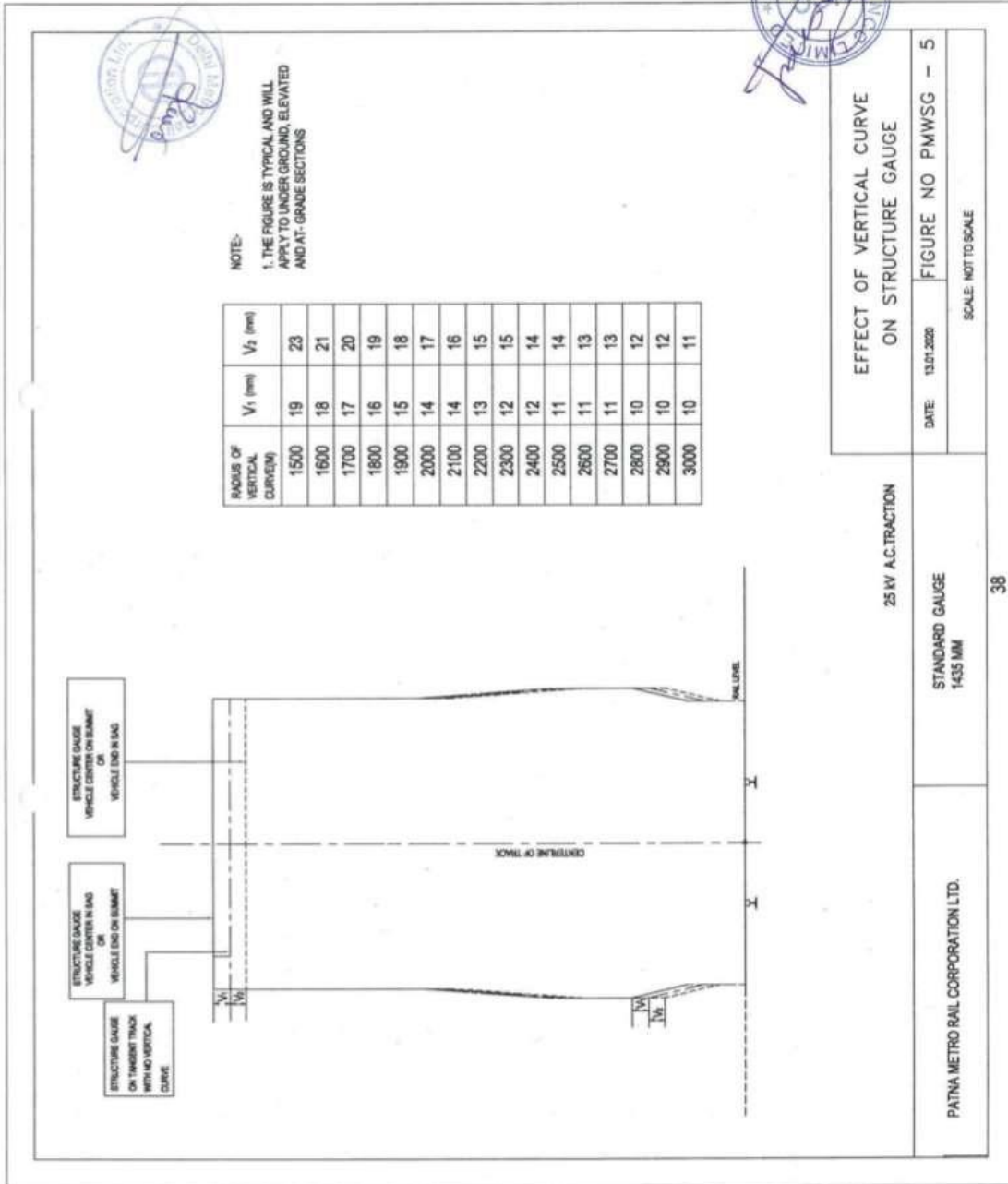


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