18.750 %
RS-F4	Obtain as above for next 6 train sets				NTP + 1170	18.750 %
RS-F5	Obtain as above for next 6 train sets				NTP + 1230	18.750 %
RS-F6	Obtain as above for next 7 train sets				NTP + 1300	21.875 %
RS-F : PRICE CENTRE TOTAL (RS-F1 ~ RS-F6)		Carried over from Price Centre 'RS-F' (After Discount)			XXXX	100 %

Notes:

1. The apportioned amounts (both foreign currency and local currency) in the above Table shall in proportion to the number of trains in all Milestones relevant to the Price Centre.
2. Specij 'Not Applicable' against each of the rows which are not applicable under this milestone.
3. Bidders shall quote for the above Price Centres including all taxes and duties.

4.4.10 Not Used.

Annexure (1) of Addendum (01):

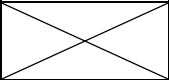
4.4.11 PRICE CENTRE 'RS-H' – TRAINING AND MANUALS.

This Price Centre comprises of all requirements / activities associated with ERTS - RS, Section 15.

DETAILS ARE NOT TO BE SUBMITTED WITHIN THE TECHNICAL BID. THEY ARE TO BE FILLED AND UPLOADED IN THE PRICE BID DOCUMENT OF E-PROCUREMENT PORTAL ONLY.

MILESTONE NUMBER	WORK DESCRIPTION	APPORTIONED AMOUNT			PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-H) %
		INR	FC1	FC2		
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
Obtain the "No Objection With Comments (NOWC)" / "Notice of No Objection (NONO)" from the Employer / Engineer for completion of all training including delivery of final training manuals for the following:						
RS-H0	<p>Training for the Employer's staff (two trainer man months) shall be arranged and will be conducted at:</p> <p>i) the site of an Operating Railway (must be part of a network that has provided GoA-4 / UTO operations for a period >10 years)</p> <p>ii) the Contractor's design/primary car building facility</p> <p>iii) the site where System's Integration simulation testing is undertaken</p> <p>The training syllabus shall be jointly decided between the Contractor and the Employer. It may consist of but shall not be limited to: Rolling Stock design, manufacturing, Testing and Commissioning, Systems Integration Testing and UTO Signalling Technology.</p>					10 %
RS-H1	Not used					
RS-H2	Not used					
RS-H3	Not used					
RS-H4	Provision of Contractor's Driving Instructors (2-man months) for Training of Employer's operating personnel in India.					10 %
RS-H5	*Provision of Contractor's Instructors and OEM's Experts (40 man months) for on job Training and supervision of Employer's maintenance personnel in the metro train depot of CMRL in India.					10 %
RS-H6	Submission of Training manuals (Original plus five hard copies) and in Electronic format.					10 %
RS-H7	Operating Manual (Original plus 5 Hard copies).					10 %
RS-H8	Operating Manual in Electronic format (interactive version).					10 %

Annexure (1) of Addendum (01):

MILESTONE NUMBER	WORK DESCRIPTION	APPORTIONED AMOUNT			PERIOD OF COMPLETION OF MILESTONE FROM COMMENCEMENT DATE	ALLOWABLE APPORTIONMENT (Under the Price Centre RS-H) %
		INR	FC1	FC2		
	MILESTONE ACTIVITY	COLUMN A	COLUMN B	COLUMN C		
RS-H9	Maintenance Manual (Original plus 5 hard copies).					10 %
RS-H10	Maintenance Manual in Electronic format (interactive version).					10 %
RS-H11	Spare parts Catalogue (Original plus 5 Hard copies).					10 %
RS-H12	Spare parts Catalogue in Electronic format					10 %
RS-H13	Any other item considered necessary by the Contractor to comply with the scope of Works					
RS-H : Price Centre Total (RS-H1 ~ RS-H13)		Carried over from Price Centre 'RS-H' (After Discount)				100 %

- On job training and supervision during maintenance includes theoretical training as well as practical training at the time of maintenance during day and night in the Depot.
- Any other specific training as provided in the Employer's Requirement Technical Specification is deemed to be included under this Milestone's scope.
- The manuals will be given for training of operation and maintenance staff. These manuals have to be updated taking into account the experience during the O&M phase regarding troubleshooting, modifications to control / eliminate failures etc. Final manuals to be supplied before expiry of Defects Liability Period.

Notes :

1. *The Bidder shall not complete the column "Weeks for completion of Milestone from commencement date" for Milestones RS-H1 to RS-H6 and RS-H13*
2. *The dates of operation of the Milestones Activities for Milestones RS-H1 to RS-H6 and RS-H13 will be at the discretion of the Employer. However, the training plan of the Contractor shall ensure that training of Employer's personnel for carrying out the scheduled maintenance tasks are completed.*
3. *Not used.*
4. *The travel, boarding and lodging expenses for the employer's trainees sent overseas will be borne by the Employer.*
5. *Amount quoted in this Price Centre shall be the Apportioned Amount.*
6. *Bidders shall quote for the above Price Centres including all taxes and duties.*

Annexure (1) of Addendum (01):

4.6.12 PRICE CENTRE 'RS-CMC' – Comprehensive Maintenance Contract of Rolling Stock for 15 years This Price Centre comprises of all requirements / activities associated with ERTS – CMC

DETAILS ARE TO BE FILLED AND UPLOADED THROUGH THE E-PROCUREMENT PORTAL AS PART OF THE PRICE BID DOCUMENT. PRICING INFORMATION MUST NOT BE SUBMITTED WITHIN THE TECHNICAL BID.

MILESTONE NUMBER	WORK DESCRIPTION	APPORTIONED AMOUNT		ALLOWABLE APPORTIONMENT (Under the Price Centre RS-CMC) %
	MILESTONE ACTIVITY	INR COLUMN A	JPY-FC1 COLUMN B	
Obtain the "No Objection With Comments (NOWC) or Notice of No Objection (NONO)" from the Employer / Engineer for CMC Works:				
RS-CMC1-1	Apportioned amount for 32 trainset : 1 st Year (Quarter 1)			1.00 %
RS-CMC1-2	Apportioned amount for 32 trainset : 1 st Year (Quarter 2)			1.00 %
RS-CMC1-3	Apportioned amount for 32 trainset : 1 st Year (Quarter 3)			1.00 %
RS-CMC1-4	Apportioned amount for 32 trainset : 1 st Year (Quarter 4)			1.00 %
RS-CMC2-1	Apportioned amount for 32 trainset : 2 nd Year (Quarter 1)			1.00 %
RS-CMC2-2	Apportioned amount for 32 trainset : 2 nd Year (Quarter 2)			1.00 %
RS-CMC2-3	Apportioned amount for 32 trainset : 2 nd Year (Quarter 3)			1.00 %
RS-CMC2-4	Apportioned amount for 32 trainset : 2 nd Year (Quarter 4)			1.00 %
RS-CMC3-1	Apportioned amount for 32 trainset : 3 rd Year (Quarter 1)			1.00 %
RS-CMC3-2	Apportioned amount for 32 trainset : 3 rd Year (Quarter 2)			1.00 %
RS-CMC3-3	Apportioned amount for 32 trainset : 3 rd Year (Quarter 3)			1.00 %
RS-CMC3-4	Apportioned amount for 32 trainset : 3 rd Year (Quarter 4)			1.00 %
RS-CMC4-1	Apportioned amount for 32 trainset : 4 th Year (Quarter 1)			1.25 %
RS-CMC4-2	Apportioned amount for 32 trainset : 4 th Year (Quarter 2)			1.25 %
RS-CMC4-3	Apportioned amount for 32 trainset : 4 th Year (Quarter 3)			1.25 %
RS-CMC4-4	Apportioned amount for 32 trainset : 4 th Year (Quarter 4)			1.25 %
RS-CMC5-1	Apportioned amount for 32 trainset : 5 th Year (Quarter 1)			1.25 %
RS-CMC5-2	Apportioned amount for 32 trainset : 5 th Year (Quarter 2)			1.25 %
RS-CMC5-3	Apportioned amount for 32 trainset : 5 th Year (Quarter 3)			1.25 %
RS-CMC5-4	Apportioned amount for 32 trainset : 5 th Year (Quarter 4)			1.25 %
RS-CMC6-1	Apportioned amount for 32 trainset : 6 th Year (Quarter 1)			1.25 %
RS-CMC6-2	Apportioned amount for 32 trainset : 6 th Year (Quarter 2)			1.25 %
RS-CMC6-3	Apportioned amount for 32 trainset : 6 th Year (Quarter 3)			1.25 %

Annexure (1) of Addendum (01):

MILESTONE NUMBER	WORK DESCRIPTION	APPORTIONED AMOUNT		ALLOWABLE APPORTIONMENT (Under the Price Centre RS-CMC) %
	MILESTONE ACTIVITY	INR COLUMN A	JPY-FC1 COLUMN B	
Obtain the “No Objection With Comments (NOWC) or Notice of No Objection (NONO)” from the Employer / Engineer for CMC Works:				
RS-CMC6-4	Apportioned amount for 32 trainset : 6 th Year (Quarter 4)			1.25 %
RS-CMC7-1	Apportioned amount for 32 trainset : 7 th Year (Quarter 1)			1.25 %
RS-CMC7-2	Apportioned amount for 32 trainset : 7 th Year (Quarter 2)			1.25 %
RS-CMC7-3	Apportioned amount for 32 trainset : 7 th Year (Quarter 3)			1.25 %
RS-CMC7-4	Apportioned amount for 32 trainset : 7 th Year (Quarter 4)			1.25 %
RS-CMC8-1	Apportioned amount for 32 trainset : 8 th Year (Quarter 1)			1.50 %
RS-CMC8-2	Apportioned amount for 32 trainset : 8 th Year (Quarter 2)			1.50 %
RS-CMC8-3	Apportioned amount for 32 trainset : 8 th Year (Quarter 3)			1.50 %
RS-CMC8-4	Apportioned amount for 32 trainset : 8 th Year (Quarter 4)			1.50 %
RS-CMC9-1	Apportioned amount for 32 trainset : 9 th Year (Quarter 1)			1.50 %
RS-CMC9-2	Apportioned amount for 32 trainset : 9 th Year (Quarter 2)			1.50 %
RS-CMC9-3	Apportioned amount for 32 trainset : 9 th Year (Quarter 3)			1.50 %
RS-CMC9-4	Apportioned amount for 32 trainset : 9 th Year (Quarter 4)			1.50 %
RS-CMC10-1	Apportioned amount for 32 trainset : 10 th Year (Quarter 1)			2.00 %
RS-CMC10-2	Apportioned amount for 32 trainset : 10 th Year (Quarter 2)			2.00 %
RS-CMC10-3	Apportioned amount for 32 trainset : 10 th Year (Quarter 3)			2.00 %
RS-CMC10-4	Apportioned amount for 32 trainset : 10 th Year (Quarter 4)			2.00 %
RS-CMC11-1	Apportioned amount for 32 trainset : 11 th Year (Quarter 1)			2.00 %
RS-CMC11-2	Apportioned amount for 32 trainset : 11 th Year (Quarter 2)			2.00 %
RS-CMC11-3	Apportioned amount for 32 trainset : 11 th Year (Quarter 3)			2.00 %
RS-CMC11-4	Apportioned amount for 32 trainset : 11 th Year (Quarter 4)			2.00 %
RS-CMC12-1	Apportioned amount for 32 trainset : 12 th Year (Quarter 1)			2.00 %
RS-CMC12-2	Apportioned amount for 32 trainset : 12 th Year (Quarter 2)			2.00 %
RS-CMC12-3	Apportioned amount for 32 trainset : 12 th Year (Quarter 3)			2.00 %
RS-CMC12-4	Apportioned amount for 32 trainset : 12 th Year (Quarter 4)			2.00 %
RS-CMC13-1	Apportioned amount for 32 trainset : 13 th Year (Quarter 1)			2.50 %
RS-CMC13-2	Apportioned amount for 32 trainset : 13 th Year (Quarter 2)			2.50 %
RS-CMC13-3	Apportioned amount for 32 trainset : 13 th Year (Quarter 3)			2.50 %

Annexure (1) of Addendum (01):

MILESTONE NUMBER	WORK DESCRIPTION	APPORTIONED AMOUNT		ALLOWABLE APPORTIONMENT (Under the Price Centre RS-CMC) %
	MILESTONE ACTIVITY	INR COLUMN A	JPY-FC1 COLUMN B	
Obtain the "No Objection With Comments (NOWC) or Notice of No Objection (NONO)" from the Employer / Engineer for CMC Works:				
RS-CMC13-4	Apportioned amount for 32 trainset : 13 th Year (Quarter 4)			2.50 %
RS-CMC14-1	Apportioned amount for 32 trainset : 14 th Year (Quarter 1)			2.50 %
RS-CMC14-2	Apportioned amount for 32 trainset : 14 th Year (Quarter 2)			2.50 %
RS-CMC14-3	Apportioned amount for 32 trainset : 14 th Year (Quarter 3)			2.50 %
RS-CMC14-4	Apportioned amount for 32 trainset : 14 th Year (Quarter 4)			2.50 %
RS-CMC15-1	Apportioned amount for 32 trainset : 15 th Year (Quarter 1)			3.00 %
RS-CMC15-2	Apportioned amount for 32 trainset : 15 th Year (Quarter 2)			3.00 %
RS-CMC15-3	Apportioned amount for 32 trainset : 15 th Year (Quarter 3)			3.00 %
RS-CMC15-4	Apportioned amount for 32 trainset : 15 th Year (Quarter 4)			3.00 %
RS-CMC : Price Centre Total 15 years CMC cost for 32 Trainsets of 3 Car configuration		Carried over from Price Centre 'RS-CMC'		100 %

- Note :
- 1) Bidders shall quote for the above Price Centres including all taxes and duties.
 - 2) Only One Foreign Currency (FC) is allowed for CMC works.
 - 3) Price adjustments for Foreign Currency (FC) is not applicable throughout the CMC period.

4.4.13 List of Additional Depot Plant & Machinery items supplied by the Contractor

Additional DM&P Item No.	Description of Additional DM&P Item supplied by the Contractor	Unit	QTY	Unit Rate			Amount		
				INR	FC1	FC2	INR	FC1	FC2

- Note :
1. Prices mentioned in the above tables are inclusive of all taxes and duties
 2. Prices are deemed to be included in the Lumpsum Price



CHENNAI METRO RAIL LIMITED

SCHEDULE OF DIMENSIONS FOR STANDARD GAUGE

(1435 mm)

CMRL PHASE 2 PROJECT

**DOCUMENT VERIFICATION AND REVISION RECORD**

PROJECT NAME		Chennai Metro Rail Project Phase – 2			
DOC/ NO.		P2C0000PRW000-0GC1-ENGERT-00001	DATE OF ISSUE	16-03-2024	
DOC/ TITLE		Schedule of Dimensions for Standard Gauge (1435 mm)			
REV. No.	DATE OF ISSUE/REV.	DESCRIPTION	PREPARED / DESIGNED	CHECKED	APPROVED
A1	25-04-2021	Submission for review	Dr. Selva	Mahatma	Tony
A2	13-07-2021	Submission for Review	Dr. Selva	Mahatma	Tony
A3	17-07-2021	Submission for Review	Dr. Selva	Mahatma	Tony
A4	14-09-2021	Submission for Review	Dr. Selva	Mahatma	Tony
A5	23-Oct-2021	Submission for Review	Dr. Selva	Mahatma	Tony
A6	14-Sep-2022	Submission for Review	Suresh D/ Selvakumar	Dr. Selva	Ian
A7	29-Nov-2022	Submission for Review	Suresh D/ Selvakumar	Dr. Selva	Ian
A8	13-Dec-2022	Submission for Review	Suresh D/ Selvakumar	Dr. Selva	Ian
A9	16-Feb-2023	Submission for Review	Suresh D/ Selvakumar	Dr. Selva	Ian
A10	08-Sep-2023	Submission for Review	Suresh D/ Selvakumar	Dr. Selva	Ian
A11	31-Oct-2023	Submission for Review	Suresh D/ Selvakumar	Dr. Selva	Ian
A12	16-Mar-2024	Submission for Review	Suresh D/ Selvakumar	Dr. Selva	Ian

Revision History		
REV. No.	Highlight of changes	Revision History
A2	Underline	CMRL/ DDC/GC comments updated
A3	Underline	Internal GC review comments updated
A4	Underline	CMRL Comments/SOD amendments / Highlighted changes from approved SOD
A5	Underline	CMRL comments/update from DMRC SOD
A6	Underline	CMRL/GC comments/update from DMRC SOD
A7	Underline	CMRL/GC comments/update from DMRC SOD
A8	Underline	CMRL/GC comments/update from DMRC SOD
A9	Underline	CMRL/GC comments/update from RDSO Guidelines for framing SOD
A10	Underline	RDSO Comments updated
A11	Underline	RDSO Comments updated
A12	Underline	RDSO Comments updated

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25 KV AC OHE TRACTION SYSTEM

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PREAMBLE

The Schedule of Dimensions (SOD) has been prepared for the Chennai Metro Rail project-Phase 2 having Standard Gauge Track(1435mm), with OHE and 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, new Rolling Stock is introduced the track and coach tolerance for maintenance should be laid down. The suitability of Rolling Stock for operation with these maintenance tolerances should be established and sanction shall be obtained from the competent authority before operation of the Rolling Stock commences.
2. The Kinematic Envelope has been developed for 2900mm wide and 3900 mm to 4048 mm high Rolling Stock and the max height of Kinematic Envelope is defined as 4200 mm.
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 that were considered for the calculation of the 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. The Kinematic Envelope of Rolling Stock should not infringe under any circumstance. Any infringement to SOD should be condoned by Railway Board.
6. The vehicle Kinematic Envelope has been calculated assuming a cross wind speed of 70 Kmph for the platform areas of At-Grade and, Elevated stations. At all other At-Grade and Elevated locations (e.g. outside of stations), the Kinematic Envelope was calculated assuming a cross wind speed of 100 Kmph.
7. At all underground sections (including stations) the Kinematic Envelope was calculated assuming a cross wind speed of 0 Kmph.
8. The cross wind speed calculations for the Kinematic Envelope has been developed taking into account all Track defects and Rolling Stock defects.
9. The speed of trains at platform on Elevated or At Grade Station shall be restricted to 40 Kmph when wind speed is more than 70 KMPH but less than 90 KMPH. Metro operations shall cease when the wind speed reaches 90 KMPH or more. Continuous recording of wind speed shall be ensured.
10. The Maximum Design Speed is 90 Kmph, however, the Operating Speed shall be limited to 80 Kmph (Except for stations where the Operating Speed is 55 kmph). The Operating speed in depots shall be 25 Kmph. The maximum speed potential on diverging lines at turnouts having:
 - (i) Weldable CMS crossing (1 in 9) and thick web switch with 300 m radius of lead curve rail shall be 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 35Kmph.
 - (iv) Weldable CMS crossing (1 in 7) and thick web switch with 140 m radius of lead curve rail shall be 25Kmph.
11. No work/workmen/equipment is allowed between vehicle and Structure gauge during operation of trains.
 12. The Fitness of OHE Installation must meet the requirements of the Rolling Stock at its Design Speed. Electrical Clearances should be measured from the Kinematic Envelope drawn at Design speed of Rolling Stock.
 13. 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.
 14. The clearance between S&T gear and Structure Gauge should always be kept not less than 25 mm.
 15. The front-end evacuation comprises of an on-train detrainment door which deploys a ramp to the 4 foot zone of the track. The minimum width of the ramp is 700mm and the door has a minimum headroom of 1900mm. The minimum clear width of the pathway (within the 4 foot zone) is 610mm.
 16. The Regional wind speed as per IS 875 is 50 m/sec and the same was considered for CMRL Phase 2 Project OHE Design.



CHENNAI METRO RAIL LIMITED

SCHEDULE OF DIMENSIONS

STANDARD GAUGE (1435mm)

(For 2900 wide stock)

INTRODUCTION

The dimension given in this Schedule of Dimensions are to be observed in all works on 1435mm, Standard Gauge, and 2900 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 Chennai Metro Rail Limited Project-Phase 2 which shall be with 25 kV AC Traction system and Over Head current collection. The Rolling Stock shall be 2900 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 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 Screen Doors

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 | : 3600 mm |
| (b) Elevated Sections | : 3650 mm |
| (c) At-Grade Sections | : 3650 mm |

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 |
| iii) <u>The Minimum transition length inside Platform</u> | : 15 m |

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.

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 or less. 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.

Minimum radius of vertical curve: 1500 m

Minimum length of vertical curve: 20 m

(To keep vertical acceleration in range of 0.3 to 0.45 m/s²)

1.2.5 Cant and Cant Deficiency (suggested values)

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

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.

1.4 BUILDINGS AND STRUCTURES

1.4.1 Minimum horizontal distance from centre of track to any structure (except a passenger platform) 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)	Rail level to 65mm	Up to 1465 mm
(ii)	65 mm to 200 mm	1465 mm increasing to 1585 mm
(iii)	200 mm to 305 mm	1585 mm
(iv)	305 mm to 940 mm	1585 mm increasing to 1670 mm
(v)	940 mm to 1095 mm	1670 mm increasing to 1675 mm
(vi)	1095 mm to 3305 mm	1675 mm increasing to 1740 mm
(vii)	3305 mm to 3965 mm	1740 mm decreasing to 1250 mm
(viii)	3965 mm to 4775 mm	1250 mm
(ix)	4775 mm to 4920 mm	1250 mm decreasing to zero along an arc of circle of radius of 2900

Also refer to Drawing No. CMSG-2(TNL)

(ii) Rectangular Box Tunnels

S.N.	Height from rail level	Horizontal distance from C.L. of track
(i)	Rail Level to 65 mm	Up to 1465 mm
(ii)	65 mm to 200 mm	1465 mm increasing to 1585 mm
(iii)	200 mm to 305 mm	1585 mm
(iv)	305 mm to 940 mm	1585 mm increasing to 1670 mm
(v)	940 mm to 1095 mm	1670 mm increasing to 1675 mm
(vi)	1095 mm to 3305 mm	1675 mm increasing to 1740 mm
(vii)	3305 mm to 3965 mm	1740 mm decreasing to 1250 mm
(viii)	3965 mm to 4838 mm	1250 mm

Also refer to Drawing No. CMSG-2(TNL)

(b) Elevated and At-Grade Sections

S.N.	Height from rail level	Horizontal distance from C.L. of track
(i)	Rail Level to 65 mm	Up to 1465 mm
(ii)	65 mm to 200 mm	1465 mm increasing to 1640 mm
(iii)	200 mm to 305 mm	1640 mm
(iv)	305 mm to 930 mm	1640 mm increasing to 1735 mm
(v)	930 mm to 1095 mm	1735 mm increasing to 1740 mm
(vi)	1095 mm to 3310 mm	1740 mm increasing to 1825 mm
(vii)	3310 mm to 3775 mm	1825 mm decreasing to 1546 mm
(viii)	3775 mm to 6250 mm	1546 mm

Also refer to Drawing No. CMSG-2

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 at-grade and elevated station shall be 2150mm from centre line of nearest track.
- iv) Minimum lateral clearance for OHE masts for tangent track at depot shall be 1950mm from centre line of nearest track.
- v) For passenger platform refer to para 2.2.1 to 2.2.3 of chapter 2.

1.5 KINEMATIC ENVELOPE

The maximum limit of Kinematic Envelope allowed for Rolling Stock (for level or constant grade tangent track) is defined in the following drawings:

- a) Drawing No. CMSG-1 for - Kinematic Envelope for 90kmph –Through & Semi through Girder Bridges At Grade, Elevated Sections on level (or constant grade) tangent track.
- b) Drawing No. CMSG-1(TNL) for - Kinematic Envelope for 90 kmph–Underground Sections on level (or constant grade) tangent track
- c) Drawing No CMSG-1A for-Kinematic Envelope for 65 kmph – At Grade and Elevated Stations on level (or constant grade) tangent track.
- d) Drawing No. CMSG-1A(TNL) for - Kinematic Envelope for 65 kmph – Underground Stations on level (or constant grade) tangent track.

1.6 STRUCTURE GAUGE

1.6.1 Under Ground Sections

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

Refer to Drawing No. CMSG-2(TNL) 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 the derived Kinematic Envelope and minimum electrical clearance of 320 mm from 25 kV live parts conforming to the stipulations in chapter – 4 of this SOD.

Refer to Drawing No. CMSG-2, 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 the derived Kinematic Envelope and minimum electrical clearance of 320mm from 25kV live parts, conforming to stipulations in chapter 4 of this SOD.

Refer to Drawing No. CMSG-2 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

C is the distance between centres of bogies in metres

C1 is the car (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 of Curve

(A) Curvature effect

(a) Mid throw at the centre of the vehicle = V (in mm) = $125xC^2/R$

(b) Allowance due to gauge widening on curves

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

Note:

Lateral shift of 26mm 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 26mm. In case the value of mid throw (V) is less than 26mm, the curvature effect shall be due to widening of the gauge only. (The Mid throw minus 26mm 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:

$$L = Ca \times h/g \text{ (all in mm)}$$

For values of Structure Gauge (E1) for inside of a curve with cant effect only, (as shown in Drawing No. CMSG-4) 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.

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 Drawing No. CMSG-3.

(C) Allowance for vertical curve (vertical throw)

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

$$V1 \text{ (with vertical centre in sag or vehicle end on summit)} = 125 \times C^2/R$$

$$V2 \text{ (with vehicle centre on summit or vehicle end in sag)} = 125 \times C1^2/R - (125 \times C^2/R)$$

Values of vertical throw due to vertical curves of different radii are given in Drawing No. CMSG-5.

1.7.2 OUTSIDE OF CURVE

(A) Curvature effect

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

$$= (125 \times C1^2/R) - (125 \times C^2/R)$$

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:

$$L = (-) Ca \times h/g \text{ (all in mm)}$$

-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 = $(Ca-50) \times h/g$.

Values of Structure Gauge (F1) on outside of curve with cant effect only (as shown in Drawing No. CMSG-4), refer to:

- i) Appendix 3 (TNL) for Under Ground Sections (Rectangular Box)
- 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.

For the values of horizontal and vertical shifts of centre of Circular Tunnel for different values of cant, refer to Appendix-4 and Drawing No. CMSG-3 .

(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 centre of a similar carriage on the outer track.

1.8.1 Without any structure between tracks

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

- a) $(E + F)$,
- b) T_1 (Extra lateral clearance due to curvature on inside of curve),
- c) 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 centre line of canted track to canted Kinematic Envelope on inside of curve at a height 'h' (from rail level) for a given cant (Drawing No. CMSG-4A) and,

'F' is the distance from vertical axis of centre line of canted track to canted Kinematic Envelope on outside of curve at a height 'h' (from rail level) for a given cant (Drawing No. CMSG-4A).

Notes:

- i) The value of 'F', calculated from the formula at Drawing No. CMSG-4A includes full relief due to cant.
- ii) The sum of 'E' and 'F' for same height (which are with cant effect only), shall be the

maximum of values calculated for various heights from rail level.

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

<u>SECTIONS</u>	<u>For E & F</u>	<u>For T₁&T₂</u>
i) Under Ground	3A (TNL)	2A & 2B
ii) Elevated and At-Grade	3A	2A & 2B

1.8.2 With a structure between adjacent tracks

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

- (E₁+T₁)** Minimum clearance to the structure from centre line of track on inside of curve (for outer track),
- (F₁+T₂)** Minimum clearance to the structure from centre line of track on outside of curve (for inner track),
- Width of structure between adjacent tracks (measured across the tracks).

Where,

E₁ is the horizontal distance from vertical axis of centre line of track to canted Structure Gauge on inside of curve for a given cant (Drawing No. CMSG-4),

F₁ is the horizontal distance from vertical axis of centre line of track to canted Structure Gauge on outside of curve for a given cant (Drawing No. CMSG-4),

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

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

Notes:

- The values of '**E₁**' and '**F₁**' 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 **F₁** 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 **F₁** shall be for ZERO cant.
- Minimum track spacing, so worked out with a structure between the adjacent tracks shall not be less than that calculated as per para 1.8.1 for tracks without any structure between adjacent tracks.