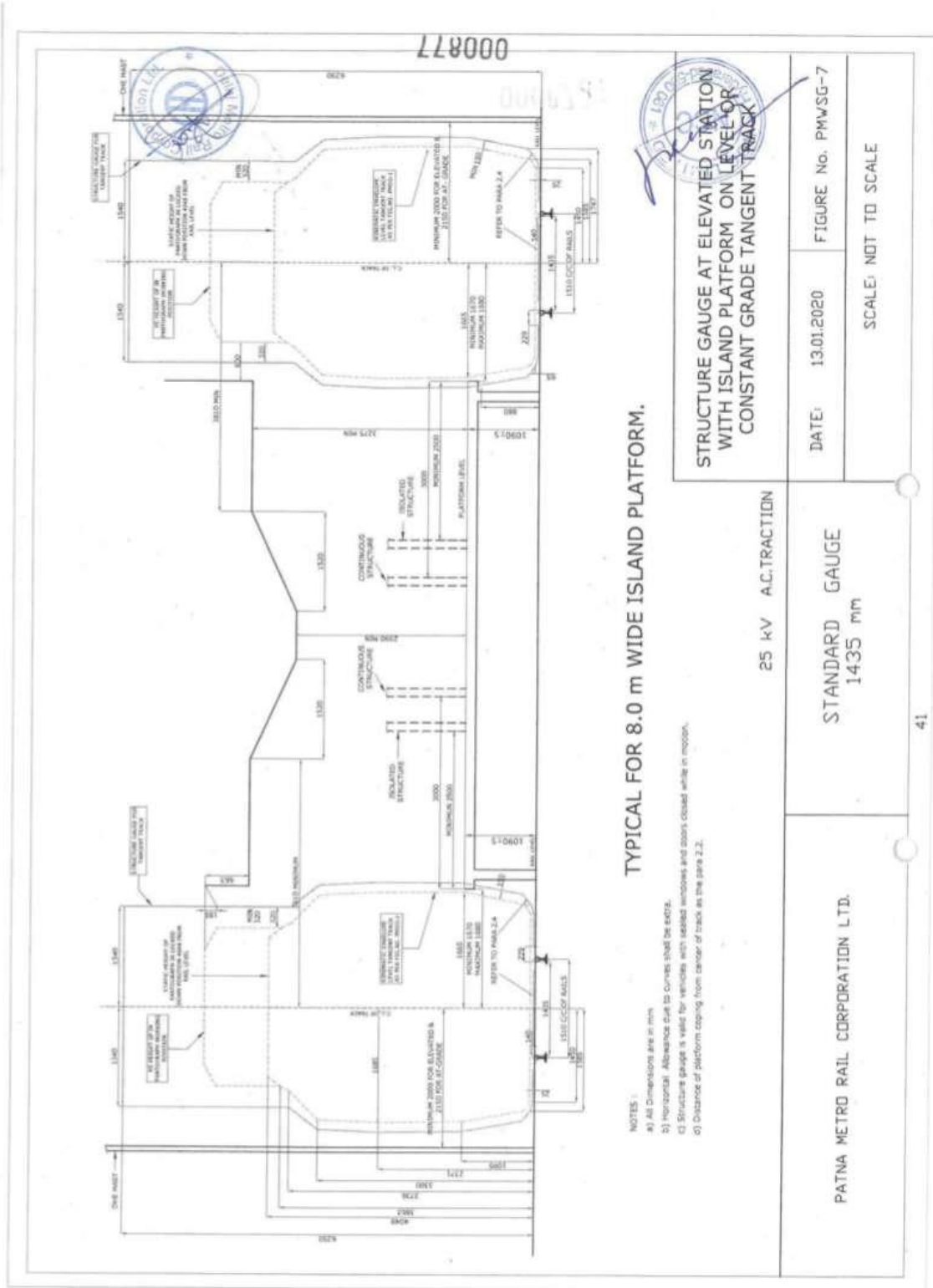
EFFECT OF VERTICAL CURVE
ON STRUCTURE GAUGE