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

<u>SECTIONS</u>	<u>For E₁ & F₁</u>	<u>For T₁&T₂</u>
i) Under Ground	3 (TNL)	2A & 2B
ii) Elevated and At-Grade	3	2A & 2B

1.9 DERAILMENT GUARD

(a) Derailment Guard shall be provided on outside of running rail on viaduct & At grade section and inside of running rail in tunnel. 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:

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. (For Risk Analysis kindly refer Drawing No: CMSG-9A, CMSG-9B, CMSG-10A & CMSG-10B).

(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.

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.

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-3900 mm.

2.2 PLATFORMS

2.2.1 Horizontal distance from Centre of track to face of passenger platform coping/PSD threshold shall be

Condition	Value
For Elevated, At Grade section,	Minimum value: 1515 Mm Maximum value: 1520 mm
For Underground section	Minimum value: 1510 Mm Maximum value: 1515mm

Notes:

- a) Passenger platforms have PSD's therefore, the closest dimension to the centreline of the track is always the PSD threshold/Platform Coping.
- b) Platform coping faces shall be flared away smoothly(whenever there is no PSD) 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	Value
Elevated, At Grade section,	1590±5
Underground section	1575±5

- c) 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 Ballasted.....	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, if platform screen door is provided	2000 mm
(ii)	Minimum horizontal distance of any continuous structure on a passenger platform from the edge of coping, if Platform Screen Door is provided	2450 mm

(Refer Appendix – 6 & 6A - Sample egress calculation report for Underground station & Elevated Station)

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)/ Signages etc. shall not be considered structures and shall be located at a minimum horizontal distance of 800 mm from platform edge/coping with minimum height of 2500 mm from top of platform.

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 Drawing No. CMSG-6 and CMSG-7 for Elevated/at grade station and Drawing No. CMSG-6(TNL) and CMSG-7(TNL) 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 drawings:

- | | |
|---------------------------------------|---------------------------|
| a) For under Ground Station | CMSG-6(TNL) & CMSG-7(TNL) |
| b) For At-Grade and Elevated Stations | CMSG-6 & CMSG-7 |

2.3 TRACK GRADIENT

2.3.1 TRACK GRADIENTS IN PLATFORM

- | | |
|----------------------------------|-------------|
| 1. Desirable Grade (Recommended) | : Level |
| 2. Maximum Grade | : 1 in 1200 |
| 3. Exceptional Grade | : 1 in 400 |

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%

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.

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:

(a) For Under Ground Stations

- From CL of track to 1330 mm 25 mm
- From 1330 mm to 1465 mm 25 mm rising to 65 mm
- From 1465 mm to 1585 mm 65 mm rising to 200 mm

(b) For Surface and Elevated Stations

- From CL of track to 1330 mm 25 mm
- From 1330 mm to 1465 mm 25 mm rising to 65 mm
- From 1465 mm to 1640 mm 65 mm rising to 200 mm

Note: Except for check rails of ordinary and diamond crossings, or wing rails and point rails of

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

2.5 Points and Crossings:

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

Note: *Minimum & Maximum clearance value of checkrails opposite to nose of crossing shall be as per the design of Turnout

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

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

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

- a) 1 in 7 type turnout 190m radius
- b) 1 in 7 type turnout 140m radius
- c) Scissors cross-over of 1 in 7 type consisting of 4 turnouts of 190m/140m radius and 1 diamond crossing
- d) 1 in 7 derailing switches/ 1 in 7 type symmetrical split turnout

2.5.10 Diamond crossings not to be flatter than 1 in 4.5

2.5.11

Note:

- a) The above restrictions shall not apply to moveable diamond crossings.
- b) There must be no change of super elevation (of outer rail over inner rail) between points 18 meters 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.

2.5.12 Minimum length of tongue rail: 9000 *mm for Standard Gauge.

Note : *As per the turnout manufacturer design value.

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.

iii) 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

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 45 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 train.

CHAPTER – 3

ROLLING STOCK

3.1 Passenger Rolling Stock

Note: all dimensions are in mm

S.No.	Description	Specified Value
1	Gauge	1435 (SG)
2	a) Maximum Length of the coach body (including end fairings)	22150
	b) Length of coach over couplers	22600
	c) Width of the Coach Body	2900
	d) Height of the coach body (maximum with pantograph in locked down condition)	4048
3	a) Distance between bogie centres*	14850±250
	b) Length of rigid wheel base for single bogie*	2400±200
	c) Maximum Distance between any two adjacent axles	12900
<p>Note: * The above dimensions a), b) should commensurate to each other as per the design selected by Metro considering the manoeuvrability of the coach and the entire train on sharper curves and maximum gradient to avoid any infringement to the structure gauge.</p>		
4	Kinematic Envelope for level tangent track	Drawing No:
	a) Kinematic Envelope for 90kmph –Through & Semi through Girder Bridges At Grade, Elevated Sections on level (or constant grade) tangent track.	CMSG-1
	b) Kinematic Envelope for 65 kmph – At Grade and Elevated Stations on level (or constant grade) tangent track.	CMSG-1A
	c) Kinematic Envelope for 90 kmph–Underground Sections on level (or constant grade) tangent track.	CMSG-1(TNL)
	d) Kinematic Envelope for 65 kmph – Underground Stations on level (or constant grade) tangent track.	CMSG-1A(TNL)
5	a) Minimum clearance from rail level under fully loaded condition for bogie mounted equipment in worst condition* (<i>*The worst condition means wheels with maximum tread wear and primary springs with maximum deflection</i>) in static condition.	75
	b) Minimum clearance from rail level under fully loaded condition for body mounted equipment in worst condition* (<i>*The worst condition means deflated secondary air spring, wheels with maximum tread wear and primary springs with maximum deflection</i>) in static condition.	102
	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 #).	50
	<p>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.</p>	
6	<p>Wheel Profile <i>Note: The "Incline of tread" for S1002 has a varying gradient and must therefore be inferred from the coordinates shown in Table C.1 of EN 13715. Alternative profiles [V135 or EPS 32.5] may be adopted, if the RS Contractor's wheel-rail interface study demonstrates significantly better overall wear characteristics.</i></p>	S1002/h28/e32.5 Reverse slope between 6.7 and 15%



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 <i>(Wheel Profile dimensions as per EN 13715 / EN15313. Wheel Diameter value "D" is measured from point D0 on the wheel tread; 70mm from wheel gauge face)</i>	860
	b) Minimum wheel diameter on the tread <i>(Wheel Profile dimensions as per EN 13715 / EN15313. Wheel Diameter value "D" is measured from point D0 on the wheel tread; 70mm from wheel gauge face)</i>	780
9	a) Maximum projection for flange of new wheel <i>(Wheel Profile dimensions as per EN 13715 / EN15313. Flange Height value "h" is measured from point D0 on the wheel tread; 70mm from wheel gauge face)</i>	36
	b) Minimum projection for flange of new wheel <i>(Wheel Profile dimensions as per EN 13715 / EN15313. Flange Height value "h" is measured from point D0 on the wheel tread; 70mm from wheel gauge face)</i>	28
10	a) Maximum thickness of flange of wheel <i>(Wheel Profile dimensions as per EN 13715 / EN15313. Flange Thickness values "e1, e2" are measured 10mm below wheel tread point D0)</i>	32.5
	b) Minimum thickness of flange of wheel. <i>(Wheel Profile dimensions as per EN 13715 / EN15313. Flange Thickness values "e1, e2" are measured 10mm below wheel tread point D0)</i>	22
11	Minimum width of Wheel as per respective wheel profile	135±1
12	a) Maximum height above rail level for floor of any unloaded vehicle	1130
	b) Minimum height above rail level for floor of fully loaded normal vehicle	1100
13	a) Maximum height of centre coupler above rail level for unloaded vehicle	815
	b) Minimum height of centre coupler above rail level for fully loaded vehicle	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 Chennai Metro System (where these cars should be plying) will conform with the kinematic envelope of the Passenger Electric Multiple Units as detailed in the annexure of KE drawings.

CHAPTER – 4

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 - 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)

4.1.2 Prescribed minimum clearance between live parts of contact 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*
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*In exceptional cases and considering operating in climatic conditions (Ref: IEC 60913)

4.1.3 Prescribed minimum clearance between live parts of contact 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 Drawing No. CMSG-1(TNL). 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 contact wire height of 4318 mm to fulfil 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) and any earthed structure or other bodies (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 (overhead equipment) or any earthed structure or other bodies (over bridges, signal gantries etc.)

	Condition	For Flexible OHE
a)	Long duration (Static)	320 mm
b)	Short Duration (Dynamic)	220 mm

4.2.3 Height of contact wire: (indicative)

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

a)	Under bridges and in ramp area	4800 mm
b)	In the open	5000 mm
c)	Minimum Height at Depot	5500 mm

d)	In running and carriage sheds wherever staff are expected to work on the roof of rolling stock	5200 mm
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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

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 Drawing No: CMSG-1.

4.3 The vertical clearance from Overhead line to power line crossing of Railway Tracks:

Sl. No	Overhead Voltage Crossing	Minimum clearance from Rail level		Minimum Clearance between Highest Traction Conductor and lowest Transmission Line Crossing Conductor
		Existing Power Line Crossing For Non-Electrified Territory	New Power Line Crossing or Planned For Alteration	
(1)	(2)	(3)	(4)	(5)
(a)	Upto and including 11kV	Normally by Underground Cable		
(b)	Above 11kV & upto 33kV	10860mm	<u>14660mm</u>	2440mm
(c)	Above 33kV & upto 66kV	11160mm	<u>14960mm</u>	2440mm
(d)	Above 66kV & upto 132kV	11760mm	<u>15560mm</u>	3050mm
(e)	Above 132kV & upto 220kV	12660mm	<u>16460mm</u>	4580mm
(f)	Above 220kV & upto 400kV	14460mm	<u>18260mm</u>	5490mm
(g)	Above 400kV & upto 500kV	15360mm	<u>19160mm</u>	7940mm
(h)	Above 500kV & upto 800kV	18060mm	<u>21860mm</u>	7940mm

Note:

- (i) All height/clearances are in mm and under maximum sag conditions.
- (ii) If the crossing is provided with a guarding, a minimum clearance of 2000mm shall be maintained between bottom of the guard wire and highest traction conductor.
- (iii) Power line crossing in yards & stations area shall be avoided.
- (iv) For any electrification work of existing track or construction of new track /gauge conversion with electrification, existing power line crossings can continue, if dimensions are as per Column (5) above, even if dimensions of Column (3) are not satisfied i.e., for electrification works Column (3) is not applicable.

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
i.	Minimum Platform Screen Door Width (clear opening)	2000 mm
ii.	Minimum Platform Screen Door Height from PF level (Full hight)	2100 mm
iii.	Minimum Platform Screen Gate Height from PF level (Half hight)	1500 mm
iv.	Minimum Platform Screen Door threshold offset from track centreline – straight track (Underground)	1510 mm
v.	Minimum Platform Screen Door panel offset from track centreline – straight track (underground)	1535 mm Excluding the deflector plate
vi.	Minimum Platform Screen Door threshold offset from track centreline – straight track (Elevated/At Grade)	1515 mm
vii.	Minimum Platform screen door panel offset from Track – centre line – straight track (Elevated/At- Grade)	1540 mm Excluding the deflector plate, drive assembly
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).	19mm dia Rod or 5mmx40mm plate

RS door width of 1400mm, stopping accuracy of +/-300mm of signalling considered for PSD door width

Note

- Stopping Accuracy of Metro Train is (+/-) 300 mm or less.
- For curved platforms, additional clearance as per appendix-5 to be considered.
- 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.
- The deflector (if provided) attached to the bottom of the sliding door shall be designed in order not to protrude beyond the door threshold.

APPENDIX-1

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

Reference Para 1.1

RADIUS OF CURVE	CANT	PERMISSIBLE SPEED	MINIMUM DISTANCE BETWEEN ADJACENT TRACKS	
			BALLASTLESS	
			UNDERGROUND	ELEVATED & AT-GRADE
metres	mm	kmph	mm	mm
>3000	-	90	3600	3650
3000	15	90	3600	3650
2800	15	90	3600	3650
2400	20	90	3600	3650
2000	20	90	3600	3650
1600	25	90	3600	3650
1500	30	90	3600	3650
1200	35	90	3600	3670
1000	45	90	3650	3700
800	55	90	3600	3750
600	70	90	3650	3750
500	95	90	3750	3800
450	115	90	3800	3850
400	120	85	3850	3900
350	120	80	3850	3900
300	125	75	3900	3950
200	120	60	4000	4050
150	110	50	4100	4150
150*	0	35	4000	4050
120	110	45	4200	4250
120*	0	30	4100	4150

Notes:

- a) The Track spacing shown in the table above is without any column / structure between two tracks and is with equal cant for both outer and inner tracks..
- b) Track spacing shown in Table above is not applicable to station which should be calculated depending on specific requirement but the spacing should not be less than the spacing stipulated in para 2.1.
- c) Cant provided is limited to Exceptional value of 125mm
- d) Maximum cant deficiency is 100mm
- e) *The curve with radius 120 and 150 without cant are used in depot/depot connections.
- f) For in between radius more sharper radius to be adopted to arrive track spacing

APPENDIX-2A
EXTRA HORIZONTAL SHIFT ON CURVES (CURVATURE EFFECT)
INSIDE OF CURVE

RADIUS	MID THROW (28500/R)	EXTRA GAUGE TOLERANCE ON CURVES	EXTRA NOSING DUE TO EXTRA GAUGE TOLERANCE	EXTRA HORIZONTAL SHIFT ON CURVE	REMARKS
R	(V)	(N)	(G)	(T1)	
100	285.0	26	9.0	268	
120	237.5	26	9.0	221	
150	190.0	26	9.0	173	
175	162.9	26	9.0	146	
190	150.0	26	9.0	133	
200	142.5	26	9.0	126	
250	114.0	26	9.0	97	
300	95.0	26	9.0	78	
350	81.4	26	9.0	64	
400	71.3	26	9.0	54	(G) Extra Gauge Tolerance on Curves sharper than 1000m Radius.
450	63.3	26	9.0	46	
500	57.0	26	5.0	36	
550	51.8	26	5.0	31	
600	47.5	26	5.0	27	9mm for curves with Radius sharper than 500 m radius and
650	43.8	26	5.0	23	
700	40.7	26	5.0	20	
750	38.0	26	5.0	17	5 mm for curves of with Radius of 500 m to less than 1000m
800	35.6	26	5.0	15	
850	33.5	26	5.0	13	
900	31.7	26	5.0	11	
950	30.0	26	0.0	4	
1000	28.5	26	0.0	3	
1100	25.9	26	0.0	0	
1200	23.8	26	0.0	0	
1300	21.9	26	0.0	0	T1 = V-N+G for V equal to or Greater than (N) and T1 = G for V <(N)
1400	20.4	26	0.0	0	
1500	19.0	26	0.0	0	
1600	17.8	26	0.0	0	
1700	16.8	26	0.0	0	
1800	15.8	26	0.0	0	
1900	15.0	26	0.0	0	
2000	14.3	26	0.0	0	
2200	13.0	26	0.0	0	
2400	11.9	26	0.0	0	
2600	11.0	26	0.0	0	
2800	10.2	26	0.0	0	
3000 OR More	9.50	26	0.0	0	

Mid Throw (in mm) $V=(125XC^2)/R =28500/R$

Where C is the distance between bogie centres = $14.850+0.250=15.100\text{m}$ OR

$14.850-0.250= 14.600\text{m}$

The worst case will be with $C= 15.100$ m

R is the Radius of curve in mtrs

Mid Throw (in MM) $V=(125x C^2) / R = 28500/R$

For in Between radius more sharper radius to be adopted

APPENDIX-2B
EXTRA HORIZONTAL SHIFT ON CURVES (CURVATURE EFFECT)
OUTSIDE OF CURVE

RADIUS	END THROW (34683/R)	EXTRA GAUGE TOLERANCE ON CURVES	EXTRA NOSING DUE TO EXTRA GAUGE TOLERANCE	EXTRA HORIZONTAL SHIFT ON CURVE	REMARKS
R	(Vo)	(G)	(EN)	(T2)	
100	346.8	9	2.3	358	
120	289.0	9	2.3	300	
150	231.2	9	2.3	242	
175	198.2	9	2.3	209	
190	182.5	9	2.3	194	
200	173.4	9	2.3	185	
250	138.7	9	2.3	150	
300	115.6	9	2.3	127	
350	99.1	9	2.3	110	
400	86.7	9	2.3	98	
450	77.1	9	2.3	88	(G) Extra Gauge Tolerance on Curves sharper than 1000m Radius.
500	69.4	5	1.3	76	
550	63.1	5	1.3	69	
600	57.8	5	1.3	64	9mm for curves with Radius sharper than 500 m radius and
650	53.4	5	1.3	60	
700	49.5	5	1.3	56	
750	46.2	5	1.3	53	5 mm for curves of with Radius of 500 m to less than 1000m
800	43.4	5	1.3	50	
850	40.8	5	1.3	47	
900	38.5	5	1.3	45	
950	36.5	5	1.3	43	
1000	34.7	0	0.0	35	
1100	31.5	0	0.0	32	
1200	28.9	0	0.0	29	
1300	26.7	0	0.0	27	T2 = V0+G+EN
1400	24.8	0	0.0	25	EN=G x 0.251986301
1500	23.1	0	0.0	23	
1600	21.7	0	0.0	22	
1700	20.4	0	0.0	20	
1800	19.3	0	0.0	19	
1900	18.3	0	0.0	18	
2000	17.3	0	0.0	17	
2200	15.8	0	0.0	16	
2400	14.5	0	0.0	14	
2600	13.3	0	0.0	13	
2800	12.4	0	0.0	12	
3000 OR More	11.6	0	0.0	12	



End Throw (in mm) $V=(125XC^2)/R - (125 XC^2)/R=34683/R$

Where C is the distance between bogie centres = $14.850+0.250=15.100\text{m}$ OR

$14.850-0.250= 14.600\text{m}$

The worst case will be with $C= 14.6000\text{m}$

C1 is the length of coach in meters = 22.150 and

R is the radius of curve in meters

For in between radius more sharper radius to be adopted.

APPENDIX-3
CANT EFFECT ON STRUCTURE GAUGE - HORIZONTAL AT-GRADE AND ELEVATED
REFERENCE: PARA 1.7.2

ALL FIGURES ARE IN MM

Height above rail level measured perpendicular to plane of track Distance from centre line of track to Structure Gauge for tangent track					h = 305 ab = 1640				h = 930 ab = 1735				h = 3310 ab = 1825				h = 3775 ab = 1546				h = 6250 ab = 1546			
Cant	Angle a Degrees	Sin a	cos a	tan a	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂
125	4.748	0.083	0.997	0.083	1660	1609	502	231	1806	1652	1133	846	2093	1545	3512	3210	1853	1228	3953	3697	2058	1023	6419	6163
120	4.558	0.079	0.997	0.080	1659	1611	494	234	1803	1656	1125	849	2082	1556	3505	3214	1841	1241	3946	3700	2038	1044	6413	6167
115	4.368	0.076	0.997	0.076	1658	1612	487	237	1801	1659	1117	853	2072	1568	3497	3219	1829	1254	3939	3704	2018	1066	6407	6172
110	4.178	0.073	0.997	0.073	1658	1613	479	240	1798	1663	1109	856	2061	1579	3489	3223	1817	1267	3933	3707	1997	1087	6401	6176
105	3.987	0.070	0.998	0.070	1657	1615	471	243	1795	1666	1101	860	2051	1590	3481	3228	1805	1280	3926	3711	1977	1108	6395	6180
100	3.797	0.066	0.998	0.066	1657	1616	463	246	1793	1670	1093	863	2040	1602	3474	3232	1793	1293	3919	3714	1957	1129	6389	6184
95	3.607	0.063	0.998	0.063	1656	1618	455	249	1790	1673	1085	867	2030	1613	3466	3236	1780	1305	3912	3718	1936	1150	6382	6188
90	3.417	0.060	0.998	0.060	1655	1619	447	252	1787	1676	1077	870	2019	1624	3458	3240	1768	1318	3905	3721	1916	1171	6376	6192
85	3.227	0.056	0.998	0.056	1655	1620	439	255	1785	1680	1069	873	2008	1636	3450	3245	1756	1331	3899	3724	1895	1192	6370	6196
80	3.037	0.053	0.999	0.053	1654	1622	431	258	1782	1683	1061	877	1998	1647	3442	3249	1744	1344	3892	3728	1875	1213	6363	6199
75	2.847	0.050	0.999	0.050	1653	1623	424	261	1779	1687	1053	880	1987	1658	3434	3253	1732	1357	3885	3731	1855	1234	6357	6203
70	2.657	0.046	0.999	0.046	1652	1624	416	264	1776	1690	1044	884	1976	1670	3426	3257	1719	1369	3878	3734	1834	1255	6350	6207
65	2.467	0.043	0.999	0.043	1652	1625	408	267	1773	1693	1036	887	1966	1681	3418	3261	1707	1382	3871	3737	1814	1276	6343	6210
60	2.277	0.040	0.999	0.040	1651	1627	400	270	1771	1697	1028	890	1955	1692	3410	3265	1695	1395	3863	3741	1793	1296	6336	6214
55	2.087	0.036	0.999	0.036	1650	1628	392	273	1768	1700	1020	894	1944	1703	3402	3269	1682	1407	3856	3744	1773	1317	6330	6217
50	1.898	0.033	0.999	0.033	1649	1629	384	276	1765	1703	1012	897	1934	1714	3394	3273	1670	1420	3849	3747	1752	1338	6323	6220
45	1.708	0.030	1.000	0.030	1648	1630	376	278	1762	1707	1004	900	1923	1726	3385	3277	1658	1433	3842	3750	1732	1359	6316	6224
40	1.518	0.026	1.000	0.026	1648	1631	368	281	1759	1710	996	904	1912	1737	3377	3280	1645	1445	3835	3753	1711	1380	6309	6227
35	1.328	0.023	1.000	0.023	1647	1632	360	284	1756	1713	987	907	1901	1748	3369	3284	1633	1458	3827	3756	1690	1401	6302	6230
30	1.138	0.020	1.000	0.020	1646	1634	353	287	1753	1716	979	910	1890	1759	3361	3288	1621	1471	3820	3759	1670	1422	6294	6233
25	0.949	0.017	1.000	0.017	1645	1635	345	290	1750	1719	971	914	1880	1770	3352	3292	1608	1483	3813	3761	1649	1442	6287	6236
20	0.759	0.013	1.000	0.013	1644	1636	337	293	1747	1723	963	917	1869	1781	3344	3296	1596	1496	3805	3764	1629	1463	6280	6239
15	0.569	0.010	1.000	0.010	1643	1637	329	296	1744	1726	955	920	1858	1792	3335	3299	1583	1508	3798	3767	1608	1484	6273	6242
10	0.379	0.007	1.000	0.007	1642	1638	321	299	1741	1729	946	923	1847	1803	3327	3303	1571	1521	3790	3770	1587	1505	6265	6245
5	0.190	0.003	1.000	0.003	1641	1639	313	302	1738	1732	938	927	1836	1814	3319	3306	1558	1533	3783	3772	1567	1525	6258	6247
0	0.000	0.000	1.000	0.000	1640	1640	305	305	1735	1735	930	930	1825	1825	3310	3310	1546	1546	3775	3775	1546	1546	6250	6250

REFER TO FIGURE: CMSG-4

$$E_1 = [ab + (h \times \tan \alpha)] \times \cos \alpha \quad F_1 = [ab - (h \times \tan \alpha)] \times \cos \alpha$$

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

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

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

APPENDIX - 3 (TNL)
CANT EFFECT ON STRUCTURE GAUGE-HORIZONTAL UNDER GROUND SECTIONS (RECTANGULAR BOX TUNNELS)
REFERENCE: PARA 1.7.2

ALL FIGURES IN MM

Height above rail level measured perpendicular to plane of track Distance from centre line of track to Structure Gauge for tangent track					h = 305 ab = 1585				h = 940 ab = 1670				h = 3305 ab = 1740				h = 3965 ab = 1250				h = 4838 ab = 1250			
Cant	Angle a Degrees	Sin a	cos a	tan a	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂
125	4.748	0.083	0.997	0.083	1605	1554	498	235	1742	1586	1138	861	2008	1460	3500	3212	1574	917	4117	3910	1646	845	4987	4780
120	4.558	0.079	0.997	0.080	1604	1556	490	238	1739	1590	1130	864	1997	1472	3493	3216	1561	931	4112	3913	1631	862	4982	4783
115	4.368	0.076	0.997	0.076	1604	1557	482	241	1737	1594	1122	868	1987	1483	3485	3220	1548	944	4106	3916	1615	878	4977	4786
110	4.178	0.073	0.997	0.073	1603	1559	475	244	1734	1597	1114	871	1976	1495	3478	3224	1536	958	4101	3918	1599	894	4971	4789
105	3.987	0.070	0.998	0.070	1602	1560	467	247	1731	1601	1106	874	1966	1506	3470	3229	1523	971	4095	3921	1583	911	4966	4792
100	3.797	0.066	0.998	0.066	1602	1561	459	249	1729	1604	1099	877	1955	1517	3463	3233	1510	985	4089	3924	1568	927	4960	4795
95	3.607	0.063	0.998	0.063	1601	1563	452	252	1726	1608	1091	881	1944	1529	3455	3236	1497	998	4083	3926	1552	943	4955	4797
90	3.417	0.060	0.998	0.060	1600	1564	444	255	1723	1611	1083	884	1934	1540	3448	3240	1484	1011	4077	3928	1536	959	4949	4800
85	3.227	0.056	0.998	0.056	1600	1565	436	258	1720	1614	1075	887	1923	1551	3440	3244	1471	1025	4072	3931	1520	976	4943	4802
80	3.037	0.053	0.999	0.053	1599	1567	429	261	1717	1618	1067	890	1913	1562	3433	3248	1458	1038	4066	3933	1505	992	4937	4805
75	2.847	0.050	0.999	0.050	1598	1568	421	263	1715	1621	1059	893	1902	1574	3425	3252	1445	1052	4060	3936	1489	1008	4932	4807
70	2.657	0.046	0.999	0.046	1597	1569	413	266	1712	1625	1051	897	1891	1585	3417	3256	1432	1065	4054	3938	1473	1024	4926	4810
65	2.467	0.043	0.999	0.043	1597	1570	405	269	1709	1628	1044	900	1881	1596	3409	3260	1420	1078	4048	3940	1457	1041	4920	4812
60	2.277	0.040	0.999	0.040	1596	1572	398	272	1706	1631	1036	903	1870	1607	3402	3263	1407	1091	4042	3942	1441	1057	4914	4815
55	2.087	0.036	0.999	0.036	1595	1573	390	275	1703	1635	1028	906	1859	1618	3394	3267	1394	1105	4035	3944	1425	1073	4908	4817
50	1.898	0.033	0.999	0.033	1594	1574	382	277	1700	1638	1020	909	1848	1630	3386	3271	1381	1118	4029	3946	1410	1089	4902	4819
45	1.708	0.030	1.000	0.030	1593	1575	375	280	1697	1641	1012	912	1838	1641	3378	3274	1368	1131	4023	3948	1394	1105	4896	4821
40	1.518	0.026	1.000	0.026	1593	1576	367	283	1694	1645	1004	915	1827	1652	3370	3278	1355	1145	4017	3950	1378	1121	4889	4823
35	1.328	0.023	1.000	0.023	1592	1578	359	286	1691	1648	996	919	1816	1663	3362	3281	1342	1158	4010	3952	1362	1138	4883	4825
30	1.138	0.020	1.000	0.020	1591	1579	351	288	1688	1651	988	922	1805	1674	3354	3285	1329	1171	4004	3954	1346	1154	4877	4827
25	0.949	0.017	1.000	0.017	1590	1580	344	291	1685	1654	980	925	1794	1685	3346	3288	1315	1184	3998	3956	1330	1170	4871	4829
20	0.759	0.013	1.000	0.013	1589	1581	336	294	1682	1657	972	928	1784	1696	3338	3292	1302	1197	3991	3958	1314	1186	4864	4831
15	0.569	0.010	1.000	0.010	1588	1582	328	297	1679	1661	964	931	1773	1707	3330	3295	1289	1211	3985	3960	1298	1202	4858	4833
10	0.379	0.007	1.000	0.007	1587	1583	320	299	1676	1664	956	934	1762	1718	3321	3298	1276	1224	3978	3962	1282	1218	4851	4835
5	0.190	0.003	1.000	0.003	1586	1584	313	302	1673	1667	948	937	1751	1729	3313	3302	1263	1237	3972	3963	1266	1234	4845	4836
0	0.000	0.000	1.000	0.000	1585	1585	305	305	1670	1670	940	940	1740	1740	3305	3305	1250	1250	3965	3965	1250	1250	4838	4838

REFER TO FIGURE: CMSG-4A

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

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

$$H_1 = (Ca/2) + (h/\cos \alpha) + (Ab - h \times \tan \alpha) \times \sin \alpha \text{ \& } H_2 = (Ca/2) + (h/\cos \alpha) - (ab + h \times \tan \alpha) \times \sin \alpha$$

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

APPENDIX - 3A
CANT EFFECT ON KINEMATIC ENVELOPE-HORIZONTAL AT-GRADE AND ELEVATED SECTIONS

REF: PARA 1.7.1

Height above rail level measured → Perpendicular to plane of track					h = 938				h = 997				h = 1130				h = 2878				h = 3296				h = 4014				h = 4866				h = 5018			
Distance from centre line of track to K.E. for tangent track →					ab = 1582				ab = 1584				ab = 1590				ab = 1658				ab = 1658				ab = 1225				ab = 1220				ab = 880			
Cant	Angle α	Sin α	cos α	tan α	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂
125	4.748	0.083	0.997	0.083	1654	1499	1128	866	1661	1496	1187	925	1678	1491	1320	1057	1891	1414	3068	2793	1925	1379	3484	3210	1553	889	4164	3961	1619	813	5013	4811	1292	462	5136	4990
120	4.558	0.079	0.997	0.080	1652	1502	1121	869	1658	1500	1180	928	1675	1495	1313	1060	1881	1424	3061	2797	1915	1391	3477	3214	1540	902	4159	3964	1603	829	5008	4814	1276	478	5132	4992
115	4.368	0.076	0.997	0.076	1649	1506	1113	872	1655	1503	1172	931	1671	1499	1305	1063	1872	1434	3053	2801	1904	1402	3470	3218	1527	916	4153	3967	1587	846	5002	4816	1260	495	5128	4994
110	4.178	0.073	0.997	0.073	1646	1509	1106	875	1652	1507	1165	934	1668	1503	1298	1066	1863	1444	3046	2805	1894	1413	3463	3221	1514	929	4148	3969	1571	862	4997	4819	1243	512	5124	4996
105	3.987	0.070	0.998	0.070	1643	1513	1098	878	1649	1511	1157	937	1665	1508	1290	1069	1854	1454	3039	2808	1883	1425	3456	3225	1501	943	4142	3972	1555	879	4992	4822	1227	529	5120	4997
100	3.797	0.066	0.998	0.066	1641	1516	1091	881	1647	1514	1150	940	1661	1512	1283	1072	1845	1464	3031	2812	1873	1436	3449	3229	1488	956	4136	3974	1540	895	4986	4825	1210	546	5115	4999
95	3.607	0.063	0.998	0.063	1638	1520	1083	884	1644	1518	1142	943	1658	1516	1275	1075	1836	1474	3024	2815	1862	1447	3441	3233	1475	970	4131	3976	1524	911	4981	4827	1194	563	5111	5000
90	3.417	0.060	0.998	0.060	1635	1523	1076	887	1641	1522	1135	946	1655	1520	1268	1078	1827	1484	3017	2819	1852	1459	3434	3236	1462	984	4125	3979	1508	928	4975	4830	1178	579	5107	5002
85	3.227	0.056	0.998	0.056	1632	1527	1068	890	1638	1525	1127	949	1651	1524	1260	1081	1817	1493	3009	2823	1841	1470	3427	3240	1449	997	4119	3981	1492	944	4969	4832	1161	596	5102	5003
80	3.037	0.053	0.999	0.053	1629	1530	1060	893	1635	1529	1120	952	1648	1528	1253	1084	1808	1503	3002	2826	1830	1481	3419	3244	1436	1011	4113	3983	1476	960	4964	4835	1145	613	5098	5004
75	2.847	0.050	0.999	0.050	1627	1533	1053	896	1632	1533	1112	955	1644	1532	1245	1087	1799	1513	2994	2830	1820	1492	3412	3247	1423	1024	4107	3986	1460	977	4958	4837	1128	630	5093	5006
70	2.657	0.046	0.999	0.046	1624	1537	1045	899	1629	1536	1104	957	1641	1536	1237	1090	1790	1523	2987	2833	1809	1503	3404	3251	1410	1038	4101	3988	1444	993	4952	4839	1112	646	5088	5007
65	2.467	0.043	0.999	0.043	1621	1540	1038	902	1625	1540	1097	960	1637	1540	1230	1093	1780	1533	2979	2836	1798	1515	3397	3254	1397	1051	4096	3990	1428	1009	4947	4841	1095	663	5084	5008
60	2.277	0.040	0.999	0.040	1618	1543	1030	904	1622	1543	1089	963	1634	1544	1222	1096	1771	1542	2972	2840	1788	1526	3389	3258	1384	1065	4090	3992	1412	1026	4941	4844	1079	680	5079	5009
55	2.087	0.036	0.999	0.036	1615	1547	1023	907	1619	1547	1082	966	1630	1548	1215	1099	1762	1552	2964	2843	1777	1537	3382	3261	1370	1078	4083	3994	1396	1042	4935	4846	1062	697	5074	5010
50	1.898	0.033	0.999	0.033	1612	1550	1015	910	1616	1550	1074	969	1627	1552	1207	1102	1752	1562	2956	2847	1766	1548	3374	3264	1357	1091	4077	3996	1380	1058	4929	4848	1046	713	5069	5011
45	1.708	0.030	1.000	0.030	1609	1553	1007	913	1613	1554	1066	972	1623	1556	1199	1105	1743	1571	2949	2850	1755	1559	3366	3268	1344	1105	4071	3998	1364	1074	4923	4850	1029	730	5064	5012
40	1.518	0.026	1.000	0.026	1606	1557	1000	916	1610	1557	1059	975	1619	1560	1192	1107	1734	1581	2941	2853	1745	1570	3359	3271	1331	1118	4065	4000	1348	1091	4917	4852	1013	747	5060	5013
35	1.328	0.023	1.000	0.023	1603	1560	992	919	1607	1560	1051	978	1616	1563	1184	1110	1724	1591	2933	2856	1734	1581	3351	3274	1318	1132	4059	4002	1332	1107	4910	4854	996	763	5055	5014
30	1.138	0.020	1.000	0.020	1600	1563	984	921	1603	1564	1043	980	1612	1567	1176	1113	1715	1600	2925	2859	1723	1592	3343	3277	1305	1145	4053	4004	1316	1123	4904	4856	980	780	5049	5015
25	0.949	0.017	1.000	0.017	1597	1566	977	924	1600	1567	1036	983	1608	1571	1169	1116	1705	1610	2918	2863	1712	1603	3335	3281	1291	1158	4046	4006	1300	1139	4898	4858	963	797	5044	5015
20	0.759	0.013	1.000	0.013	1594	1569	969	927	1597	1571	1028	986	1605	1575	1161	1119	1696	1620	2910	2866	1702	1614	3328	3284	1278	1172	4040	4007	1284	1155	4892	4859	946	813	5039	5016
15	0.569	0.010	1.000	0.010	1591	1573	961	930	1594	1574	1020	989	1601	1579	1153	1122	1687	1629	2902	2869	1691	1625	3320	3287	1265	1185	4033	4009	1268	1172	4885	4861	930	830	5034	5017
10	0.379	0.007	1.000	0.007	1588	1576	953	933	1591	1577	1012	991	1597	1582	1146	1124	1677	1639	2894	2872	1680	1636	3312	3290	1252	1198	4027	4011	1252	1188	4879	4863	913	847	5029	5017
5	0.190	0.003	1.000	0.003	1585	1579	946	935	1587	1581	1005	994	1594	1586	1138	1127	1668	1648	2886	2875	1669	1647	3304	3293	1238	1212	4021	4012	1236	1204	4873	4864	897	863	5023	5018
0	0.000	0.000	1.000	0.000	1582	1582	938	938	1584	1584	997	997	1590	1590	1130	1130	1658	1658	2878	2878	1658	1658	3296	3296	1225	1225	4014	4014	1220	1220	4866	4866	880	880	5018	5018

REFER TO FIGURE: CMSG-4A

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

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

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

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

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

ac = Distance from centre line of canted track to K.E. for Tangent track at height 'h' from rail level.

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

APPENDIX - 3A (TNL)

CANT EFFECT ON KINEMATIC ENVELOPE UNDER GROUND SECTIONS (RECTANGULAR BOX/ TUNNELS)

REF: PARA 1.7.2

Height above rail level measured perpendicular to plane of track →					h = 947				h = 1130				h = 2885				h = 3287				h = 4005				h = 4158				h = 4318			
Distance from centre line of track to K.E. for tangent track →					ab = 1570				ab = 1576				ab = 1629				ab = 1629				ab = 1089				ab = 980				ab = 820			
Cant	Angle a	Sin a	cos a	tan a	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂
125	4.748	0.083	0.997	0.083	1643	1486	1136	876	1664	1477	1319	1058	1862	1385	3072	2803	1896	1351	3473	3203	1417	754	4144	3964	1321	632	4287	4125	1175	460	4434	4298
120	4.558	0.079	0.997	0.080	1640	1490	1129	879	1661	1481	1312	1061	1853	1395	3065	2806	1885	1363	3466	3207	1404	767	4139	3966	1307	646	4283	4127	1161	474	4430	4299
115	4.368	0.076	0.997	0.076	1638	1493	1121	882	1657	1485	1304	1064	1844	1405	3058	2810	1875	1374	3459	3211	1391	781	4134	3968	1294	660	4278	4129	1146	489	4425	4301
110	4.178	0.073	0.997	0.073	1635	1497	1114	885	1654	1489	1297	1067	1835	1415	3051	2814	1864	1385	3452	3215	1378	794	4129	3970	1280	674	4273	4131	1132	503	4421	4302
105	3.987	0.070	0.998	0.070	1632	1500	1106	888	1651	1494	1289	1070	1826	1424	3044	2817	1854	1396	3445	3218	1365	808	4124	3972	1267	688	4269	4132	1118	518	4417	4303
100	3.797	0.066	0.998	0.066	1629	1504	1099	891	1647	1498	1282	1073	1816	1434	3037	2821	1843	1408	3438	3222	1352	821	4118	3974	1253	702	4264	4134	1104	532	4413	4304
95	3.607	0.063	0.998	0.063	1626	1507	1091	894	1644	1502	1274	1076	1807	1444	3029	2824	1833	1419	3430	3226	1339	835	4113	3976	1240	716	4259	4136	1090	547	4409	4305
90	3.417	0.060	0.998	0.060	1624	1511	1084	897	1641	1506	1267	1079	1798	1454	3022	2828	1822	1430	3423	3229	1326	848	4108	3978	1226	730	4254	4137	1076	561	4404	4306
85	3.227	0.056	0.998	0.056	1621	1514	1076	900	1637	1510	1259	1082	1789	1464	3015	2831	1811	1441	3416	3233	1313	862	4102	3980	1213	744	4249	4139	1062	576	4400	4307
80	3.037	0.053	0.999	0.053	1618	1518	1069	902	1634	1514	1252	1085	1780	1474	3007	2835	1801	1453	3409	3236	1300	875	4097	3982	1199	758	4244	4140	1048	590	4395	4308
75	2.847	0.050	0.999	0.050	1615	1521	1061	905	1630	1518	1244	1088	1770	1484	3000	2838	1790	1464	3401	3240	1287	889	4092	3983	1185	772	4239	4142	1033	605	4391	4309
70	2.657	0.046	0.999	0.046	1612	1524	1054	908	1627	1522	1237	1091	1761	1494	2992	2841	1780	1475	3394	3243	1273	902	4086	3985	1172	786	4234	4143	1019	619	4386	4310
65	2.467	0.043	0.999	0.043	1609	1528	1046	911	1623	1526	1229	1094	1752	1503	2985	2845	1769	1486	3387	3246	1260	916	4081	3987	1158	800	4229	4144	1005	633	4382	4311
60	2.277	0.040	0.999	0.040	1606	1531	1039	914	1620	1530	1222	1096	1742	1513	2977	2848	1758	1497	3379	3250	1247	929	4075	3989	1144	814	4224	4146	991	648	4377	4312
55	2.087	0.036	0.999	0.036	1603	1534	1031	917	1616	1534	1214	1099	1733	1523	2970	2851	1748	1508	3372	3253	1234	942	4070	3990	1131	828	4218	4147	977	662	4373	4313
50	1.898	0.033	0.999	0.033	1600	1538	1023	919	1613	1538	1207	1102	1724	1533	2962	2854	1737	1519	3364	3256	1221	956	4064	3992	1117	842	4213	4148	963	677	4368	4313
45	1.708	0.030	1.000	0.030	1598	1541	1016	922	1609	1542	1199	1105	1714	1542	2955	2858	1726	1530	3357	3259	1208	969	4058	3993	1103	856	4208	4149	948	691	4363	4314
40	1.518	0.026	1.000	0.026	1595	1544	1008	925	1605	1546	1191	1108	1705	1552	2947	2861	1716	1541	3349	3263	1195	983	4052	3995	1090	870	4203	4151	934	705	4358	4315
35	1.328	0.023	1.000	0.023	1592	1548	1001	928	1602	1549	1184	1111	1695	1562	2939	2864	1705	1552	3341	3266	1182	996	4047	3996	1076	883	4197	4152	920	720	4353	4315
30	1.138	0.020	1.000	0.020	1589	1551	993	931	1598	1553	1176	1113	1686	1571	2932	2867	1694	1563	3334	3269	1168	1009	4041	3998	1062	897	4192	4153	906	734	4348	4316
25	0.949	0.017	1.000	0.017	1585	1554	985	933	1594	1557	1168	1116	1677	1581	2924	2870	1683	1574	3326	3272	1155	1023	4035	3999	1049	911	4186	4154	891	748	4343	4316
20	0.759	0.013	1.000	0.013	1582	1557	978	936	1591	1561	1161	1119	1667	1591	2916	2873	1672	1585	3318	3275	1142	1036	4029	4000	1035	925	4181	4155	877	763	4338	4317
15	0.569	0.010	1.000	0.010	1579	1561	970	939	1587	1565	1153	1122	1658	1600	2909	2876	1662	1596	3311	3278	1129	1049	4023	4001	1021	939	4175	4156	863	777	4333	4317
10	0.379	0.007	1.000	0.007	1576	1564	962	942	1583	1568	1145	1125	1648	1610	2901	2879	1651	1607	3303	3281	1115	1062	4017	4003	1008	952	4169	4156	849	791	4328	4317
5	0.190	0.003	1.000	0.003	1573	1567	955	944	1580	1572	1138	1127	1639	1619	2893	2882	1640	1618	3295	3284	1102	1076	4011	4004	994	966	4164	4157	834	806	4323	4318
0	0.000	0.000	1.000	0.000	1570	1570	947	947	1576	1576	1130	1130	1629	1629	2885	2885	1629	1629	3287	3287	1089	1089	4005	4005	980	980	4158	4158	820	820	4318	4318

REFER TO FIGURE: MSG-4A

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

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

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

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

ab=Ab=Distance from centre line of vehicle to K.E. for Tangent Track at height 'h' from rail level & ac = Distance from centre line of canted track to K.E. for Tangent track at height 'h' from rail level.

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

APPENDIX – 4

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

(With D₁ = 880 mm & Radius r=2900mm)

REFER TO FIGURE: CMSG-3 AND PARA Nos. 1.7.1 (B)-b & 1.7.2 (B)-b

All figures are in mm

CANT	Sin α = Cant / 1510	Angle α	Angle θ	Lateral Shift of Tunnel centre - X	Vertical Shift of Tunnel centre = Y	Remark
Min		Degrees	Degrees	mm	mm	
125	0.08278	4.7485	69.5061	170	56	<p>(a) The cant is provided by raising the outer rail which will mean, rotating the tunnel about the mid point of top of inner rail.</p> <p>(b) 'X' is lateral shift of the centre of the tunnel towards inside of the curve $X = \left[\frac{2 \times (r-D_1)}{\sin \theta} \right] \times \left[\frac{\sin \alpha}{2} \right] \times \cos (90-\theta - \alpha/2)$</p> <p>(c) 'Y' is the vertical shift of the centre of the tunnel (upwards) $Y = \left[\frac{2 \times (r-D_1)}{\sin \theta} \right] \times \left[\frac{\sin \alpha}{2} \right] \times \sin (90-\theta - \alpha/2)$ where,</p> <p>'r' is internal radius of the circular tunnel=2900 mm D₁ = depth from rail level to invert of circular tunnel=880 mm α = angle of rotation=$\sin^{-1} (\text{Cant}/g)$ 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 = $\tan^{-1} [(r-D_1) / (g/2)]$ in degrees=69.5061 g= Centre to centre of rails = 1510 mm</p>
120	0.07947	4.5581	69.5061	163	54	
115	0.07616	4.3678	69.5061	156	52	
110	0.07285	4.1776	69.5061	149	50	
105	0.06954	3.9874	69.5061	142	48	
100	0.06623	3.7972	69.5061	135	46	
95	0.06291	3.6071	69.5061	129	43	
90	0.05960	3.4170	69.5061	122	41	
85	0.05629	3.2270	69.5061	115	39	
80	0.05298	3.0370	69.5061	108	37	
75	0.04967	2.8470	69.5061	101	35	
70	0.04636	2.6570	69.5061	94	33	
65	0.04305	2.4671	69.5061	88	31	
60	0.03974	2.2773	69.5061	81	28	
55	0.03642	2.0874	69.5061	74	26	
50	0.03311	1.8976	69.5061	67	24	
45	0.02980	1.7077	69.5061	61	22	
40	0.02649	1.5179	69.5061	54	19	
35	0.02318	1.3282	69.5061	47	17	
30	0.01987	1.1384	69.5061	40	15	
25	0.01656	0.9486	69.5061	34	12	
20	0.01325	0.7589	69.5061	27	10	
15	0.00993	0.5692	69.5061	20	7	
10	0.00662	0.3794	69.5061	13	5	
5	0.00331	0.1897	69.5061	7	2	
0	0	0	69.5061	0	0	

APPENDIX – 5
ADDITIONAL CLERANCE FOR PLATFORMS ON CURVES UNDER GROUND, ELEVATED AND AT GRADE STATIONS

Refer Para 2.7

EXTRA CLEARANCE														
RADIUS	INSIDE OF CURVE								OUTSIDE OF CURVE					
	At centre line between Bogies				At Edge of Open Door, Nearest to the centre line between Bogies				At End of Coach	At Edge of Open Door, Farthest from the centre line between Bogies				
	Mid throw =28500/R	Nosing	Additional Clearance	Additional Clearance (rounded up)	Throw =27720/R	Nosing= 13*1.25/11.075	Additional Clearance	Additional Clearance (rounded up)	End throw =34683/R	Throw =23856/R	Nosing =13*10.05 /11.075	Diff bet N & N2	Additional Clearance	Additional Clearance (rounded up)
R	V	N	V-N	V-N	V ₃	N ₁	V ₃ -(N-N ₁)	V ₃ -(N-N ₁)	V ₀	V ₄	N ₂	N-N ₂	V ₄ -(N-N ₂)	V ₄ -(N-N ₂)
Metres	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1	2	3	4a	4	5	6	7a	7	8	9	10	11	12a	12
3000	10	13	-3.5	0	9.2	1.5	-2.3	0	12	8.0	11.8	1.2	6.7	5
2800	10	13	-2.8	0	9.9	1.5	-1.6	0	12	8.5	11.8	1.2	7.3	10
2600	11	13	-2.0	0	10.7	1.5	-0.9	0	13	9.2	11.8	1.2	8.0	10
2400	12	13	-1.1	0	11.6	1.5	0.0	0	14	9.9	11.8	1.2	8.7	10
2200	13	13	0.0	0	12.6	1.5	1.1	5	16	10.8	11.8	1.2	9.6	10
2000	14	13	1.3	5	13.9	1.5	2.3	5	17	11.9	11.8	1.2	10.7	10
1800	16	13	2.8	5	15.4	1.5	3.9	5	19	13.3	11.8	1.2	12.1	10
1700	17	13	3.8	5	16.3	1.5	4.8	5	20	14.0	11.8	1.2	12.8	15
1600	18	13	4.8	5	17.3	1.5	5.8	10	22	14.9	11.8	1.2	13.7	15
1500	19	13	6.0	10	18.5	1.5	6.9	10	23	15.9	11.8	1.2	14.7	15
1400	20	13	7.4	10	19.8	1.5	8.3	10	25	17.0	11.8	1.2	15.8	20
1300	22	13	8.9	10	21.3	1.5	9.8	10	27	18.4	11.8	1.2	17.1	20
1200	24	13	10.8	15	23.1	1.5	11.6	15	29	19.9	11.8	1.2	18.7	20
1100	26	13	12.9	15	25.2	1.5	13.7	15	32	21.7	11.8	1.2	20.5	25
1000	29	13	15.5	20	27.7	1.5	16.2	20	35	23.9	11.8	1.2	22.7	25

NOTES:

- For outside of curve, the difference between clearance required at coach end that the farthest door edge is less than 25mm. As half width of coach at ends is at least 25mm less than that at doors locations, additional clearance to be provided is additional clearance required at the farthest door edge (column 12).
- Values of additional clearances (Column 4,7 and 12) rounded UP to the nearest value that is divisible by 5mm.
- Negative values of additional clearance are taken as zero in the columns 4 & 7 with rounded off figures.
- Extra clearance for curve:
 - Inside of curve:**
 $V = (125C^2 / R) = 28500/R$ when $C=15.10m$ (worst case/ max bogie pitch)
 $V_3 = [(125) \times (15.1^2 - 4 \times 1.25^2) / R] = 27720 / R$
 $N_1 = N \times (X) / (C_1/2) = 13 \times 1.25 / 11.075 = 1.467$ mm
 The 1.25m value (X) above is the distance between the centre line between the Bogies and the edge of the nearest door leaf (0.875m wide) in its open position
 The higher of (i) column 4 and (ii) column 7 shall be adopted.
 - Outside of curve**
 $V_0 = (125 C_1^2 / R) - (125c^2 / R) = 34683 / R$ for coach end when $c=14.6$ meters (worst case/ min bogie pitch) and $C_1 = 2 \times 11.075$ meters.
 $V_4 = 125 \times (20.1 \times 20.1 - 14.6 \times 14.6) / R = 23856.3 / R$ for furthest edge of end door in open position with
 $C_1 = 2 \times 10.05 = 20.1$ meters and $C = 14.60$ meters for the worst case.
 $N_2 =$ Nosing at the farthest edge of an open door $= N \times (X) / (C_1/2) = 13 \times 10.05 / 11.075 = 11.8$ mm
 $R =$ Radius of curve in meters
 The 10.05m value (X) above is the distance between the centre line between the Bogies and the edge of the furthest door leaf (0.875m wide) in its open position.
- There will be no super elevation on curves in platform portion.