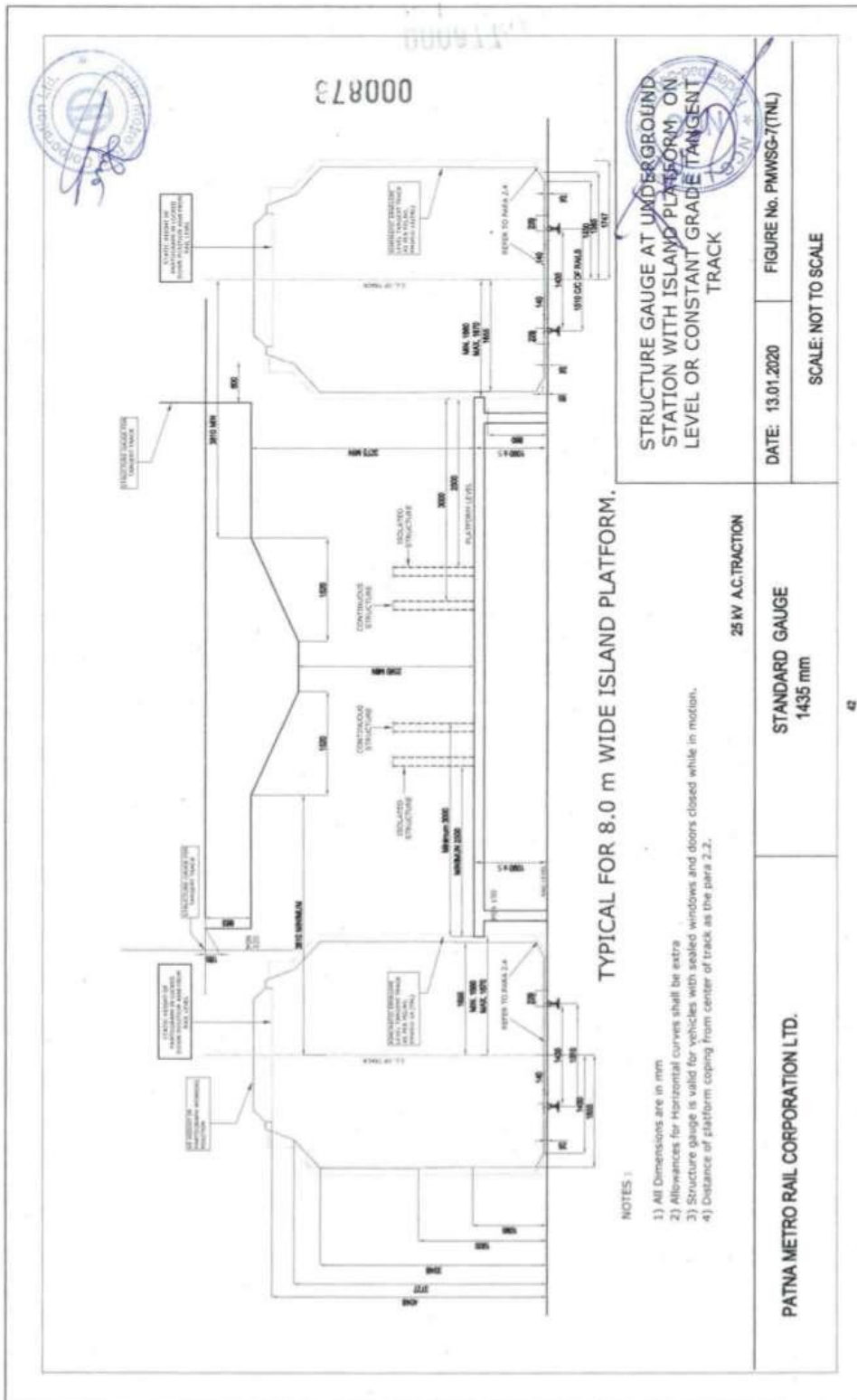
DATE: 13.01.2020 FIGURE NO PMWSG - 5
SCALE: NOT TO SCALE

25 KV A.C. TRACTION

STANDARD GAUGE
1435 MM

PATNA METRO RAIL CORPORATION LTD.





TYPICAL FOR 8.0 m WIDE ISLAND PLATFORM.

NOTES :

- 1) All Dimensions are in mm
- 2) Allowances for Horizontal curves shall be extra
- 3) Structure gauge is valid for vehicles with sealed windows and doors closed while in motion.
- 4) Clearance of platform coping from center of track as per para 2.2.