APPENDIX – 6
Sample Egress calculation report for Underground Station

UNDERGROUND STATION				
Year	Boarding	Alighting		
Dir 1 (Towards CMBT)	57.55	44.67	Per Min	
Dir 2 (Towards MMC)	11.42	28.93	Per Min	
Head way			3.54	mins
Sectional Load Direction 1			5176	Considering 1 missed headway and surge factor
Sectional Load Direction 2			2996	
Dense Crush Load			2004	
Platform Evacuation Time		<i>within</i>	4	mins
Surge Factor			1.3	mins
2 Headway entraining load for Peak Direction			7.1	mins
1 Headway entering entraining load for off-peak Direction			3.54	mins
POL (Emergency Service) Incident Direction 1			2586.2	
POL (Emergency Service) Incident Direction 2			2373.9	
Required Egress Capacity of Platform 1 (PEC)			646.56	
<i>(Evacuation Load / Evacuation Time)</i>				
Staircase Egress Capacity (Per/min)			55.50	
Working Escalator Egress Capacity (Per/min)			120.00	
Stopped Escalator Egress Capacity (Per/min)			55.50	
Elements			Width	Nos
Public Staircase			3.6	1
Fire Escape staircase inside station box			1.5	2
Working Escalator (4 nos; 3 used)			1	3
Stopped Escalator (0 nos; 0 used)			1	0
Proposed Egress Capacity			726.3	
Proposed Time For evacuation of Platform(Fp)			3.56	

APPENDIX – 6A
Sample Egress calculation report for Elevated Station

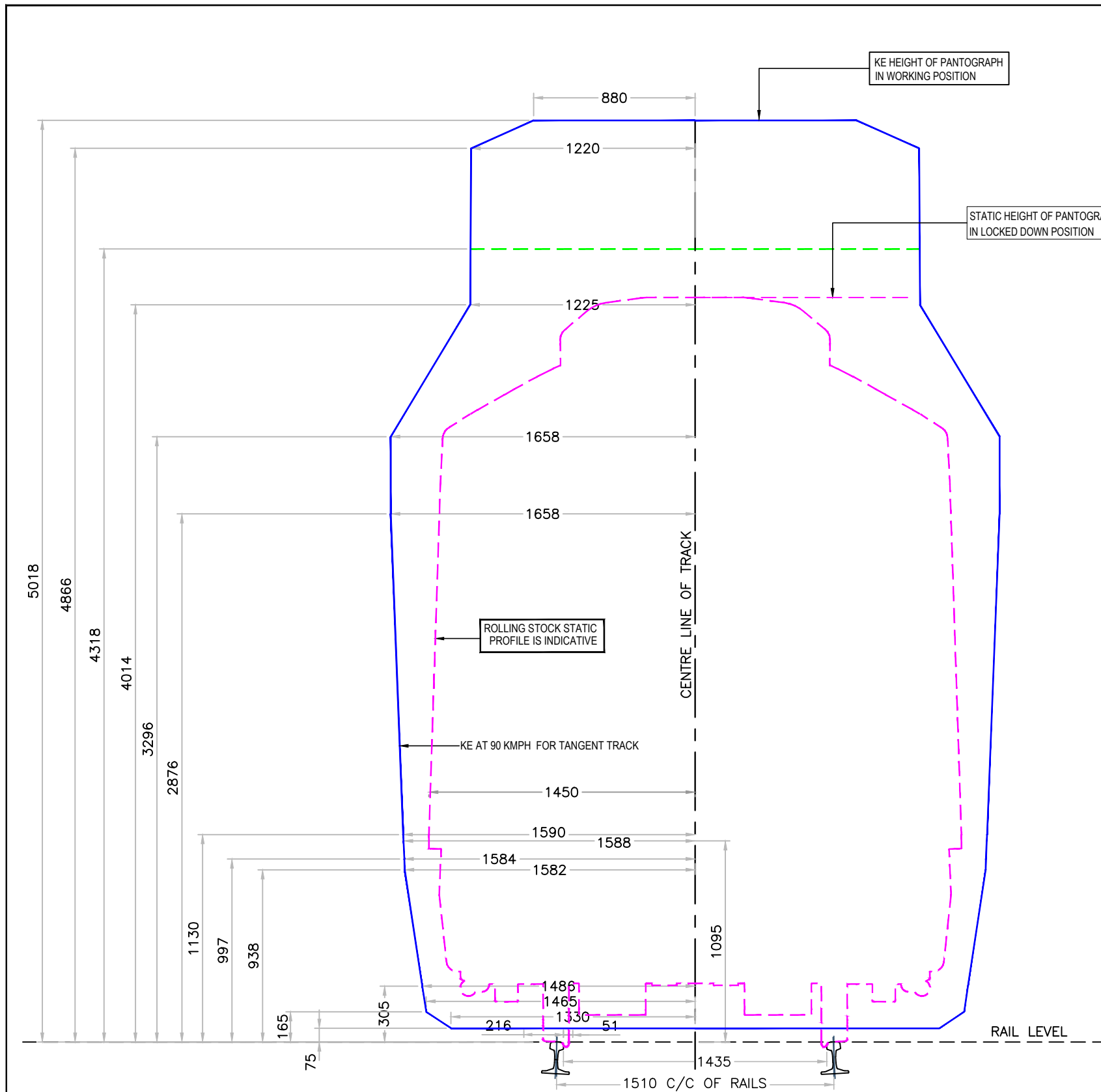
ELEVATED STATION			
Year	Boarding	Alighting	
Dir 1 (Towards CMBT)	34.47	3.80	Per Min
Dir 2 (Towards MMC)	5.27	31.52	Per Min

Head way	8.56		mins
Sectional Load Direction 1	1181		Considering 1 missed headway and surge factor
Sectional Load Direction 2	997		
Dense Crush Load	2004		
Platform Evacuation Time		<i>within</i>	5.5 mins
Surge Factor	1.3		mins
2 Headway entraining load for Peak Direction	17.1		mins
1 Headway entering entraining load for off-peak Direction	8.56		mins

POL (Emergency Service) Direction 1	1947.8
POL (Emergency Service) Direction 2	1114.6

Direction 1		
Elements	Width	Nos
Public Staircase	3.6	1
Fire Escape staircase inside station box	3.6	1
Fire Escape staircase outside station box	0	0
Working Escalator (2 nos; 1 used)	1	1
Stopped Escalator (0 nos; 0 used)	1	0
Proposed Egress Capacity	519.6	
Proposed Time For evacuation of Platform(Fp)	3.75	

Direction 2		
Elements	Width	Nos
Public Staircase	3.6	1
Fire Escape staircase inside station box	3.6	1
Fire Escape staircase outside station box	0	0
Working Escalator (2 nos; 1 used)	1	1
Stopped Escalator (0 nos; 0 used)	1	0
Proposed Egress Capacity	519.6	
Proposed Time For evacuation of Platform(Fp)	2.15	



NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE ADDITIONAL.
3. KINEMATIC ENVELOPE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
4. THE CONDUCTOR HEIGHT ABOVE RAIL LEVEL SHALL ALSO TAKE IN TO CONSIDERATION PRESCRIBED ELECTRICAL CLEARANCES BETWEEN ALL LIVE OVERHEAD EQUIPMENT & PANTOGRAPH/VEHICLE AND ALL PARTS THEREOF.
5. 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 WHEEL.
6. KINEMATIC ENVELOPE IS VALID FOR VEHICLE SPEEDS UPTO 90 KMPH
7. ROLLING STOCK STATIC PROFILE IS REPRESENTATIVE. ALL ROLLING STOCK CONTRACTORS WILL COMPLY TO THE KINEMATIC ENVELOPE AS IT HAS BEEN FIXED
8. THE CROSS WIND SPEED FOR CALCULATING THE KINEMATIC ENVELOPE WAS CONSIDERED AS 100 KMPH ON AT-GRADE /ELEVATED SECTION.
9. STATIC AND DYNAMIC ELECTRICAL CLEARANCES 290 MM AND 190 MM AS PER CLAUSE 4.1.3
10. REGIONAL WIND SPEED OF THE LOCATION OF TRAIN OPERATION AS PER IS: 875 (LATEST) : 50 M/SEC.
11. DESIGN SPEED : 90 KMPH
12. INFRINGEMENT TO SOD :NIL
13. LEGEND

- KINEMATIC ENVELOPE LEVEL TANGENT TRACK
- - - ROLLING STOCK STATIC PROFILE
- - - REDUCED HEIGHT KINEMATIC ENVELOPE LIMIT IS APPLICABLE FOR THROUGH & SEMI THROUGH GIRDER BRIDGES.

CHENNAI METRO RAIL LIMITED
 Phase-2 Project
 MetroS, No:327, Anna Salai, Nandanam,
 Chennai-600035.
 Ph: 044-23792000 , Fax: 044-23792200.
 Email- chennai-metro-rail@gmail.com

STANDARD GAUGE
 (1435mm)
25KV 50Hz A.C. TRACTION

GENERAL NOTES :

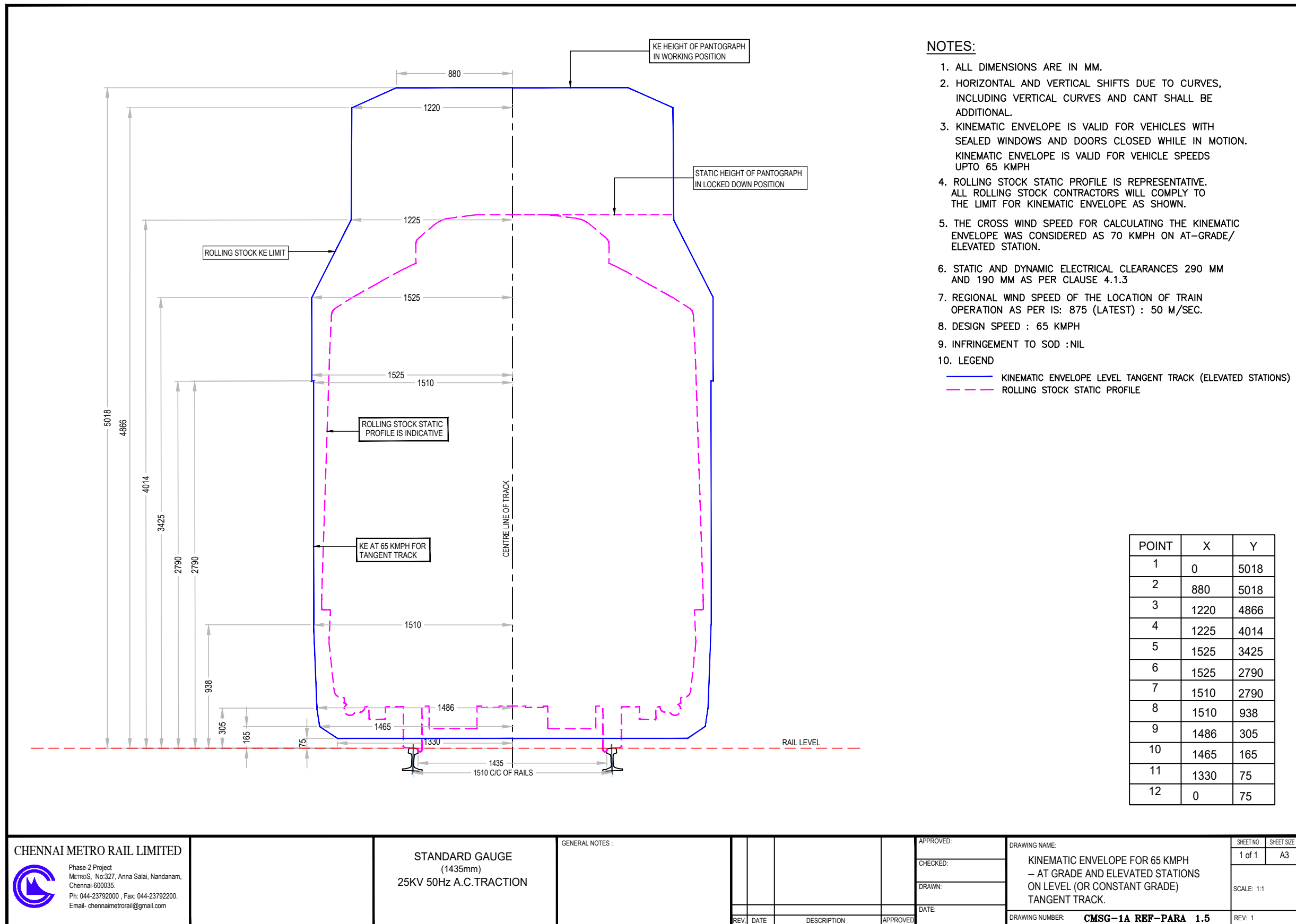
REV.	DATE	DESCRIPTION	APPROVED

APPROVED:	
CHECKED:	
DRAWN:	
DATE:	

DRAWING NAME:
KINEMATIC ENVELOPE FOR 90 KMPH –THROUGH & SEMI THROUGH GIRDER BRIDGES, AT GRADE, AND ELEVATED SECTIONS ON LEVEL (OR CONSTANT GRADE) TANGENT TRACK.

DRAWING NUMBER: **CMSG-1 REF-PARA 1.5**

SHEET NO	SHEET SIZE
1 of 1	A3
SCALE: 1:1	
REV:	1



CHENNAI METRO RAIL LIMITED
 Phase-2 Project
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STANDARD GAUGE
 (1435mm)
25KV 50Hz A.C. TRACTION

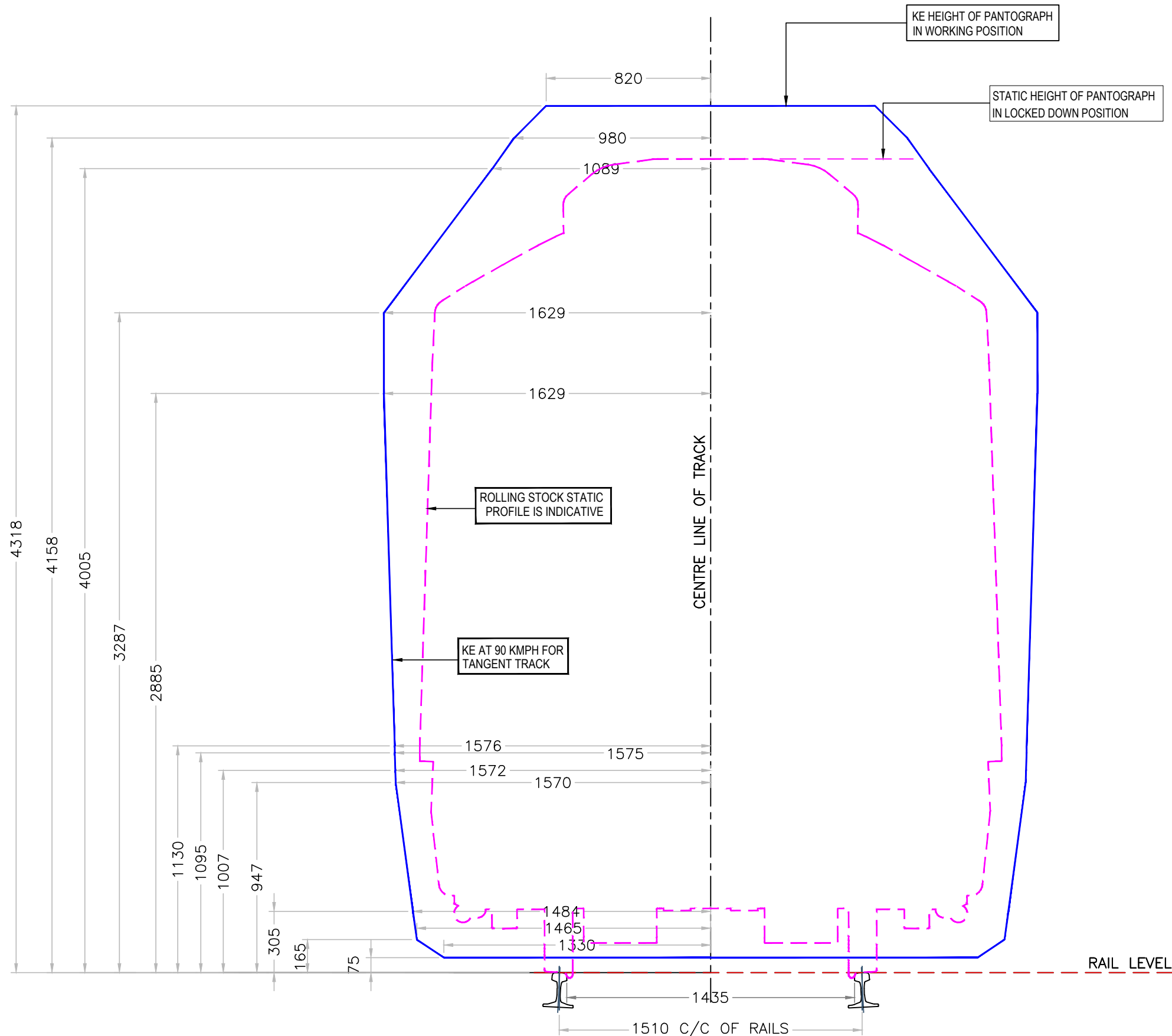
GENERAL NOTES :

REV.	DATE	DESCRIPTION	APPROVED

APPROVED: _____
 CHECKED: _____
 DRAWN: _____
 DATE: _____

DRAWING NAME:
**KINEMATIC ENVELOPE FOR 65 KMPH
 – AT GRADE AND ELEVATED STATIONS
 ON LEVEL (OR CONSTANT GRADE)
 TANGENT TRACK.**

SHEET NO: 1 of 1
 SHEET SIZE: A3
 SCALE: 1:1
 DRAWING NUMBER: **CMSG-1A REF-PARA 1.5**
 REV: 1



NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE ADDITIONAL.
3. KINEMATIC ENVELOPE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
4. THE CONDUCTOR HEIGHT ABOVE RAIL LEVEL SHALL ALSO TAKE IN TO CONSIDERATION PRESCRIBED ELECTRICAL CLEARANCES BETWEEN ALL LIVE OVERHEAD EQUIPMENT AND PANTOGRAPH/VEHICLE AND ALL PARTS THEREOF.
5. 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 WHEEL.
6. KINEMATIC ENVELOPE IS VALID FOR VEHICLE SPEEDS UPTO 90 KMPH
7. ROLLING STOCK STATIC PROFILE IS REPRESENTATIVE. ALL ROLLING STOCK CONTRACTORS WILL COMPLY TO THE KINEMATIC ENVELOPE LIMIT SHOWN
8. THE CROSS WIND SPEED FOR CALCULATION THE KINEMATIC ENVELOPE WAS CONSIDERED AS ZERO KMPH FOR UNDERGROUND SECTIONS
9. STATIC AND DYNAMIC ELECTRICAL CLEARANCES 290 MM AND 190 MM AS PER CLAUSE 4.1.3
10. REGIONAL WIND SPEED OF THE LOCATION OF TRAIN OPERATION AS PER IS: 875 (LATEST) : 50 M/SEC.
11. DESIGN SPEED : 90 KMPH
12. INFRINGEMENT TO SOD :NIL
13. LEGEND

- KINEMATIC ENVELOPE LEVEL TANGENT TRACK
- - - ROLLING STOCK STATIC PROFILE

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 Email- chennai-metro-rail@gmail.com

STANDARD GAUGE
 (1435mm)
 25KV 50 Hz A.C. TRACTION

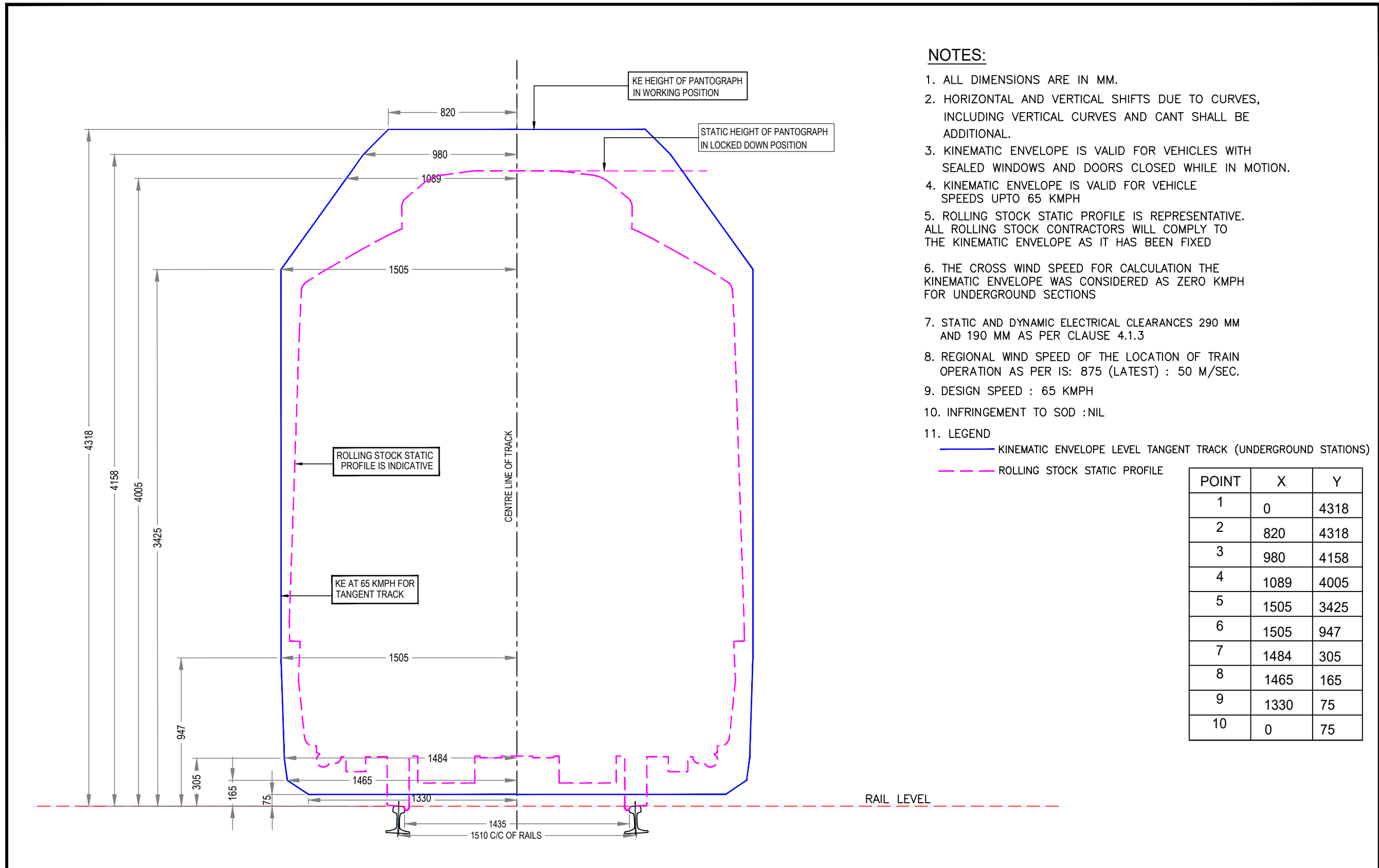
GENERAL NOTES :

REV.	DATE	DESCRIPTION	APPROVED

APPROVED:
CHECKED:
DRAWN:
DATE:

DRAWING NAME:
 KINEMATIC ENVELOPE FOR 90 KMPH
 – UNDERGROUND SECTIONS ON LEVEL
 (OR CONSTANT GRADE) TANGENT TRACK.
 DRAWING NUMBER: **CMSG-1(TNL)REF-PARA 1.5**

SHEET NO	SHEET SIZE
1 of 1	A3
SCALE: 1:1	
REV: 2	

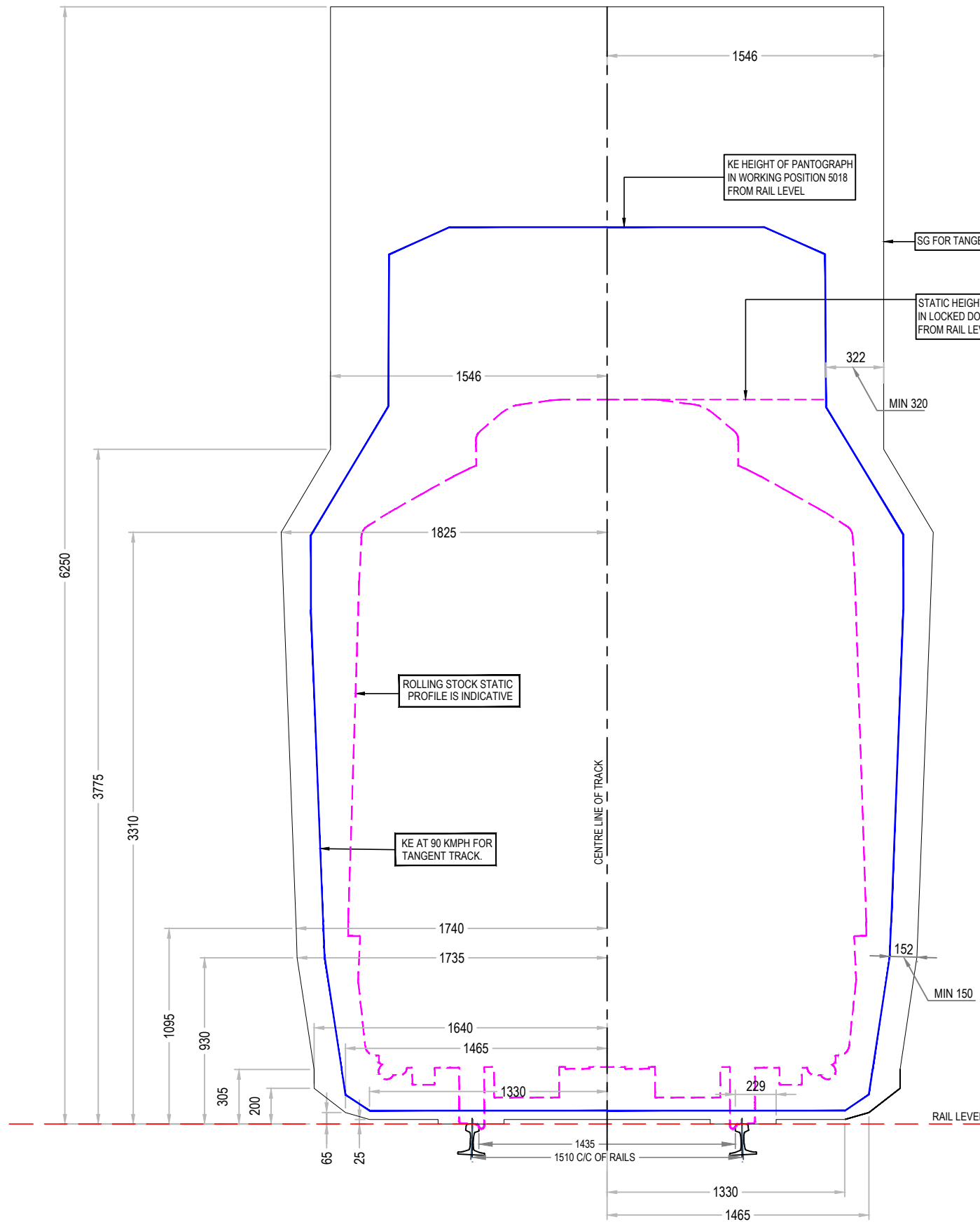


NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE ADDITIONAL.
3. KINEMATIC ENVELOPE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
4. KINEMATIC ENVELOPE IS VALID FOR VEHICLE SPEEDS UPTO 65 KMPH
5. ROLLING STOCK STATIC PROFILE IS REPRESENTATIVE. ALL ROLLING STOCK CONTRACTORS WILL COMPLY TO THE KINEMATIC ENVELOPE AS IT HAS BEEN FIXED
6. THE CROSS WIND SPEED FOR CALCULATION THE KINEMATIC ENVELOPE WAS CONSIDERED AS ZERO KMPH FOR UNDERGROUND SECTIONS
7. STATIC AND DYNAMIC ELECTRICAL CLEARANCES 290 MM AND 190 MM AS PER CLAUSE 4.1.3
8. REGIONAL WIND SPEED OF THE LOCATION OF TRAIN OPERATION AS PER IS: 875 (LATEST) : 50 M/SEC.
9. DESIGN SPEED : 65 KMPH
10. INFRINGEMENT TO SOD : NIL
11. LEGEND
 - KINEMATIC ENVELOPE LEVEL TANGENT TRACK (UNDERGROUND STATIONS)
 - - - ROLLING STOCK STATIC PROFILE

POINT	X	Y
1	0	4318
2	820	4318
3	980	4158
4	1089	4005
5	1505	3425
6	1505	947
7	1484	305
8	1465	165
9	1330	75
10	0	75

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			CHECKED:		1 of 1	A3
			DRAWN:	DRAWING NUMBER: CMSG-1A(TNL)REF-PARA 1.5	SCALE: 1:1	
			DATE:		REV: 1	
			REV.	DATE	DESCRIPTION	APPROVED



NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. THIS STRUCTURE GAUGE WILL ALSO BE APPLICABLE FOR ROB/FOBS AT STATIONS WITHOUT THE MAST UNDER THE STRUCTURES.
3. WHERE IT IS NECESSARY TO PROVIDE MAST UNDER THE ROB/FOB, THE HEIGHT SHALL BE INCREASED FROM 6250 mm TO 6290 mm. IN CASE THE CONTACT WIRE IS HIGHER, THE HEIGHT OF THE ROB/FOB SHALL BE INCREASED ACCORDINGLY.
4. MINIMUM CLEARANCE BETWEEN KINEMATIC ENVELOPE AND STRUCTURE GAUGE WILL BE 150 mm.
5. MINIMUM ELECTRICAL CLEARANCE OF 320 mm SHALL BE MAINTAINED BETWEEN 25 KV LIVE PARTS AND THE EARTHED STRUCTURES.
6. MINIMUM CLEARANCE FOR OHE MAST WILL BE 2150 mm FROM THE CENTRE OF TRACK.
7. KINEMATIC ENVELOPE AND STRUCTURE GAUGE ARE VALID FOR ROLLING STOCK WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
8. HORIZONTAL AND VERTICAL SHIFTS DUE TO CURVES, INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA.
9. FOR KINEMATIC ENVELOPE, REFER TO DRG.NO:CMSG-1.

LEGEND:

- - KINEMATIC GAUGE
- - - - STATIC PROFILE
- - STRUCTURE GAUGE

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STANDARD GAUGE
 (1435mm)
 25KV 50Hz A.C. TRACTION

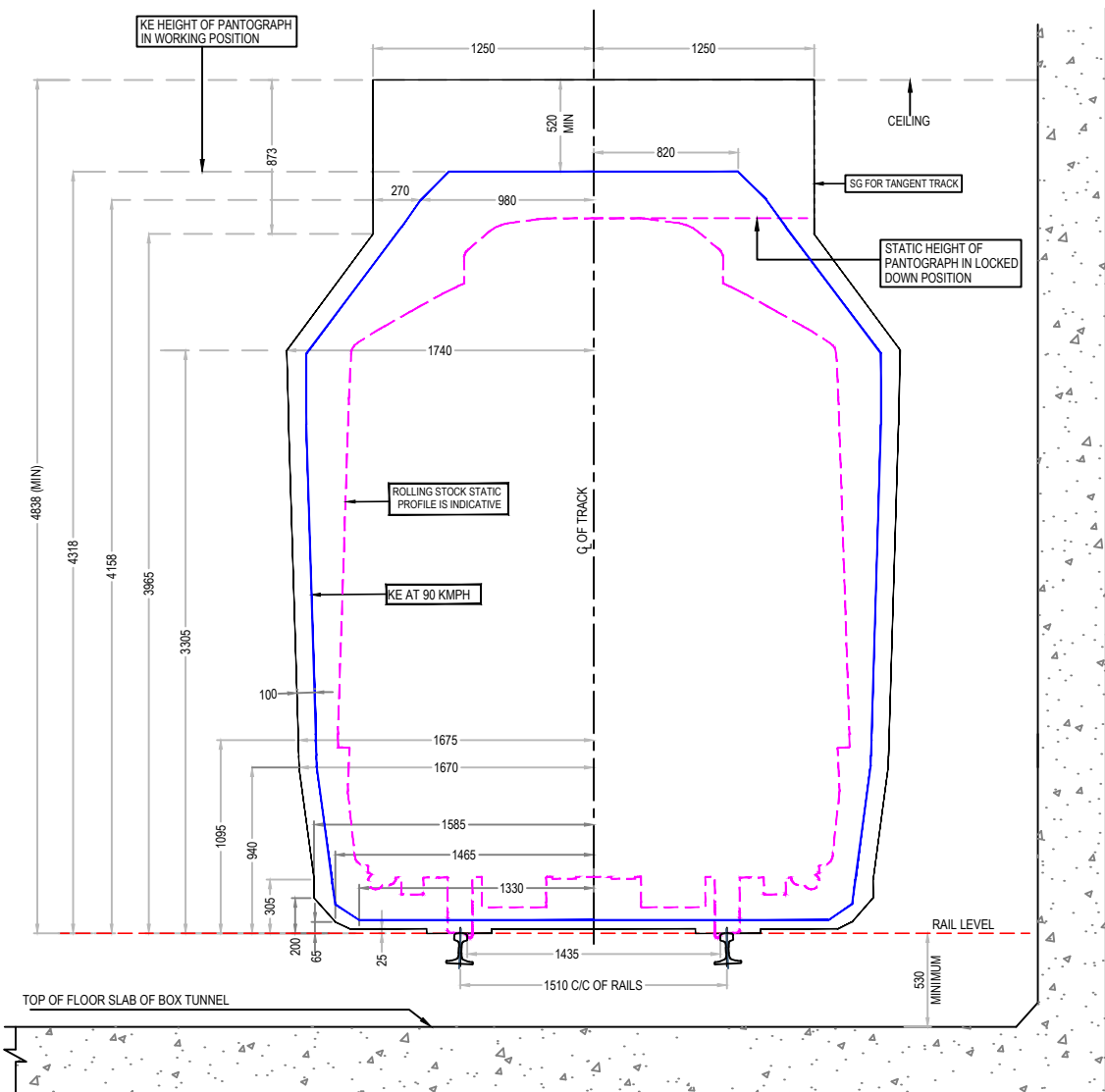
GENERAL NOTES :

REV.	DATE	DESCRIPTION	APPROVED

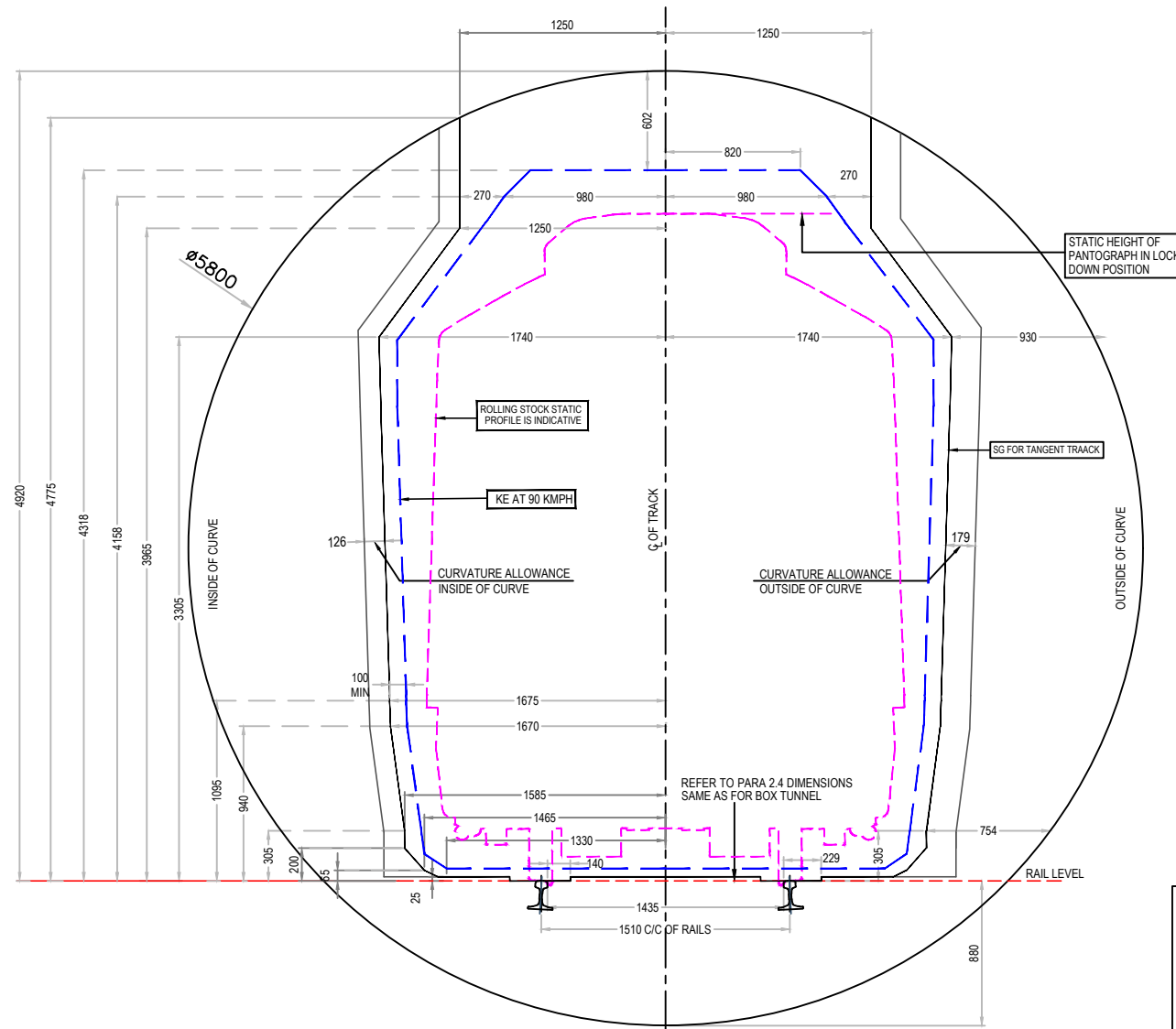
APPROVED:	
CHECKED:	
DRAWN:	
DATE:	

DRAWING NAME:	STRUCTURE GAUGE - AT GRADE AND ELEVATED SECTIONS ON LEVEL OR CONSTANT GRADE TANGENT TRACK (OUTSIDE STATION)
DRAWING NUMBER:	CMSG-2

SHEET NO	SHEET SIZE
1 of 1	A3
SCALE: NOT TO SCALE	
REV: 0	



RECTANGULAR BOX TUNNEL



CIRCULAR TUNNEL 5800 mm DIA

- 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 SHIFTS DUE TO CURVES INCLUDING VERTICAL CURVES AND CANT SHALL BE EXTRA.
 5. CANT WILL BE PROVIDED 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 = 100mm.
 7. THE ELECTRICAL CLEARANCE FROM 25KV LIVE PARTS AND EARTHED STRUCTURES SHALL BE 270 mm.
 8. VERTICAL THROW DUE TO VERTICAL CURVE HAS NOT BEEN SHOWN IN THE FIGURE AND SHALL BE EXTRA.
 9. FOR DETAILS OF KINEMATIC ENVELOPE, REFER TO DRAWING No. CMSG-1(TNL).
- LEGEND:**
- KINEMATIC GAUGE
 - STATIC PROFILE
 - STRUCTURE GAUGE

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STANDARD GAUGE
 (1435mm)
 25KV 50 Hz A.C. TRACTION

GENERAL NOTES :

REV.	DATE	DESCRIPTION	APPROVED

APPROVED:
 CHECKED:
 DRAWN:
 DATE:

DRAWING NAME: **STRUCTURE GAUGE**
 CIRCULAR TUNNEL (5800MM DIA) AND RECTANGULAR BOX
 TUNNEL ON TANGENT TRACK AND CURVE UPTO R=200M .

DRAWING NUMBER: **CMSG-2(TNL)**

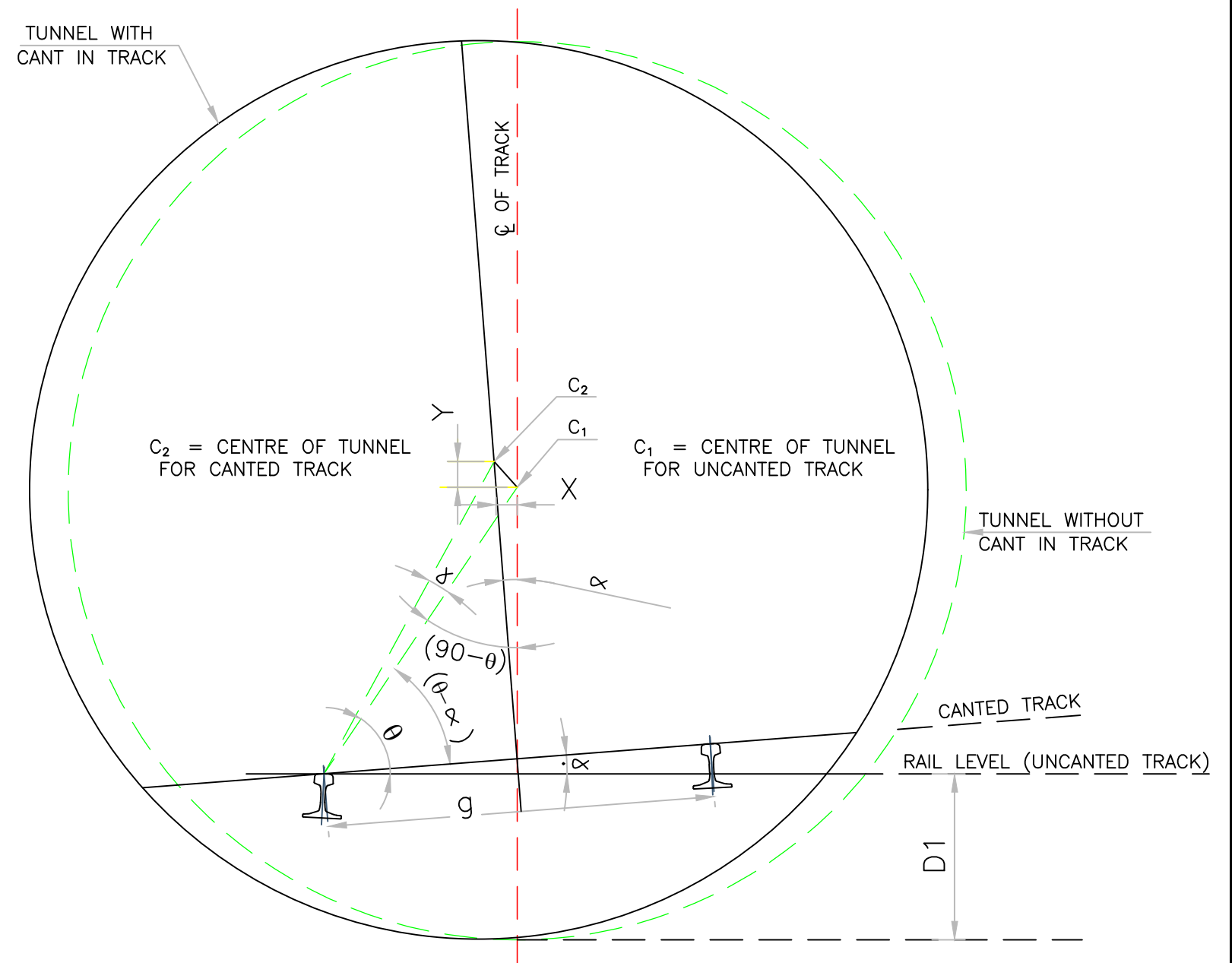
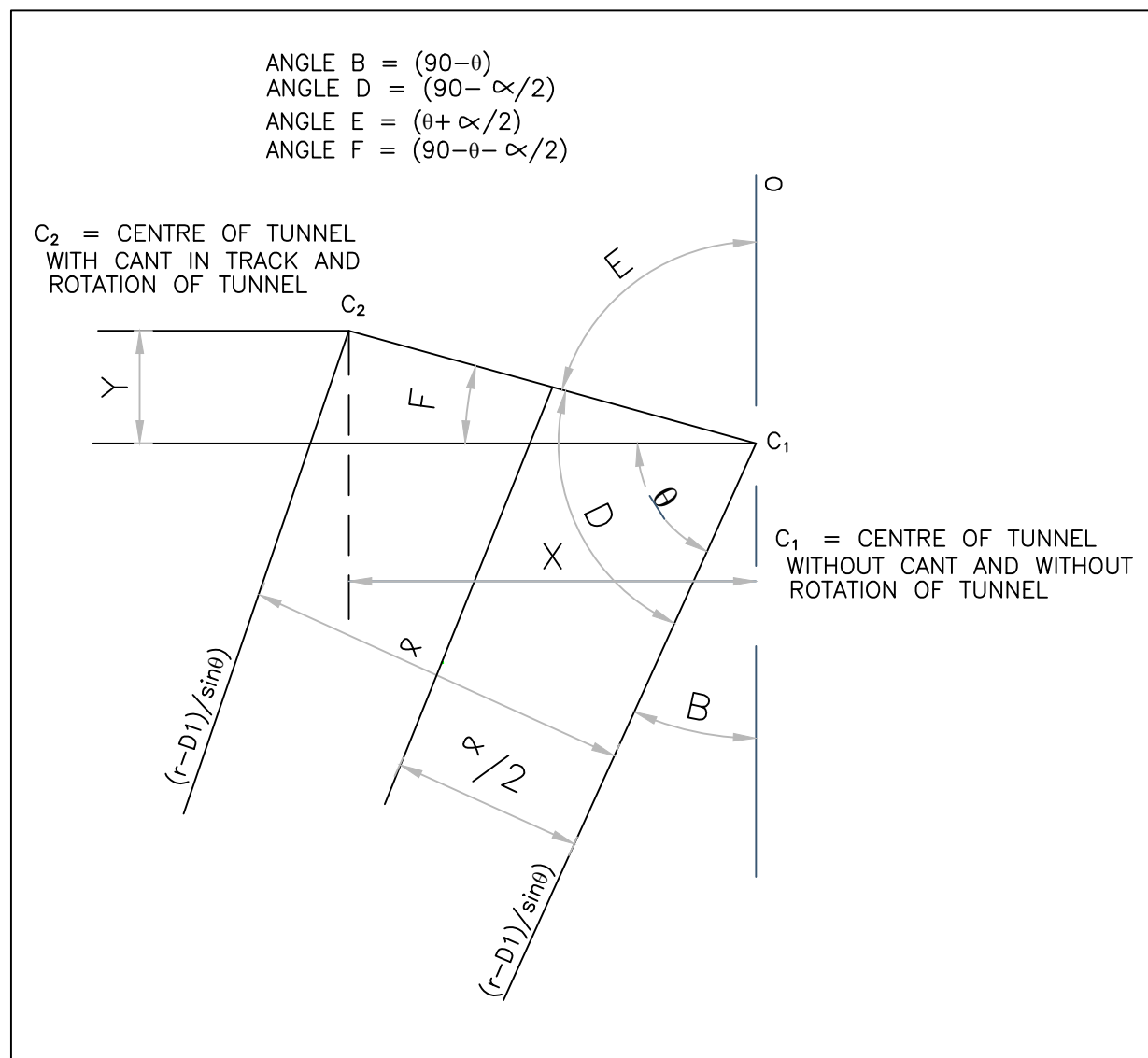
SHEET NO	SHEET SIZE
1 of 1	A3
SCALE: NOT TO SCALE	
REV: 0	

$\tan \theta = (r-D_1)/(g/2)$
 $\theta = \tan^{-1}[(r-D_1)/(g/2)]$
 $\sin \alpha = \text{cant}/g$
 $\alpha = \sin^{-1}(\text{cant}/g)$
 $\text{Chord } C_1C_2 = 2 \times [(r-D_1)/\sin\theta] \times (\sin \alpha/2)$
 $X = C_1C_2 \times \cos(90-\theta-\alpha/2)$
 $= 2 \times [(r-D_1)/\sin\theta] \times (\sin \alpha/2) \times \cos(90-\theta-\alpha/2)$
 $Y = 2 \times [(r-D_1)/\sin\theta] \times (\sin \alpha/2) \times \sin(90-\theta-\alpha/2)$
 where 'r' is internal radius of tunnel,
 D_1 = depth from Rail level to invert of tunnel
 g = distance between centres of rails = 1510 mm

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

DETAIL AT CENTRE OF TUNNEL



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STANDARD GAUGE
 (1435mm)
 25KV 50Hz A.C. TRACTION

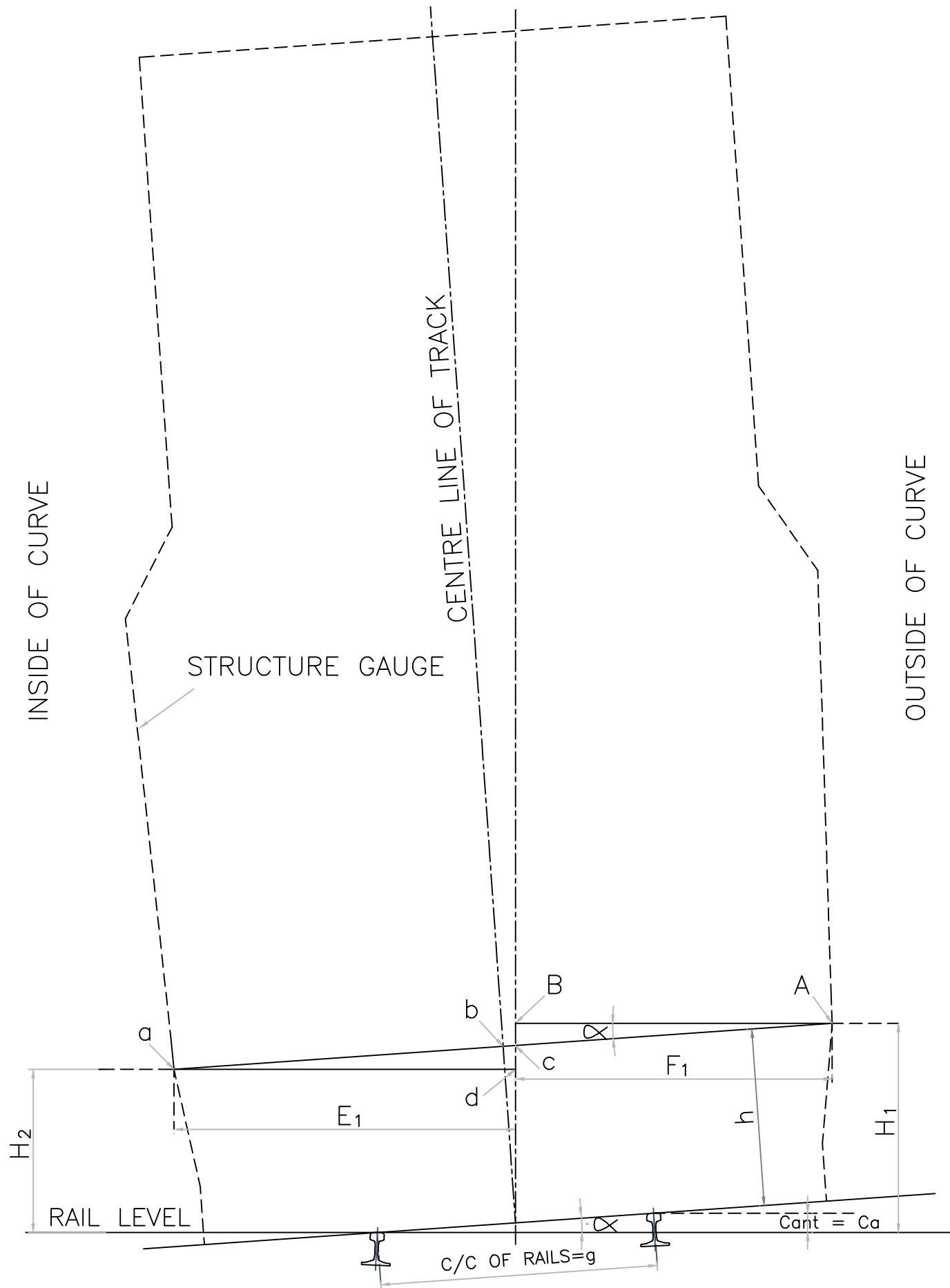
GENERAL NOTES :

REV	DATE	DESCRIPTION	APPROVED

APPROVED:	
CHECKED:	
DRAWN:	
DATE:	

DRAWING NAME:
 SHIFT OF THE CENTRE OF CIRCULAR TUNNEL DUE TO ROTATION OF TUNNEL TO PROVIDE CANT
 DRAWING NUMBER: **CMSG-3**

SHEET NO	SHEET SIZE
1 of 1	A3
SCALE: NOT TO SCALE	
REV: 0	

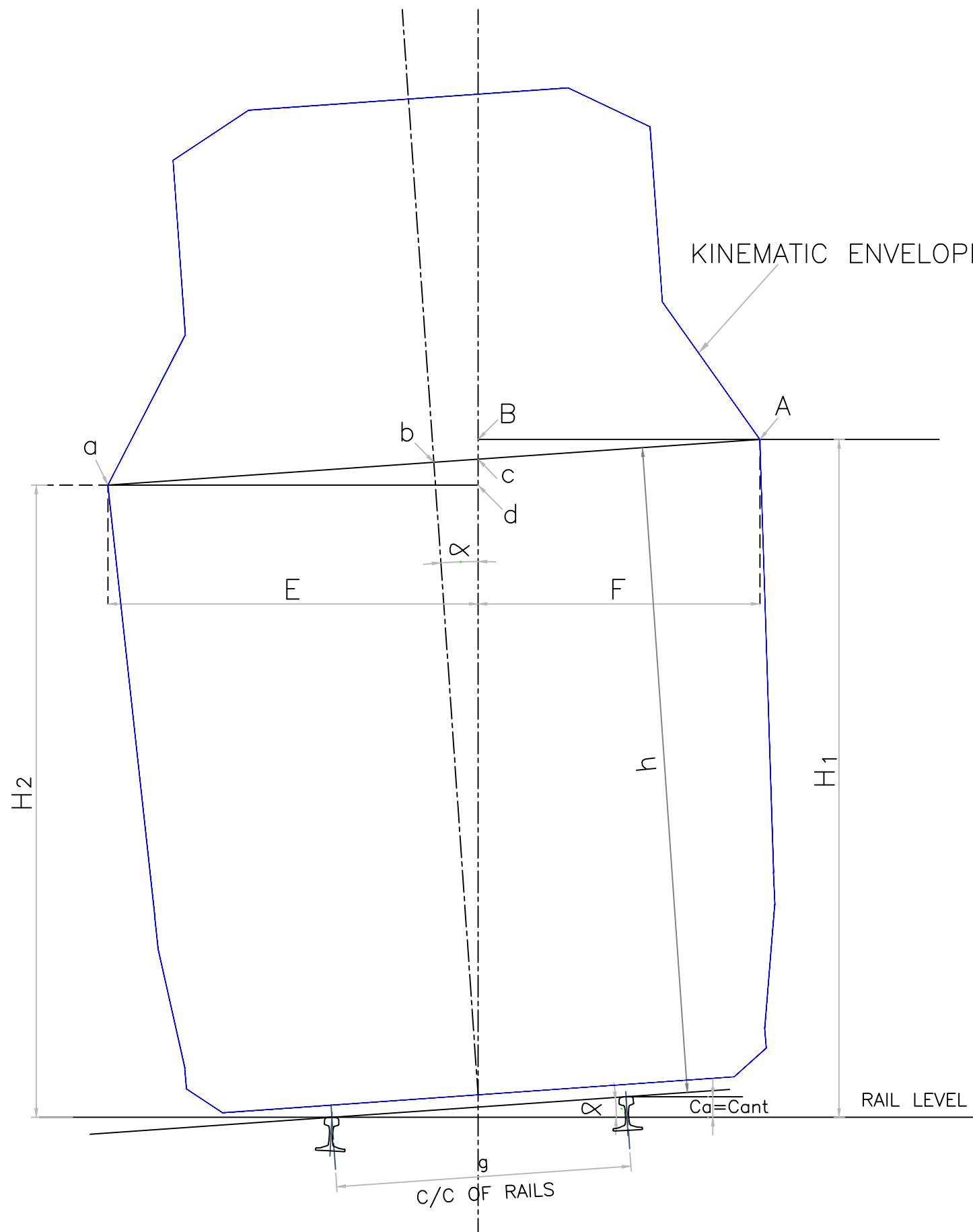


$ab=Ab$ =Distance from centre line of track to Structure Gauge for Tangent Track at height 'h'
 $\sin \alpha = \text{cant}/g$
 $g = 1510\text{mm}$
 $Ca = \text{Cant applied}$
 $E_1 = [ab+(h \times \tan \alpha)] \times \cos \alpha$
 $F_1 = [Ab-(h \times \tan \alpha)] \times \cos \alpha$
 $H_1 = (Ca/2)+(h/\cos \alpha)+(Ab-h \times \tan \alpha) \times \sin \alpha$
 $H_2 = (Ca/2)+(h/\cos \alpha)-(ab+h \times \tan \alpha) \times \sin \alpha$
 For values of E_1 , F_1 , H_1 AND H_2 refer to Appendix 3 and 3 (TNL)

NOTES:-

1. STRUCTURE GAUGE FOR AT – GRADE/ELEVATED SECTION HAS BEEN SHOWN AS A TYPICAL FIGURE.
2. THE FORMULAE FOR E_1 , F_1 , H_1 AND H_2 SHOWN IN THIS FIGURE WILL ALSO APPLY TO UNDER GROUND BOX TUNNELS.

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			CHECKED:		DRAWING NUMBER: CMSSG-4	SCALE: NOT TO SCALE
			DRAWN:			
			DATE:			
REV.	DATE	DESCRIPTION	APPROVED			



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

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

$$g = 1510\text{mm}$$

Ca = Cant applied

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

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

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

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

For values of E, F, H1 and H2 refer to Appendix 3A and 3A (TNL)

NOTES:-

1. KINEMATIC ENVELOPE FOR AT-GRADE/ELEVATED SECTIONS HAS BEEN SHOWN AS A TYPICAL FIGURE.
2. THE FORMULAE FOR E, F, H1 AND H2 SHOWN IN THIS FIGURE WILL ALSO APPLY TO UNDER GROUND BOX TUNNELS.