STRUCTURE GAUGE AT UNDERGROUND STATION WITH ISLAND PLATFORM ON LEVEL OR CONSTANT GRADE TANGENT TRACK

DATE: 13.01.2020 FIGURE No. PMMSG-7(TNL)	25 KV AC TRACTION STANDARD GAUGE 1435 mm	PATNA METRO RAIL CORPORATION LTD.
SCALE: NOT TO SCALE		

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PREAMBLE

The schedule of Dimensions for Standard Gauge Corridor has been prepared based on following factors:

1. The kinematic envelope and other infringements have been calculated for the 3200mm wide and 4048 mm high rolling stock, based on the kinematic envelope calculations. The track and vehicle maintenance shall conform to the clearances indicated therein during the period these stocks are in operation.
2. The clearances are based on assumption that windows are sealed and doors are closed during movement
3. Track shall be maintained to the tolerances taken for calculation of Kinematic Envelope.
4. The Structure Gauge indicated in SOD shall not be violated under any circumstances except for designated railway operational structures. Designated railway operational structures include platform coping, hand railing in back-of-house platform edge, Track Access Gates.
5. The Kinematic Envelope(s) indicated in SOD shall not be violated under any circumstance.
6. The vehicle Kinematic Envelope for the platform area shall be applied only within confines of stations up to 80 Kmph vehicle speed for underground and 70 Kmph for elevated/At grade sections. At all other location, the Kinematic envelope corresponding to 80 kmph vehicle speed shall be used for determining the Structure Gauge and electrical clearances.
7. The Design speed of the Metro Rail System shall be 90 KMPH.
8. The maximum operating speed shall be 80 kmph in the section, 80 Kmph in underground stations, 70 kmph in elevated/At Grade stations and 25 kmph in Depot.
9. The evacuation of passengers in between stations shall be done from front & rear emergency doors of the train, hence no separate walkway is provided. However, space available between the track paths shall be used as walkway. The evacuation system shall be legislated by Patna Metro Rail Administration and evacuation shall be effected under the supervision of concerned Metro Rail Administration. It shall be ensured that no train operation on the adjacent track will be allowed during evacuation.
10. The SOD is applicable for Ballastless track on main line and ballasted/ballastless track in Depots.
11. No vertical curve shall be provided on the platform portion.



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PATNA METRO
SCHEDULE OF DIMENSIONS
STANDARD GAUGE (1435 mm GAUGE)
(FOR 3200 mm wide stock)

INTRODUCTION

The dimensions given in this Schedule of Dimensions are to be observed in all works on 1435 mm gauge (STANDARD GAUGE) and 3200 mm wide Rolling Stock, unless prior sanction has been obtained from the Railway Board through the Commissioner of Metro Railway Safety to execute works which infringe this Schedule of Dimensions

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

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

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

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



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CHAPTER-I
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 Sections3800 mm
- (b) Elevated Sections3900 mm
- (c) At-Grade Sections3900 mm

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

1.2 CURVES

1.2.1 Minimum radius of curves (horizontal)

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

1.2.2 Check Rail/Restraining Rail

Check rail/Restraining Rail shall be provided on curves on main line where radius is 190m 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. The clearance between check/restraining rail and running rail shall be suitably decided by metro.

1.2.3 Minimum radius of vertical curve 1500m

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.

1.3.2 Maximum permissible gradient on turnouts

- i) On Ballasted Track 0.25%
- ii) On Ballastless Track 3.00%



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Note:

- (i) There shall be no change of gradient (i.e. vertical curve) on and within 15.0 m (desirable)/3.0 m (minimum) of any turnout on Ballastless track. In case of Ballasted track, there shall be no change of gradient on and within 30 meters of any turnout.
- (ii) There shall be no horizontal curve within 15.0m (desirable)/ 3.0 m (minimum) of any turnout on Ballastless Track and 30 meters of 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 190m. The negotiability of rolling stocks 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 confirmed from rolling stock supplier for the negotiability of rolling stock.
- (vi) The above stipulations shall also be applicable for turnout to be laid outside station limit, if any.

1.4 BUILDINGS AND STRUCTURES

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

(a) Under Ground Sections

(i) Circular tunnels Height from rail level	Horizontal distance from C.L. of track
(i) Upto 65 mm	1585 mm
(ii) 65 mm to 200 mm	1585 mm increasing to 1720 mm
(iii) 200 mm to 305 mm	1720 mm
(iv) 305 mm to 880 mm	1720 mm increasing to 1849 mm
(v) 880 mm to 1095 mm	1849 mm
(vi) 1095 mm to 1130 mm	1849 increasing to 1875 mm
(vii) 1130 mm to 2030 mm	1875 mm
(viii) 2030 mm to 3346 mm	1875 mm decreasing to 1815 mm
(ix) 3346 mm to 3738 mm	1815 mm decreasing to 1390 mm
(x) 3738 mm to 4601 mm	1390 mm
(xi) 4601 mm to 4970 mm	1390 mm decreasing to zero along an arc of radius 2800 mm