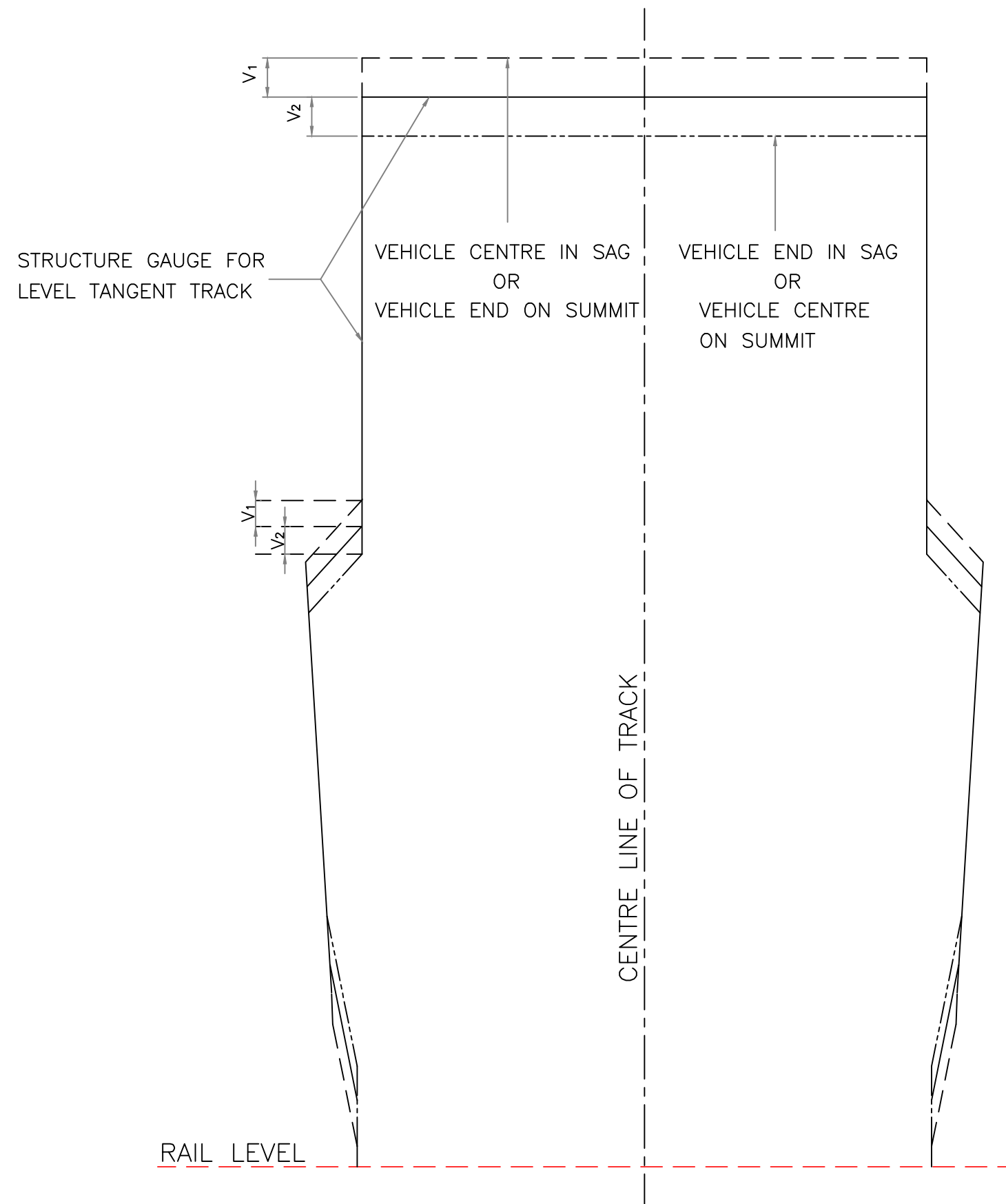
GENERAL NOTES:

REV.	DATE	DESCRIPTION	APPROVED

APPROVED:
CHECKED:
DRAWN:
DATE:

DRAWING NAME:	EFFECT OF CANT ON KINEMATIC ENVELOPE
DRAWING NUMBER:	CMSG-4A

SHEET NO.	SHEET SIZE
1 of 1	A3
SCALE: NOT TO SCALE	
REV:	0



VERTICAL THROW

RADIUS OF VERTICAL CURVE metres	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. THE FIGURE IS TYPICAL AND WILL APPLY TO UNDER GROUND, ELEVATED AND AT GRADE SECTIONS.

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STANDARD GAUGE
 (1435mm)
 25KV 50 Hz A.C. TRACTION

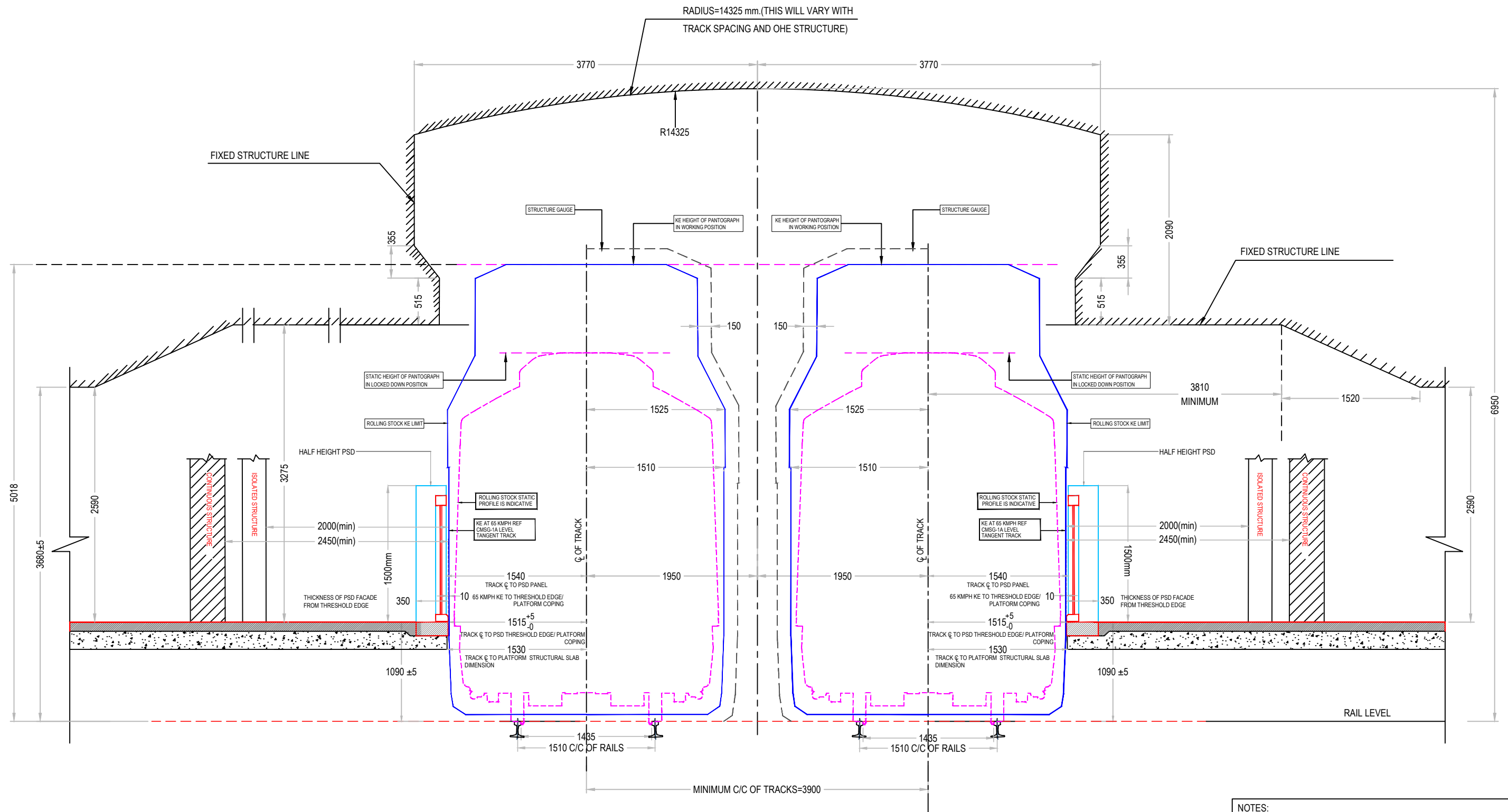
GENERAL NOTES :

REV.	DATE	DESCRIPTION	APPROVED

APPROVED:
CHECKED:
DRAWN:
DATE:

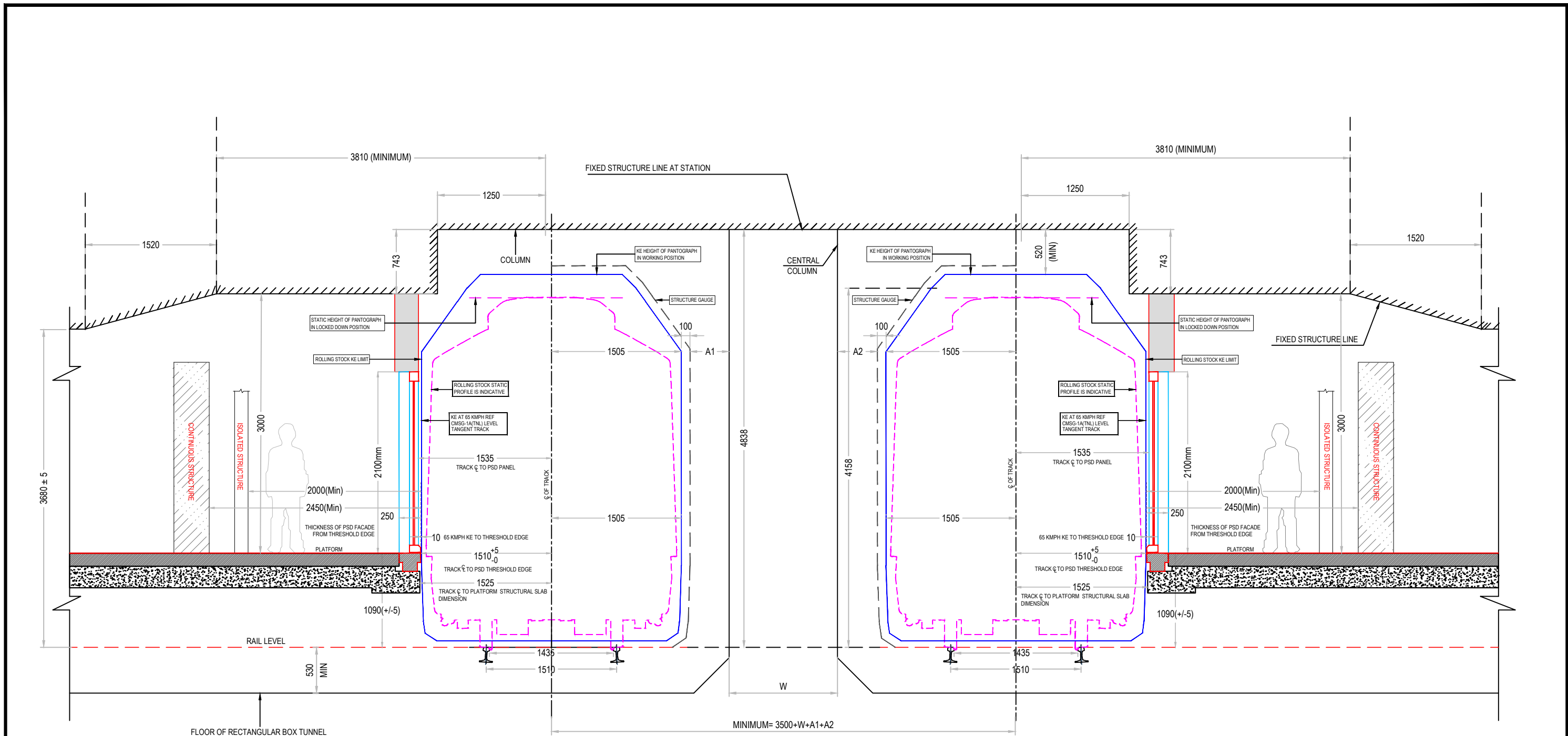
DRAWING NAME:
**EFFECT OF VERTICAL CURVE ON
 STRUCTURE GAUGE**
 DRAWING NUMBER: **CMSG-5**

SHEET NO	SHEET SIZE
1 of 1	A3
SCALE: NOT TO SCALE	
REV: 0	



- NOTES:**
1. ALL DIMENSIONS ARE IN MM.
 2. ADDITIONAL CLEARANCE FOR PLATFORM ON CURVES SHALL BE AS PER APPENDIX-5. HOWEVER THE TRACK CENTRES AT STATION WILL NOT INCREASE WITH CURVES OF RADIUS OF 1000 M AND ABOVE.
 3. STRUCTURE CLEARANCE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
 4. OHE IS SUSPENDED FROM CEILING BY DROP ARM.

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			CHECKED:	STRUCTURAL CLEARANCE AT -GRADE AND ELEVATED STATION WITH PSD IN SIDE PLATFORMS ON LEVEL (OR CONSTANT GRADE) TANGENT TRACK	1 of 1	A3
			DRAWN:	SCALE: 1:1		
			DATE:	DRAWING NUMBER: CMSG-6		
			REV. DATE	DESCRIPTION		
			APPROVED			



- NOTES:**
1. ALL DIMENSIONS ARE IN MM.
 2. ADDITIONAL CLEARANCE FOR PLATFORM ON CURVES SHALL BE AS PER APPENDIX-5.
 3. THE STRUCTURE CLEARANCE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
 4. CLEARANCES 'A1' AND 'A2' FOR SERVICES AND PATHWAY SHALL BE AS PER REQUIREMENT AND SHALL BE APPROVED BY THE COMPETENT AUTHORITY.

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STANDARD GAUGE
 (1435mm)
 25KV 50Hz A.C. TRACTION

GENERAL NOTES :

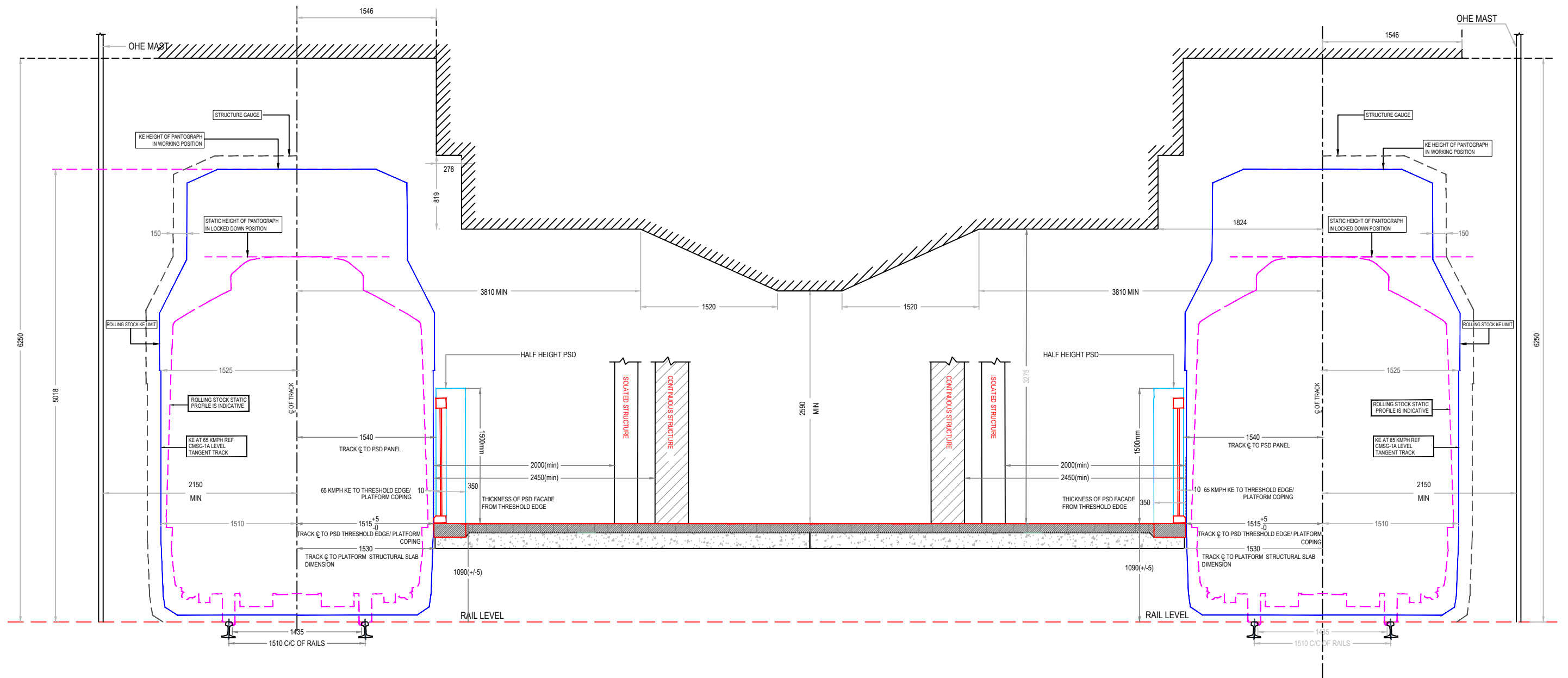
REV.	DATE	DESCRIPTION	APPROVED

APPROVED:	
CHECKED:	
DRAWN:	
DATE:	

DRAWING NAME:
 STRUCTURAL CLEARANCE AT UNDERGROUND STATION WITH PSD IN SIDE PLATFORMS RECTANGULAR BOX TUNNEL ON LEVEL OR CONSTANT GRADE TANGENT TRACK

DRAWING NUMBER: **CMSG-6(TNL)**

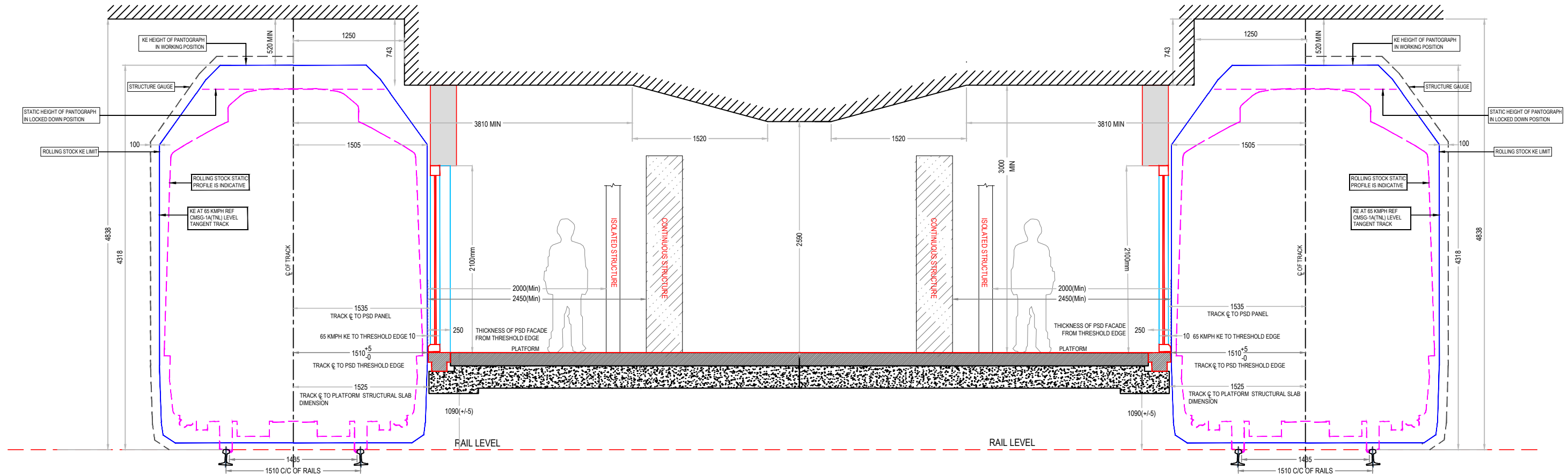
SHEET NO	SHEET SIZE
1 of 1	A3
SCALE: NOT TO SCALE	
REV: 0	



NOTES:

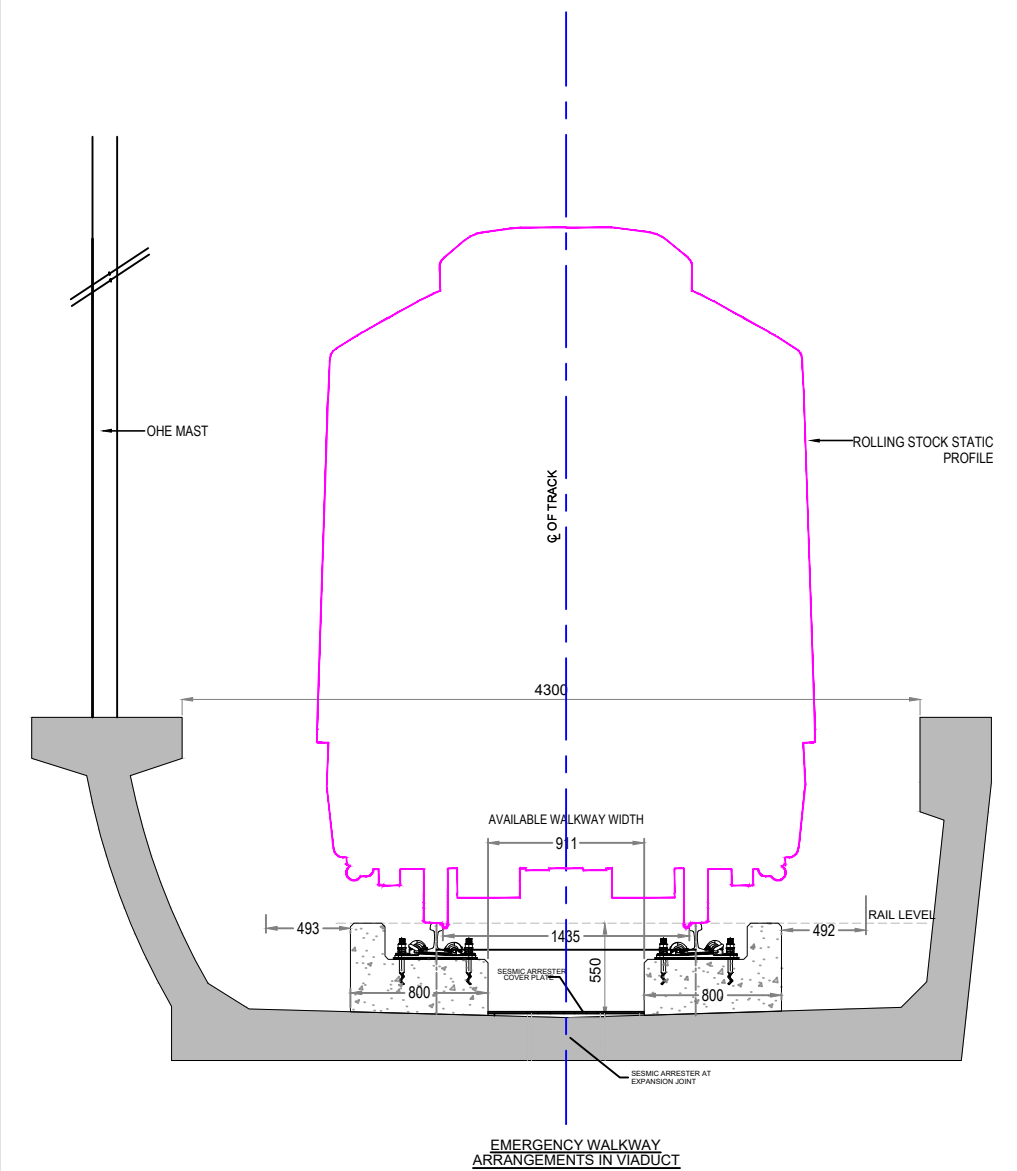
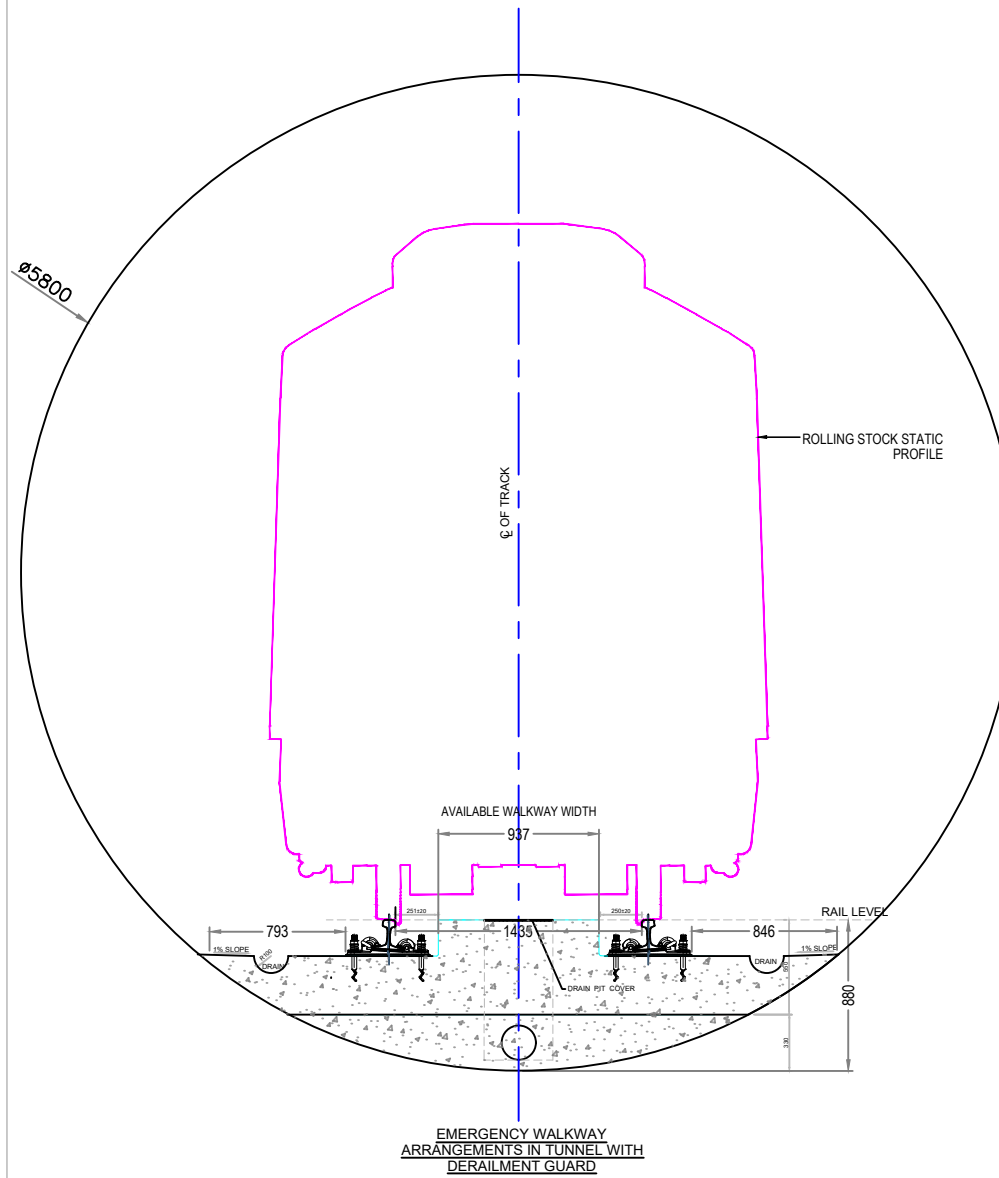
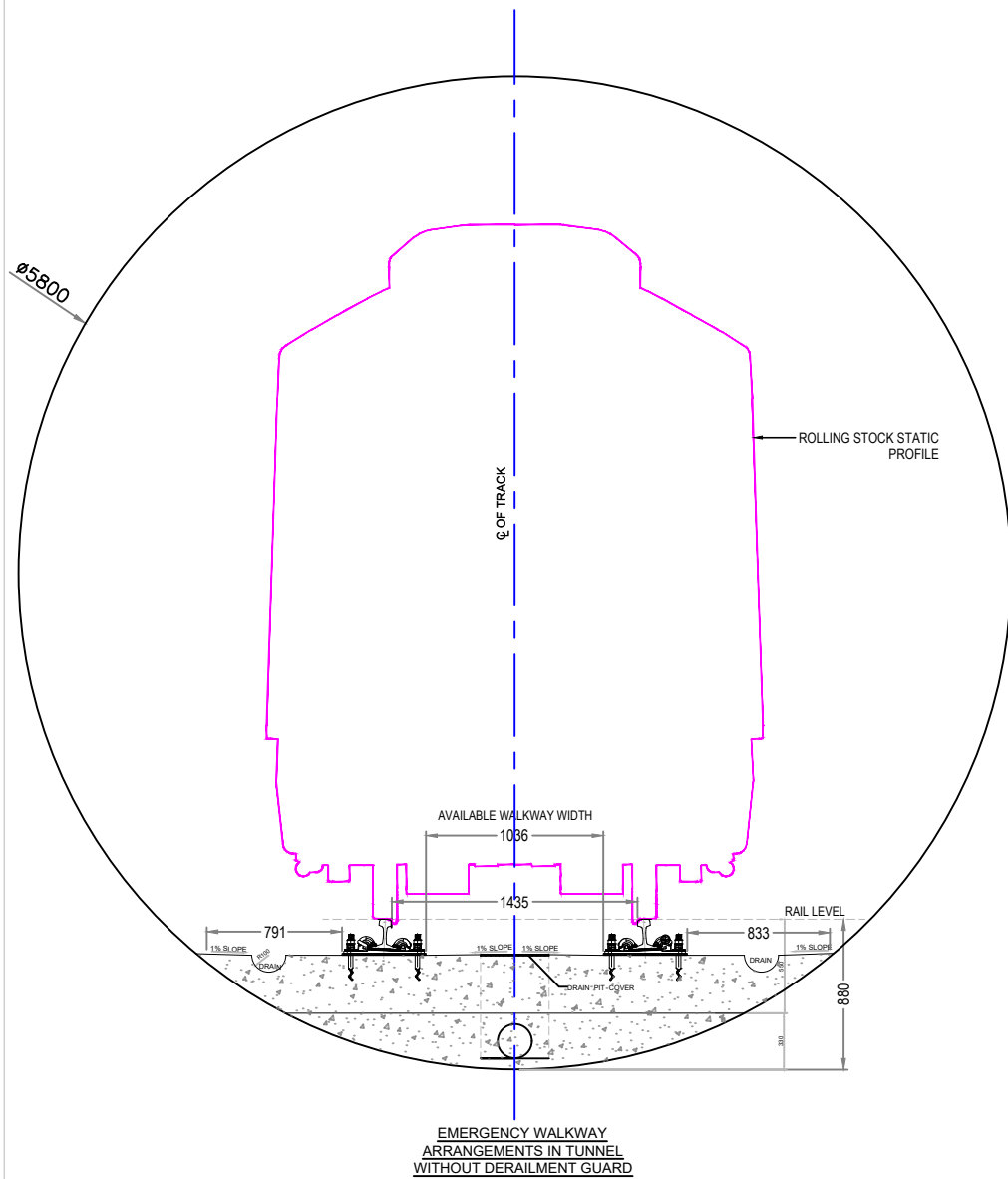
1. ALL DIMENSIONS ARE IN MM.
2. ADDITIONAL CLEARANCE FOR PLATFORM ON CURVES SHALL BE AS PER APPENDIX-5.
3. STRUCTURE CLEARANCE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.

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			CHECKED:		DRAWING NUMBER: CMSG-7	SCALE: NOT TO SCALE
			DRAWN:	REV: 0		
			DATE:			
			REV. DATE DESCRIPTION APPROVED			



- NOTES:**
1. ALL DIMENSIONS ARE IN MM.
 2. ADDITIONAL CLEARANCE FOR PLATFORM ON CURVES SHALL BE AS PER APPENDIX-5.
 3. THE STRUCTURE CLEARANCE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.
 4. CLEARANCES 'A1' AND 'A2' FOR SERVICES AND PATHWAY SHALL BE AS PER REQUIREMENT AND SHALL BE APPROVED BY THE COMPETENT AUTHORITY.

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			CHECKED:		1 of 1	A3
			DRAWN:	DRAWING NUMBER: CMSG-7(TNL)	SCALE: NOT TO SCALE	
			DATE:		REV: 0	
			REV.	DATE	DESCRIPTION	APPROVED



NOTES:

1. ALL DIMENSIONS ARE IN MM

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STANDARD GAUGE
 (1435mm)
 25KV 50Hz A.C.TRACTION

GENERAL NOTES :

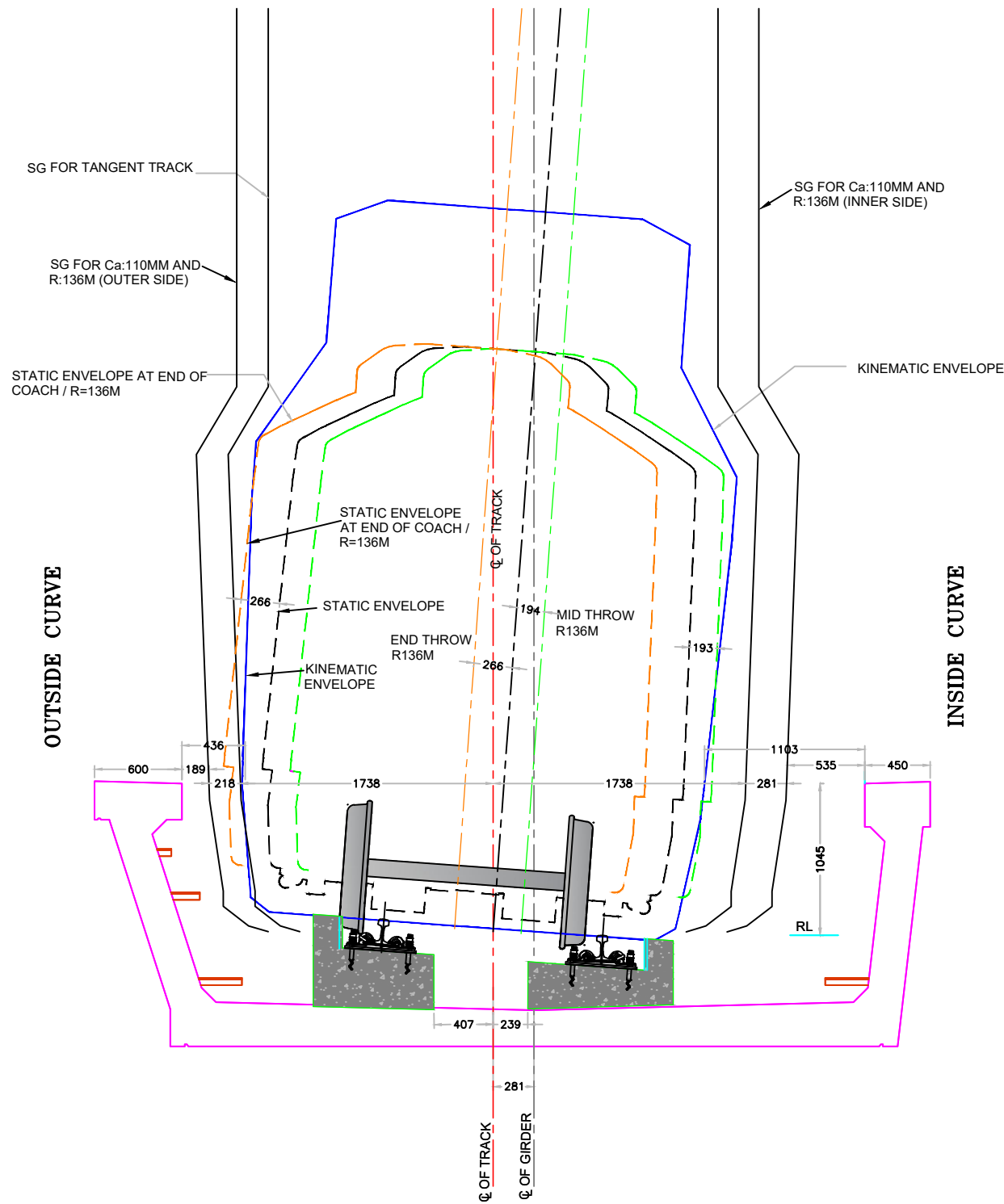
REV	DATE	DESCRIPTION	APPROVED

APPROVED:	
CHECKED:	
DRAWN:	
DATE:	

EMERGENCY WALKWAY ARRANGEMENTS IN TUNNEL AND VIADUCT.

DRAWING NUMBER: CMSG-8

SHEET NO	SHEET SIZE
	A3
REV: 0	



DOWN LINE RADIUS 136M

COACH POSITION IN DERAILED CONDITION-OUT WARD

SECTION A-A

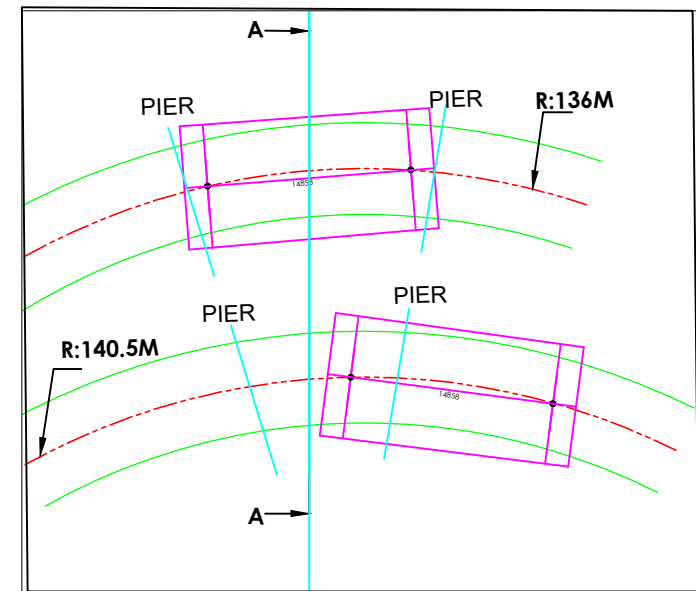


FIG-1

- NOTES:**
1. ALL DIMENSIONS ARE IN MM.
 2. TRACK CENTERLINES IS EQUAL TO SUM OF E+F+T1+T2 FOR 136/140.55M RADIUS AND CANT OF 110MM, TRACK CENTER TO AT CENTRE (1894+193+1652+258+300=4297) SAY 5711 MM FOR U GIRDER.
 3. FOR OUTER TRACK R136 M STRUCTURE GAUGE HAS BEEN MOVED FROM CENTER LINE TOWARDS INNER SIDE 281MM FOR HEIGHT 1045MM ABOVE RL.
 4. FOR INNER TRACK R140.5 M , STRUCTURE GAUGE HAS BEEN MOVED FROM CENTER LINE TOWARDS OUTER SIDE 209 MM FOR HEIGHT OF 1045MM ABOVE RL.
 5. DERAILMENT GAURD IS PLACED AT 250+/- 20 (WORST CONDITION IS 250+20=270MM)
 6. WORST CONDITION OF DERAILMENT IS MENTIONED IN ABOVE FIGURE SECTION A-A (FIG-1)
 7. THE DRAWING IS FOR MID SPAN OF THE U GIRDER.

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STANDARD GAUGE
(1435mm)
25KV 50Hz A.C. TRACTION

GENERAL NOTES :

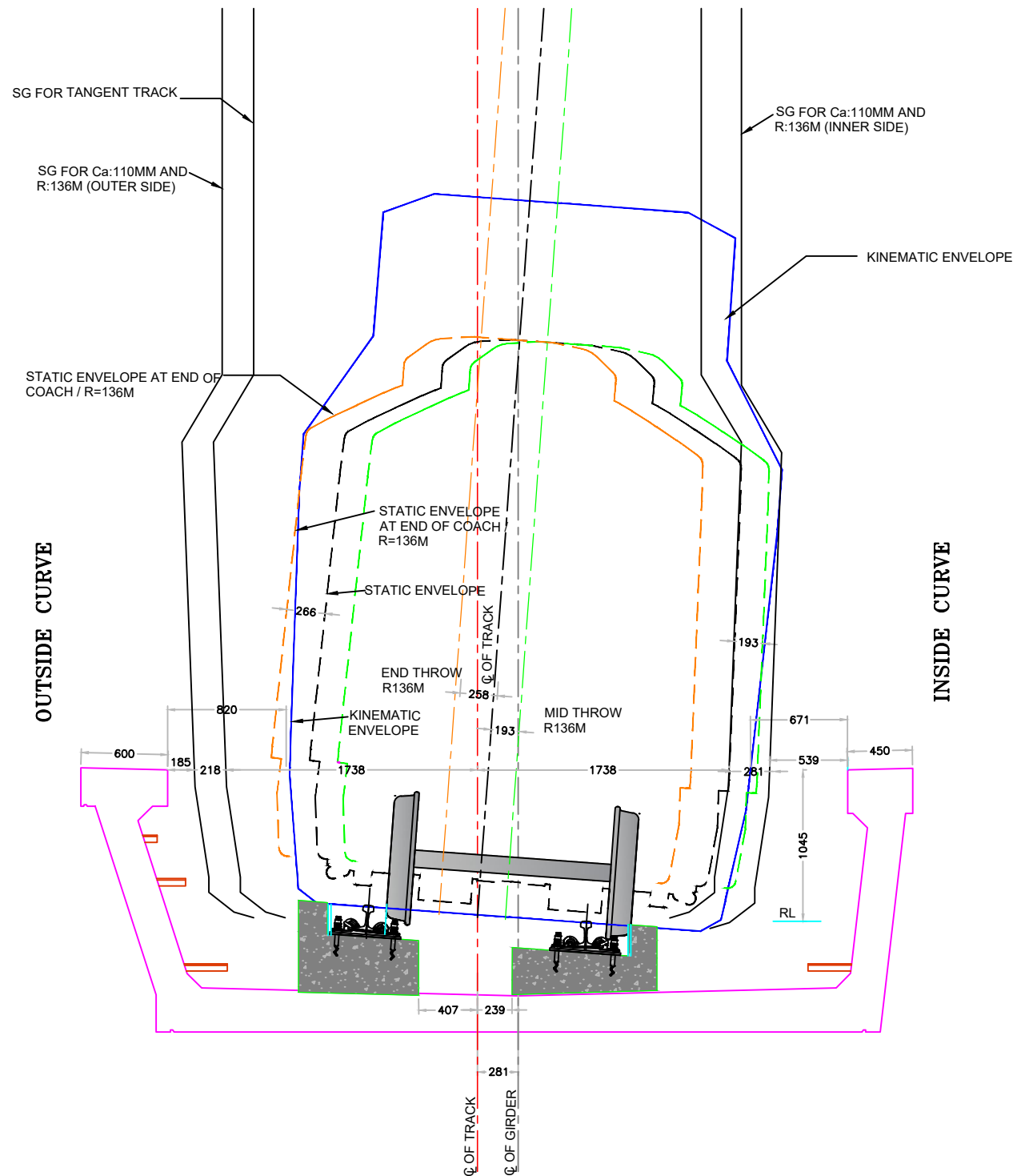
REV	DATE	DESCRIPTION	APPROVED

APPROVED:	
CHECKED:	
DRAWN:	
DATE:	

CHECK FOR DERAILMENT CONDITION FOR VIADUCT SECTION WITH SHARPEST CURVE AND MAX.CANT-DERAILED CONDITION (R136/140.5m, CANT110mm) (OUT WARD)

DRAWING NUMBER: **CMSG-9A**

SHEET NO	SHEET SIZE
	A3
REV: 0	



DOWN LINE RADIUS 136M

**COACH POSITION IN DERAILED CONDITION-IN WARD
SECTION A-A**

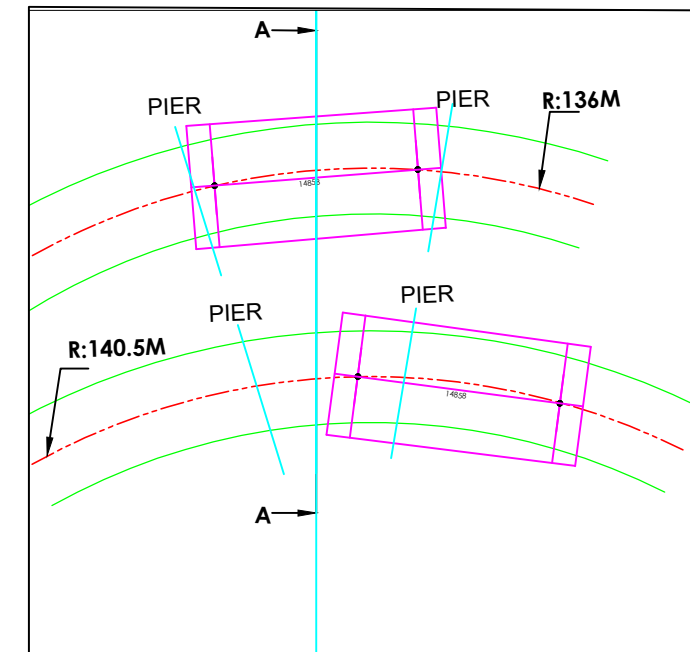


FIG-1

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. TRACK CENTERLINES IS EQUAL TO SUM OF E+F+T1+T2 FOR 136/140.55M RADIUS AND CANT OF 110MM, TRACK CENTER TO AT CENTRE (1894+193+1652+258+300=4297) SAY 5711 MM FOR U GIRDER.
3. FOR OUTER TRACK R136 M STRUCTURE GAUGE HAS BEEN MOVED FROM CENTER LINE TOWARDS INNER SIDE 281MM FOR HEIGHT 1045MM ABOVE RL.
4. FOR INNER TRACK R140.5 M , STRUCTURE GAUGE HAS BEEN MOVED FROM CENTER LINE TOWARDS OUTER SIDE 209 MM FOR HEIGHT OF 1045MM ABOVE RL.
5. DERAILMENT GAURD IS PLACED AT 250+/- 20 (WORST CONDITION IS 250+20=270MM)
6. WORST CONDITION OF DERAILMENT IS MENTIONED IN ABOVE FIGURE SECTION A-A (FIG-1)
7. THE DRAWING IS FOR MID SPAN OF THE U GIRDER.

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STANDARD GAUGE
(1435mm)
25KV 50Hz A.C. TRACTION

GENERAL NOTES :

APPROVED:

CHECKED:

DRAWN:

DATE:

CHECK FOR DERAILMENT CONDITION FOR VIADUCT SECTION WITH SHARPEST CURVE AND MAX.CANT-DERAILED CONDITION (R136/140.5m, CANT110mm) (IN WARD)

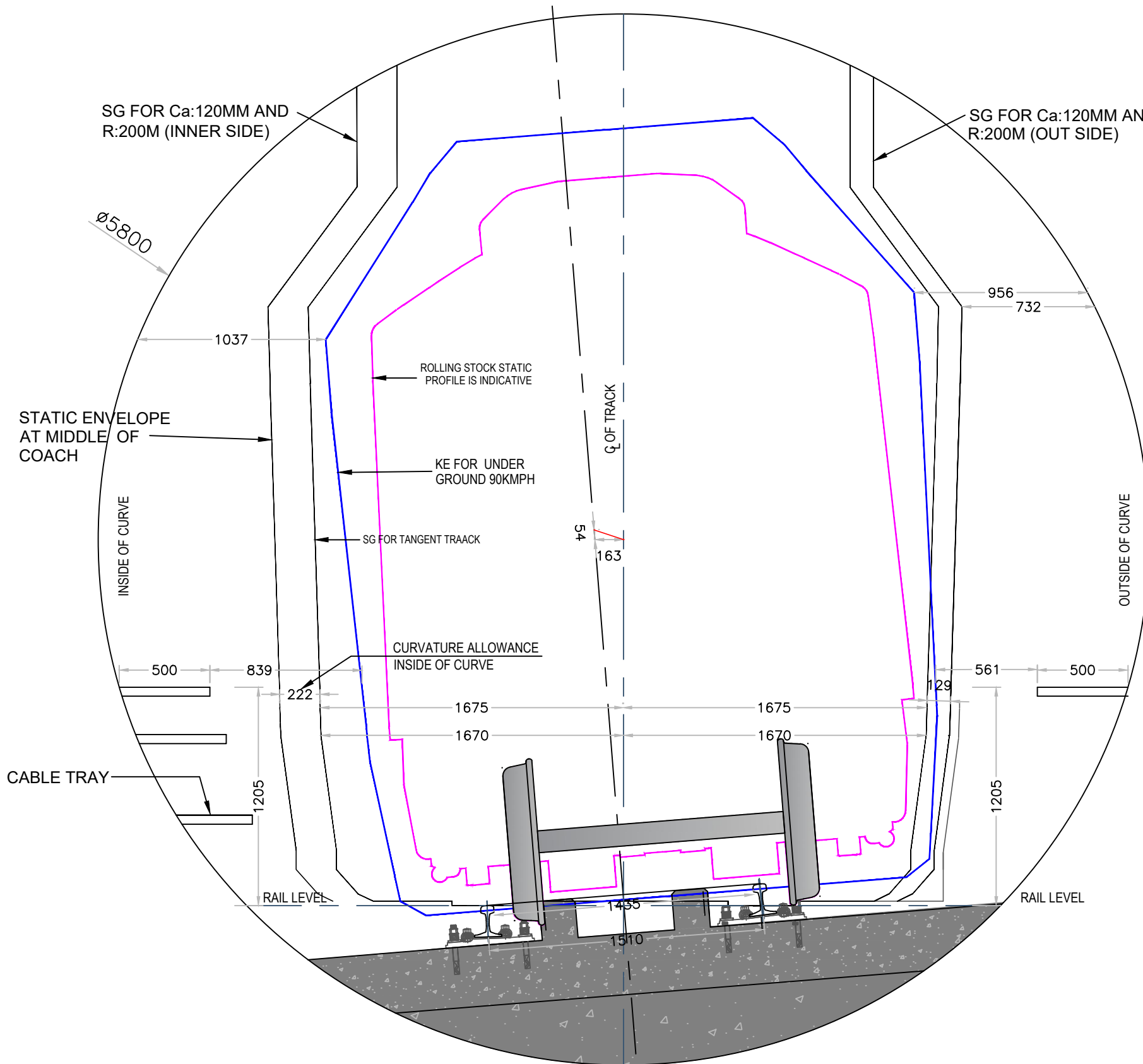
DRAWING NUMBER: **CMSG-9B**

SHEET NO SHEET SIZE

A3

REV: 0

REV	DATE	DESCRIPTION	APPROVED



**CIRCULAR TUNNEL 5800 mm DIA
COACH POSITION IN DERAILED CONDITION OUTSIDE OF CURVE**

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURE GAUGE HAS BEEN MOVED AWAY FROM CENTRE LINE BY (96MM FOR 120MM CANT EFFECT +126MM FOR MID THROW) 222MM TOWARDS INSIDE OF THE CURVE
3. STRUCTURE GAUGE HAS BEEN MOVED AWAY FROM CENTRE LINE BY (129 MM FOR END THROW, SINCE CANT EFFECT WAS NEGATIVE , IT WAS IGNORED) 129 MM TOWARDS OUTSIDE OF THE CURVE.
4. DERAILMENT GAURD IS PLACED AT 250+/- 20 (WORST CONDITION IS 250+20=270MM)

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STANDARD GAUGE
(1435mm)
25KV 50Hz A.C. TRACTION

GENERAL NOTES :

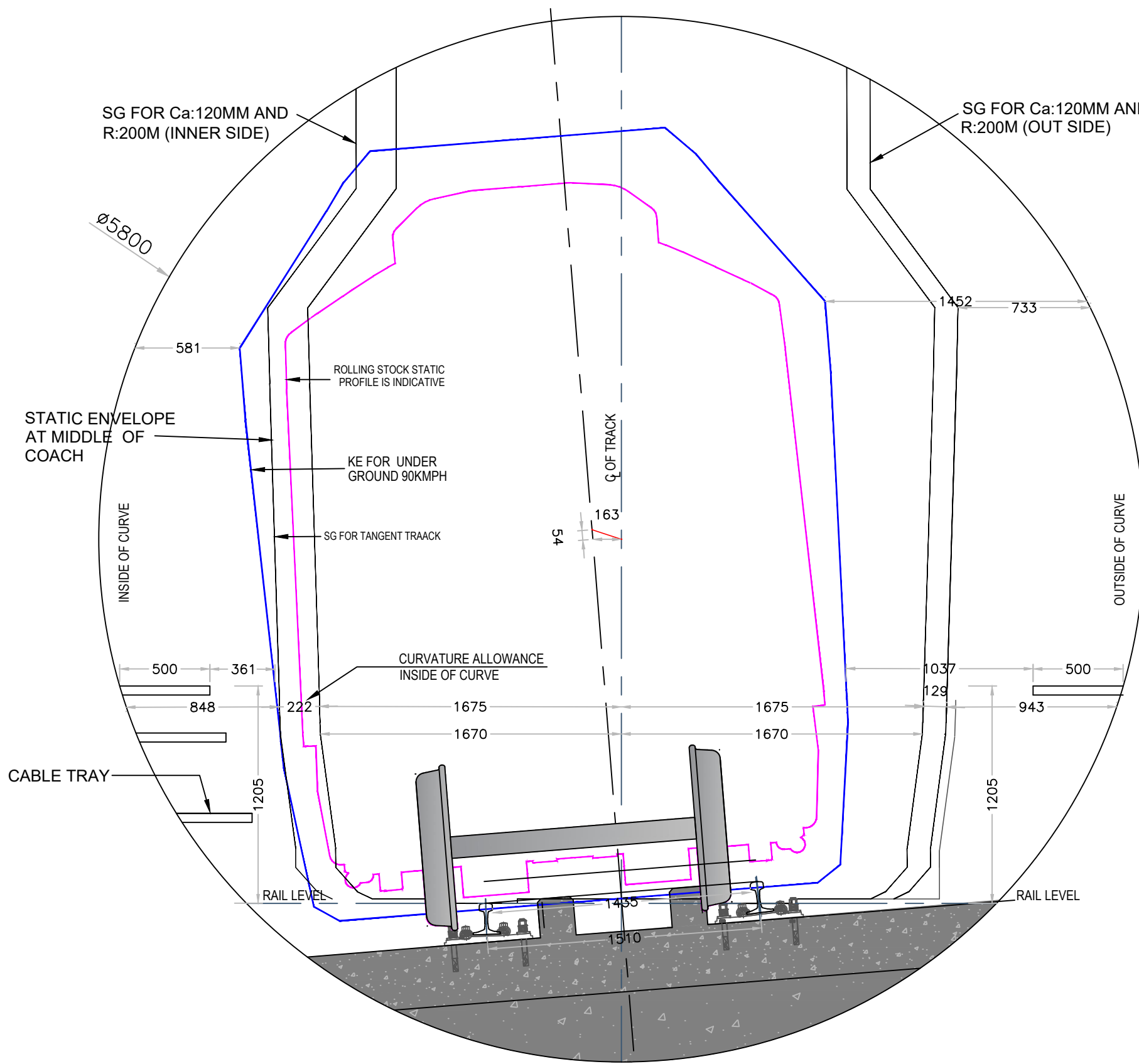
REV	DATE	DESCRIPTION	APPROVED

APPROVED:	
CHECKED:	
DRAWN:	
DATE:	

CHECK FOR DERAILMENT CONDITION FOR
TUNNEL SECTION WITH SHARPEST CURVE
AND MAX.CANT-DERAILED CONDITION (R200m,
CANT 120mm)
(OUTWARD)