Also refer to Figure No. PMWSG-2 (TNL)



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(ii) Rectangular Box Tunnels	
<u>Height from rail level</u>	<u>Horizontal distance from C.L. of track</u>
(i) Upto 65 mm	1585 mm
(ii) 65 mm to 200 mm	1585 mm increasing to 1720 mm
(iii) 200 mm to 305 mm	1720 mm
(iv) 305 mm to 880 mm	1720 mm increasing to 1849 mm
(v) 880 mm to 1095 mm	1849 mm
(vi) 1095 mm to 1130 mm	1849 increasing to 1875 mm
(vii) 1130 mm to 2030 mm	1875 mm
(viii) 2030 mm to 3346 mm	1875 mm decreasing to 1815 mm
(ix) 3346 mm to 3738 mm	1815 mm decreasing to 1390 mm
(x) 3738 mm to 4838 mm	1390 mm

Also refer to Figure No. PMWSG – 2(TNL)

(b) Elevated and At-Grade Sections	
<u>Height from rail level</u>	<u>Horizontal distance from C.L. of track</u>
(i) Upto 65 mm	1585 mm
(ii) 65 mm to 200 mm	1585 mm increasing to 1745 mm
(iii) 200 mm to 305 mm	1745 mm increasing to 1771 mm
(iv) 305 mm to 880 mm	1771 mm increasing to 1903 mm
(v) 880 mm to 1095 mm	1903 mm
(vi) 1095 mm to 1130 mm	1903 mm increasing to 1938 mm
(vii) 1130 mm to 2030 mm	1938 mm
(viii) 2030 mm to 3300 mm	1938 mm decreasing to 1875 mm
(ix) 3300 mm to 3736 mm	1875 mm decreasing to 1540 mm
(x) 3736 mm to 6250 mm	1540 mm

Also refer to Figure No. PMWSG -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, cables, OHE Masts etc. erected alongside the track.
- iii) For passenger platform refer to para 2.2.1 to 2.2.3 of chapter 2.
- iv) Minimum Lateral clearance of OHE Mast shall be 2000 mm in Elevated sections and 2150 mm on At - Grade sections for Tangent Track from centre line of track.

1.5 KINEMATIC ENVELOPE

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

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

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 Kinematic Envelope and minimum electrical



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clearance of 270 mm from 25 KV live parts conforming to the stipulations in chapter- 4 of this SOD.

Refer to Figure No. PMWSG-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 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 Figure No. PMWSG-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 Kinematic Envelope and minimum electrical clearance of 320 mm from 25 KV live parts, conforming to stipulations in chapter 4 of this SOD.

Refer to Figure No. PMWSG-2, for Structure Gauge for outside stations on level or constant grade tangent track.

Note:

Extra clearance shall be provided for curves as laid down at para 1.7

1.7 EXTRA CLEARANCES ON CURVES

Following are the extra allowances considered for curves.

Abbreviations used in para 1.7:

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

1.7.1 INSIDE OF CURVE

(A) Curvature effect

(i) Mid throw at the center of the vehicle = V (in mm) = $125 \times C^2 / R$

(ii) Allowance due to gauge widening on curves

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



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Note:

Lateral shift of 32.0 mm due to nosing is included in Kinematic Envelope for tangent track (and as a result, included in Structure Gauge also) shall be subtracted from the total extra allowance worked out as at para 1.7.1(A)- i and ii above for inside of a curve in case the value of mid throw (V) is equal to or greater than 32.0 mm. In case the value of mid throw (V) is less than 32.0 mm, the curvature effect shall be due to widening of the gauge only. (The Mid throw minus 32.0 mm 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 Figure No. PMWSG-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 shall also be rotated with the tunnel so as to be along the centre line of canted track.

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

(C) Allowance for vertical curve (vertical throw)

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

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

$$V_2 \text{ (with vehicle centre on summit or vehicle end in sag)}$$

$$= (125xC_1^2/R) - (125xC^2/R)$$

Values of vertical throw due to vertical curves of different radii are given in Figure - PMWSG-5.