DRAWING NUMBER: **CMSG-10A**

SHEET NO	SHEET SIZE
	A3
REV: 0	



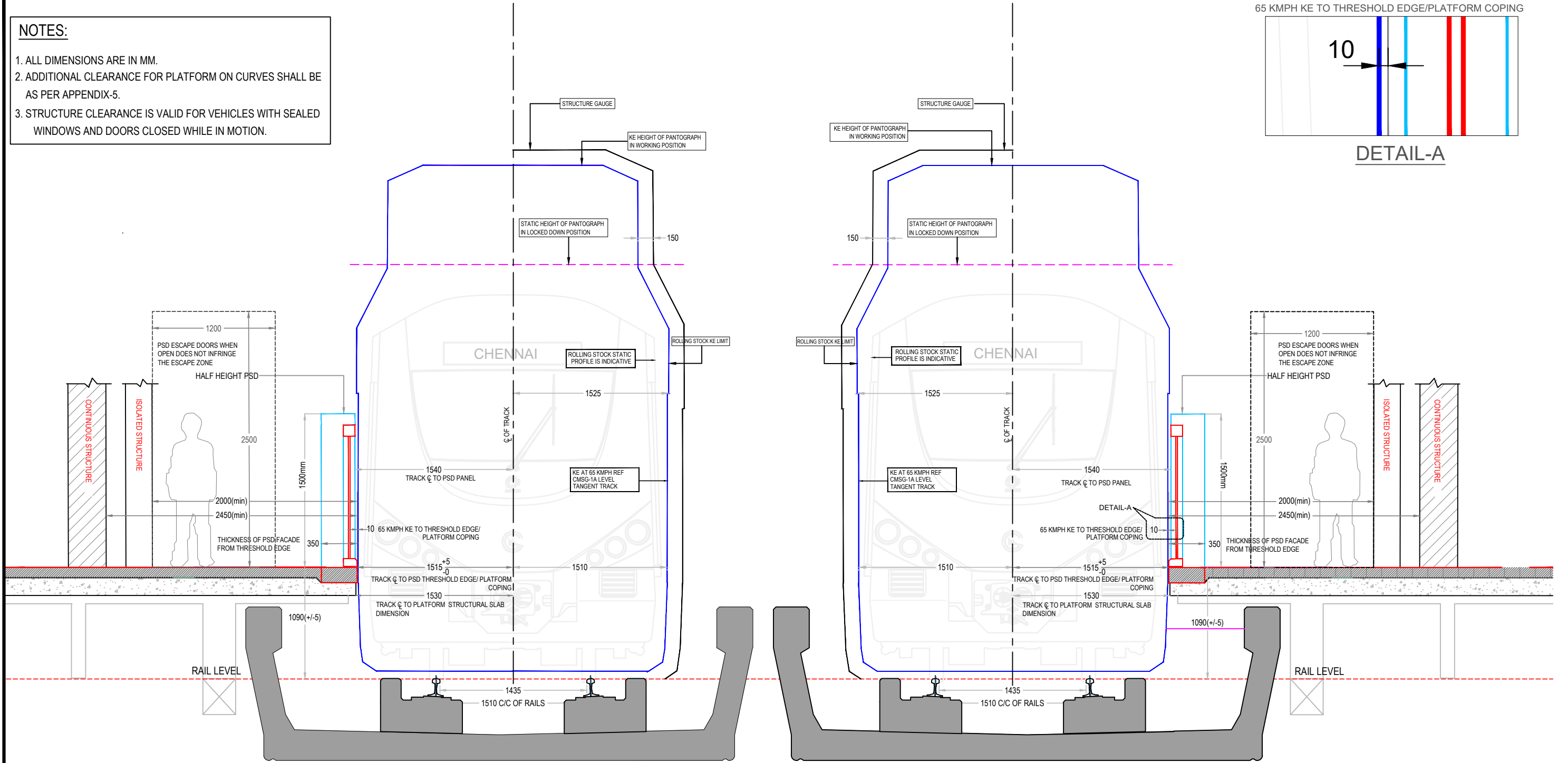
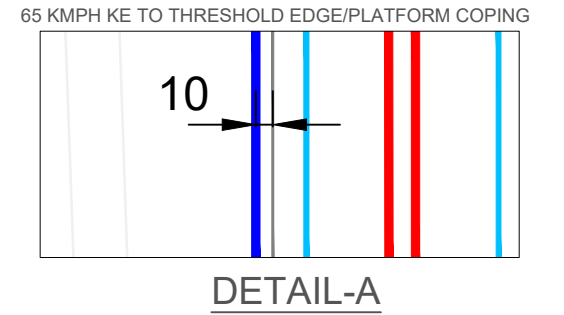
**CIRCULAR TUNNEL 5800 mm DIA
COACH POSITION IN DERAILED CONDITION INSIDE OF CURVE**

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURE GAUGE HAS BEEN MOVED AWAY FROM CENTRE LINE BY (96MM FOR 120MM CANT EFFECT +126MM FOR MID THROW) 222MM TOWARDS INSIDE OF THE CURVE
3. STRUCTURE GAUGE HAS BEEN MOVED AWAY FROM CENTRE LINE BY (129 MM FOR END THROW, SINCE CANT EFFECT WAS NEGATIVE , IT WAS IGNORED) 129 MM TOWARDS OUTSIDE OF THE CURVE.
4. DERAILMENT GAURD IS PLACED AT 250+/- 20 (WORST CONDITION IS 250+20=270MM)

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			CHECKED:	DRAWN:	DATE:			A3	
			REV	DATE	DESCRIPTION	APPROVED			REV: 0

NOTES:
 1. ALL DIMENSIONS ARE IN MM.
 2. ADDITIONAL CLEARANCE FOR PLATFORM ON CURVES SHALL BE AS PER APPENDIX-5.
 3. STRUCTURE CLEARANCE IS VALID FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.



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STANDARD GAUGE
 (1435mm)
 25KV 50Hz A.C. TRACTION

GENERAL NOTES :

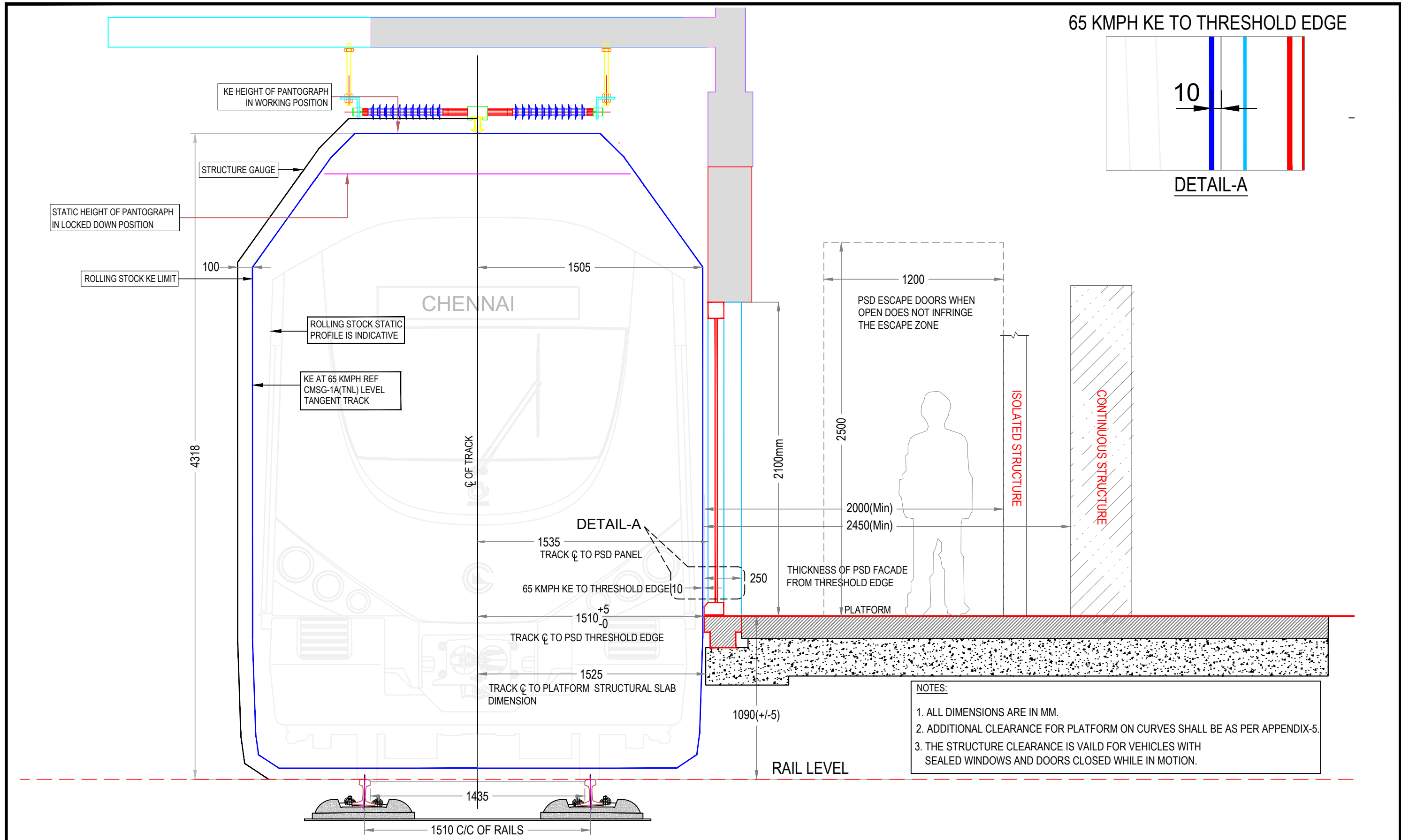
REV.	DATE	DESCRIPTION	APPROVED

APPROVED:	
CHECKED:	
DRAWN:	
DATE:	

DRAWING NAME:
STRUCTURAL CLEARANCE PLATFORM SCREEN DOOR FOR ELEVATED STATIONS

DRAWING NUMBER: **CMSG-11**

SHEET NO	SHEET SIZE
1 of 1	A3
SCALE: NOT TO SCALE	
REV:	0



NOTES:
 1. ALL DIMENSIONS ARE IN MM.
 2. ADDITIONAL CLEARANCE FOR PLATFORM ON CURVES SHALL BE AS PER APPENDIX-5.
 3. THE STRUCTURE CLEARANCE IS VAILD FOR VEHICLES WITH SEALED WINDOWS AND DOORS CLOSED WHILE IN MOTION.

CHENNAI METRO RAIL LIMITED Phase-2 Project METRO S, No:327, Anna Salai, Nandanam, Chennai-600035. Ph: 044-23792000 , Fax: 044-23792200. Email- chennai-metro-rail@gmail.com	STANDARD GAUGE (1435mm) 25KV 50Hz A.C. TRACTION	GENERAL NOTES :	APPROVED:	DRAWING NAME: STRUCTURAL CLEARANCE PLATFORM SCREEN DOOR FOR UNDERGROUND STATIONS	SHEET NO 1 of 1	SHEET SIZE A3
			CHECKED:		DRAWING NUMBER: CMSG-11(TNL)	SCALE: NOT TO SCALE
			DRAWN:	REV. 0		
			DATE:	REV. DATE	DESCRIPTION	APPROVED

ARE04A : Annexure (03) to Addendum (01)

1.17 KEY PERFORMANCE INDICATORS (KPI) – PASSENGER SAFETY & COMFORT

- 1.17.1 Performance of Rolling Stock sub-system related to Passenger Safety & Comfort shall be evaluated against a range of Key Performance Indicators (KPI).
- 1.17.2 Evaluation of the Contractor's performance against the KPIs will be carried out on a monthly basis in accordance with the provisions set out in this chapter. Penalties (if any) will also be calculated on monthly basis and the total Penalties accumulated over three months will be deducted from the Quarterly payment.
- 1.17.3 A Performance KPI Report shall be submitted by the Contractor every month starting from the commencement of the DLP period for Rolling Stock. However, payments and penalties shall only be calculated and applied during the CMC Period. In accordance with Clause 1.18.4(v) the reports shall be App generated from the start of the CMC Period.
- 1.17.4 Passenger Safety & Comfort KPI Calculation

Only the below mentioned subsystems will be considered for this KPI calculation.

Failure scenarios identified (after Train fitness) through physical inspection or OCC workstation or were recorded by the TCMS logs shall be considered. If any of the Failure scenarios listed in below table are accounted for and penalized under clause 3.3.5, then such incidents will not be considered for Penalty calculations under this clause.

Deduction shall be calculated on the respective Quarter Price Centre RS-CMC apportioned amount. The stated deduction % shall only be applied one time per month for each respective KPI.

Table 1-2 : KPI Passenger Safety & Comfort

KPI		Failure Scenarios	No of incidents allowed in the fleet per month	Deduction per month beyond allowed No. of Incidents
1	PAPIS System	a) Non-functioning / broadcasting of any passenger announcement in a car. b) Non-functioning / broadcasting of any display (DRM, FD, ID, advertisement etc) in a car. c) Non-functioning of PEI in a car. d) Non-functioning of any internal and external door indicator in a car.	4	0.20 %
2	CCTV System	a) Any non- functioning of CCTV in a car.	8	0.20 %
3	Saloon / Detrainment Door	a) Failure of train door opening automatically. b) Failure of door closing in a car. c) Isolation of any door in a car. d) Emergency Door opening and closing failure.	2	0.20 %
4	VAC System	a) Temperature and Humidity are not maintained as defined in VAC chapter in a car. b) Nonfunctioning of Emergency Vent in a car. c) Non-functioning of a VAC in a car.	4	0.20 %

ARE04A : Annexure (03) to Addendum (01)

1.18 KEY PERFORMANCE INDICATORS (KPI) – MAINTENANCE.

- 1.18.1 Performance of Maintenance services rendered by the Contractor shall be evaluated against a range of Key Performance Indicators (KPI) as mentioned in this section. It covers for Rolling Stock, Depot Machinery & Plant and the RS Maintenance Depot.
- 1.18.2 Evaluation of the Contractor's performance against the KPIs will be carried out on a monthly basis in accordance with the provisions set out in this chapter. Penalties (if any) will also be calculated on monthly basis and the total Penalties accumulated over three months will be deducted from the Quarterly payment.
- 1.18.3 A Performance KPI report shall be submitted by the Contractor every month starting from the commencement of the DLP period for Rolling Stock. However, payments and penalties shall only be calculated and applied during the CMC Period. In accordance with Clause 1.19.4(v) the reports shall be App generated from the start of the CMC Period.
- 1.18.4 Rolling Stock – Maintenance KPI :
- Preventive Maintenance (PM) of Rolling Stock shall be carried out in accordance with the applicable manuals and in alignment with the maintenance schedule. PM activities shall be planned in advance by the Contractor.
- The number of scheduled PM activities verses the actual number of activities carried out during each month shall be available in real-time via the Software Application Tool (detailed in Clause 1.19) and shall be summaries in the App generated reports and penalty calculations. The same may subject to audit.
- Note** : In the event that CMRL fails to provide Rolling Stock for planned maintenance activities, such activity shall not be deemed as incomplete for the purposes of KPI calculations.
- 1.18.5 Rolling Stock – Cleaning Schedule :
- Rolling Stock Cleaning Schedule shall be carried out in accordance with applicable manuals and in alignment with the maintenance schedule. Cleaning activities shall be planned in advance by the Contractor.
- The number of Cleaning schedule activities verses the actual number of activities carried out during each month shall be available in real-time via the Software Application Tool (detailed in Clause 1.19) and shall be summaries in the App generated reports and penalty calculations. The same may subject to audit.
- Note** : In the event that CMRL fails to provide Rolling Stock for planned maintenance activities, such activity shall not be deemed as incomplete for the purposes of KPI calculations.
- 1.18.6 Depot Machinery & Plant – Maintenance KPI :
- Preventive Maintenance (PM) of Depot Machinery & Plant shall be carried out in accordance with the applicable manuals and in alignment with the maintenance schedule. PM activities shall be planned in advance by the Contractor.
- The number of scheduled PM activities verses the actual number of activities carried out during each month shall be available in real-time via the Software Application Tool (detailed in Clause 1.19) and shall be summaries in the App generated reports and penalty calculations. The same may subject to audit.
- Note** : In the event that CMRL fails to provide DM&P for planned maintenance activities, such activity shall not be deemed as incomplete for the purposes of KPI calculations.

ARE04A : Annexure (03) to Addendum (01)

1.18.7 Table – Maintenance KPI

Deductions (as applicable) will be calculated as below,

Table 1-3 : KPI Maintenance

KPI	Attributes		Critical Attributes	Measurement Frequency	Deduction rate
KPI 1	KPI 1 – Rolling Stock Preventive Maintenance Schedule			Records will be taken directly from AMMS for each train every Month.	1.00 %
	1	Preventive activities achieved vs planned activities for Rolling Stock (according to the approved maintenance plan)	Y		
KPI 2	KPI 2 – Depot M&P Preventive Maintenance Schedule			Records will be taken directly from AMMS for each train every Month.	0.05 %
	1	Preventive activities achieved vs planned activities for Automatic Train Wash Plant	Y		
	2	Preventive activities achieved vs planned activities for Under Floor Wheel Lathe	Y		
	3	Preventive activities achieved vs planned activities for Synchronised Mobile Lifting Jacks for 3 car length & car body stands for 3 car length			
	4	Preventive activities achieved vs planned activities for Diesel Operated Rail Cum Road Rescue Vehicle With Rerailing Rescue Equipment & Auxiliary Truck	Y		
	5	Preventive activities achieved vs planned activities for Battery Operated Rail Cum Road Shunter			
	6	Preventive activities achieved vs planned activities for Bogie Wash Plant			
	7	Preventive activities achieved vs planned activities for Pit Jacks	Y		
	8	Preventive activities achieved vs planned activities for Bogie Testing Unit			
	9	Preventive activities achieved vs planned activities for Bogie Frame Manipulator / Turn table.			
	10	Preventive activities achieved vs planned activities for EOT Cranes	Y		
	11	Preventive activities achieved vs planned activities for Bogie Turn Table			
	13	Preventive activities achieved vs planned activities for Wheel Profile Measuring System (way side)			
	14	Preventive activities achieved vs planned activities for Depot Machinery & Plant (All Machine)			
KPI 3	KPI 3 – Rolling Stock Cleaning Schedule			Score will be taken directly from AMMS for each train every Month.	0.10 %
	1	Cleaning activities achieved vs planned activities (according to the requirements specified in Clause 1.6.16)	Y		
KPI 4	KPI 4 – Rolling Stock Internal Cleaning			Once in a month for 20	0.20 %
	1	Noticeable dust / dirt / stain / improper cleaning on Floor or Seat.	Y		

ARE04A : Annexure (03) to Addendum (01)

KPI	Attributes		Critical Attributes	Measurement Frequency	Deduction rate
	2	Noticeable dust / dirt / stain / improper cleaning on Glass surface like Window, Draught, Door.	Y	Rakes randomly.	
	3	Noticeable dust / dirt / stain / improper cleaning on Interior Panel, Gangway panel, Emergency operator desk.			
	4	Noticeable dust / dirt / stain / improper cleaning on VAC grill, Saloon Light.			
KPI 5	KPI 5 – Rolling Stock External Cleaning			Once in a month for 20 Rakes randomly.	0.10 %
	1	Noticeable dust / dirt / stain / improper cleaning on cab masks.	Y		
	2	Noticeable dust / dirt / stain / improper cleaning on Rake Side walls.	Y		
	3	Noticeable dust / dirt / stain / improper cleaning on Rake Underframe.			
	4	Noticeable dust / dirt / stain / improper cleaning on Rake Roof.			
KPI 6	KPI 6 – Depot M&P Cleaning			Five (5) inspections in a month	0.05 %
	1	Planned Cleaning activity of Depot M&P as approved by CMRL is not fulfilled.	Y		
	2	UFWL : Not removing Metal chips after work completion.	Y		
	3	Water stagnation, improper cleaning of ATWP / BWP zone.			
KPI 7	KPI 7 – RS Maintenance Depot (Premises Areas Allocated to the Contractor)			Five (5) inspections in a month	0.10 %
	1	Noticeable dust / dirt / stain / improper cleaning of floor in IBL or SBL or RBL.	Y		
	2	Non removal of garbage / debris / cotton waste in RS Maintenance Depot.	Y		
	3	Evidence of Cobweb / Termite nest / Pigeon dropping / animal dropping in RS Maintenance Depot.			
	4	Any area has a prolonged / lingering bad smell (which is not perceived to be temporary).			
KPI 8	KPI 8 – Safety and Work ethics			Any time during the assessment period.	0.50 %
	1	Safety incident occurred in Employer's premises for the reasons attributable to the Contractor	Y		
	2	Contractor's Staff not following Safety Practice			
	3	Evidence of creating unsafe conditions.			

1.18.8 Conditions For Calculating Penalties based on CMRL Inspection KPI Score.

- i) The applicable deductions for each month shall be calculated based on CMRL KPI Inspection score obtained from minimum 5 times / month conducted randomly.
- ii) The Plan for all scheduled activities for Train Cleanliness, Depot Machinery & Plant cleanliness and Depot Premises Cleanliness shall be submitted CMRL before start of

ARE04A : Annexure (03) to Addendum (01)

CMC works and approved by CMRL. During execution of the works, in case of any changes to the schedules prior approval from CMRL is mandatory.

- iii) Conditions for calculating monthly deductions on such Inspection KPI score is as follows:
- a) Each KPI is categorised into one or more attributes as listed in above table.
 - b) Each attribute under a KPI category shall be Inspected.
 - c) Scores for all attributes from will be taken directly from Application, for the purposes of calculation.
 - d) A minimum of five (5) Inspections would be conducted by CMRL in each month.
 - e) Pass percentage for each KPI category for each inspection shall be calculated separately as below:-

$$\text{Pass \% of each KPI} = \frac{\text{Total number of attributes passed under a KPI category}}{\text{Total number of attributes under the KPI category}} \times 100$$

- f) The average pass percentage for that month for each KPI category shall be calculated as per the formula below:-

$$\text{Average Pass \% for KPI Category} = \frac{\text{Sum of the lowest five pass percentages calculated at (d) above}}{5}$$

- iv) If average pass percentage calculated at (f) is $\geq 90\%$ in a monthly cycle, no deduction shall be made for that KPI.
- v) If average pass percentage calculated at (f) is $< 90\%$ in a monthly cycle, a commensurate deduction shall be made for that KPI from the amounts payable to the Contractor, as per the following formula:-

$$\text{Deduction amount for each KPI category} = \frac{(100\% - \text{average pass \% of that KPI}) \times \text{Deduction Rate in \% of that KPI}}{\text{Quarterly payment value as per contract}^*}$$

* for KPI 1 to KPI 8, "Quarterly payment value as per contract" shall be the Price Centre RS-CMC apportioned amount for the respective quarter.

- vi) If any critical attribute under a KPI category fails in an Inspection, the pass percentage of that specific KPI category shall be zero for that Inspection in that month.
- vii) Nature of CMRL Inspection shall be by way of Periodic and/or High-Level surprise Inspection, for which the Contractor shall ensure absolute coordination and facilitation.

1.19 SOFTWARE APPLICATION TOOL FOR CMC PAYMENTS, KPI & PENALTY REGIME

- 1.19.1 Prior to commencement of the CMC Period, the Contractor shall develop a fully functional, App based Software Application Tool that will be integrated with the AMMS System and will be used to provide governance for the performance of the CMC Works.
- 1.19.2 The App shall be developed by the Contractor in accordance with the requirements in this Chapter and shall be subject to prior approval by CMRL. Development and any reoccurring costs for the application are deemed to be included in the Quoted Price.
- 1.19.3 The App shall be used by both the Contractor and CMRL. User privileges shall be securely demarcated and the role of the user categories shall be broadly as follows:
- i) Contractor's App Users: shall enter data related to planning and execution of the KPI dependant Works.
 - ii) CMRL's App Users: shall enter details of the inspection / audits.
- 1.19.4 The App shall facilitate the following, but shall not be limited to:-
- i) Recording of entered data (as well as data fetched from AMMS) in relation to the KPI and Penalty regime.
 - ii) Tracking of scheduled KPI dependant Works vs. Actual Works achieved.
 - iii) Recording of data entered by CMRL during inspection done as part of the audit regime

ARE04A : Annexure (03) to Addendum (01)

(including image / video capture).

- iv) Calculation of billing for all CMC Price Centers (including deduction of any penalties).
 - v) Report generation.
- 1.19.5 The Contractor shall not be entitled to submit penalty calculations performed outside of application environment; thus the full rate of penalties shall apply if the Contractor fails to develop the App to produce the requisite calculations once the CMC Period commences.
- 1.19.6 CMRL performance and acceptance parameters shall be incorporated in the App in a checklist format to facilitate CMRL's audits and performance evaluation.
- 1.19.7 All data available in this system is confidential and shall be the property of CMRL. The Contractor shall ensure that the data is also stored in the AMMS system.
- 1.19.8 The Contractor shall ensure that there is a facility to apply changes to the App (if required) to evaluation check sheets and other documents as per the discretion of CMRL, without any additional cost.

1.20 CMC PAYMENTS

- 1.20.1 Whenever, the Contractor successfully completes the works without any Deductions / Penalties based on KPI for three (3) consecutive months' an incentive payment of INR 1,00,000 (One Lakh Rupees) shall be awarded.
- Note:** Accrued incentive months will always reset to zero at the end of any period following which the Contractor claims the incentive payment. Hence, the maximum incentive payable within a 12 month period shall be INR 4,00,000 (Four Lakh Rupees).
- 1.20.2 Whenever, the Contractor gets any Deductions / Penalties of >8% of Quarterly CMC payments for TWO (2) consecutive quarters, then CMRL reserves the right to Terminate the Works in accordance with GCC.
- 1.20.3 Payments will be made on a quarterly basis subject to the submission of valid invoice / IPA by the Contractor and approval of CMRL.
- 1.20.4 The quarterly payment amounts shall be calculated based on the Price Centre 'RS-CMC' apportionments duly applying the penalties / incentives (available in Part 2-Section 6C) as applicable during the quarter.
- 1.20.5 Price adjustment as per clause 2 (Table D) & clause 3.2.7 of Part-1, Section IV-Bidding Forms, shall be calculated on the amount arrived at 1.20.4 above (i.e. after application of penalties / incentives as applicable).
- 1.20.6 Taxes shall be calculated on 1.20.4 & 1.20.5 and paid to the authorities by the Contractor.
- 1.20.7 IPA / Invoice shall be raised only for the amount payable considering the above.
- 1.20.8 Taxes will be reimbursed by CMRL to the Contractor subject to the conditions of Contract.

1.21 DELIVERABLES

- 1.21.1 Submission of Compliance matrix for entire works (NTP + 63 days)
- 1.21.2 Submission of Design Submission Programme with all activities for all works (NTP + 70 days)
- 1.21.3 Submission of Master Schedule Programme with all activities for entire works (120 days before Completion of DLP).
- 1.21.4 Submission of a Price List covering all categories of Spares for all categories of CMC Assets shall be submitted during Design Phase. The Key Dates for Final Design Documents (Part-3, Section - VIII Particular Conditions (Part A: Contract Data) shall be considered as final deadline for submission.

ARE04A : Annexure (04) to Addendum (01)

3.3.6 DM&P Availability Target

3.3.6.1 Penalties for not achieving availability target:

For cases where the Availability of a machine falls short of the Minimum Guaranteed Availability target, the following Penalties shall be levied as calculated over each quarterly payment period.

Table 3-6: DM&P Availability Penalty calculation

Sl. No	Availability Slab	Applicable Penalty % for each Category
1	> 95%	No Penalty shall be imposed during the respective Quarter when this target is met.
2	< 95% to \geq 85%	0.05% Penalty on the respective quarter Price Centre RS-CMC apportioned amount
3	< 85% to \geq 75%	0.07% Penalty on the respective quarter Price Centre RS-CMC apportioned amount
4	< 75%	0.10% Penalty on the respective quarter Price Centre RS-CMC apportioned amount

Minimum Guaranteed Availability target calculation

A. Total days in the Quarter:

B. Standard down days for preventive maintenance (in days/quarter):

C. Total Plant Down Time due to Breakdown including response time for break down (in days):

D. Guaranteed Availability for the quarter (in days): $(A - (B+C))$

Actual availability in %age = $(D / A) \times 100$:

Note : Availability of the DM&Ps shall be calculated against each quantity of each machine.

3.3.6.2 Vital Category

For this category DM&P list (ATWP, EOT CRANE, UFWL, BORRS, SPJ, RRV) the Penalty shall be calculated on 60% of RS-CMC Price Centre from Quarterly amount.

3.3.6.3 Essential Category

For this category DM&P list (SMLJ, CBS, BWP, BTU) the Penalty shall be calculated on 40% of RS-CMC Price Centre from Quarterly amount.

3.3.6.4 Desirable Category

For this category DM&P list (Bogie Manipulator, BTT, WPMS Wayside) the Penalty shall be calculated on 20% of RS-CMC Price Centre from Quarterly amount.

3.3.6.5 Type 1 Category

For any additional DM&P list (supplied by the Contractor) the Penalty shall be calculated on 10% of RS-CMC Price Centre from Quarterly amount.