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1.7.2 OUTSIDE OF CURVE**(A) Curvature effect**

- i) End throw at the end of vehicle = V_o (in mm)
 $= [125xC_1^2/R] - [125xC^2/R]$
- ii) Allowance due to gauge widening on curves
- iii) Additional nosing due to gauge widening on curves

The values of items (i) to (iii) are shown in Appendix-2

(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 50 mm and shall be limited to a value = $(Ca - 50) \times h/g$.

Values of Structure Gauge (F_1) on outside of curve with cant effect only (as shown in Figure No. PMWSG-4), refer to:

- i) Appendix 3(TNL) for Under Ground Sections
 ii) Appendix 3 for Elevated and At-Grade Sections

(b) Circular Tunnels

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

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

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

(C) Allowance for vertical curve (vertical throw)

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



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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 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:

- i) $(E + F)$,
- ii) T_1 (Extra lateral allowance due to curvature on inside of curve)
- iii) T_2 (Extra lateral allowance due to curvature on outside of curve)
- iv) Minimum clearance between adjacent Kinematic Envelopes stipulated is as under:
 - a) 200 mm for Under-Ground Sections
 - b) 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 (Figure No. PMWSG-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 (Figure No. PMWSG-4A).

Notes:

- i) The value of 'F', calculated from the formula at Figure No. PMWSG-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, T_1 and T_2 , refer to the Appendices as shown below:

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

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:

- i) $(E_1 + T_1)$ Minimum clearance to the structure from centre line of track on inside of curve (for outer track)
- ii) $(F_1 + T_2)$ Minimum clearance to the structure from centre line of track on outside of curve (for inner track)
- iii) Width of structure between adjacent tracks (measured across the tracks)



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Where,

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

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

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

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

Notes:

- a) The values of ' E_1 ' and ' F_1 ' for a given cant Ca, shall each be the maximum of values at different heights of structure from rail level. In case the cant provided is greater than 50 mm on inner track, the value of F_1 shall be for the cant of (Ca-50) mm. In case the cant provided is 50 mm or less on inner track, the value of F_1 shall be for ZERO cant.
- b) Minimum track spacing, so worked out with a structure between the adjacent tracks as per para 1.8.2 shall not be less than that calculated as per para 1.8.1 for tracks without any structure between adjacent tracks.

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

<u>SECTIONS</u>	<u>For E_1 & F_1</u>	<u>For T_1 & T_2</u>
a) Under Ground	3(TNL)	2
c). Elevated and At-Grade	3	2

1.9 CANT AND CANT DEFICIENCY

- a) Maximum Cant on curves = 110 mm
- b) Maximum Cant Deficiency = 85 mm

1.10 DERAILMENT GUARD

(a) Derailment Guard shall be provided inside/outside of running rail on viaduct as well as in tunnel having multiple tracks and at grade section at locations specified by Metro Railway. In tunnel, the derailment guard should preferably be provided inside the track so that it permits less sway of coach towards tunnel wall in case of derailment.

(b) Lateral Clearance between the running rail and the derailment Guard shall be 210 ± 30 mm. It shall not be lower than 25mm below the top of running rail and should be clear of the rail fastenings to permit installation, replacement and maintenance.



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Note: -

In case of single track tunnels, the derailment guards shall be provided:

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

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

Additional 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 K.E. for adjacent track is not infringed so long as the wheels of any derailed vehicle are within the main rail and derailment guard.



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CHAPTER - 2

STATION

2.1 SPACING OF TRACKS AT STATIONS

Minimum spacing of tracks at station on straight and on curve of radius of 1000m and flatter, without any structure between tracks

At-Grade, Elevated and Under-Ground Stations..... 4100 mm

2.2 PLATFORMS

2.2.1 Maximum horizontal distance from centre of track to face of passenger platform coping

(i) For Elevated/At Grade section 1680 mm

(ii) For Underground section 1670 mm

2.2.2 Minimum horizontal distance from centre of track to face of passenger platform coping

(i) For Elevated/At Grade section 1670 mm

(ii) For Underground section 1660 mm

Notes:

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

- 1795 ± 5 for Under Ground Stations
- 1785 ± 5 for At-Grade and Elevated Stations

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

2.2.3 Height above rail level for passenger platform:

	Maximum	Minimum
(a) Ballasted Track.....	1085 mm	1075 mm
(b) Ballastless Track.....	1095 mm	1085 mm

2.2.4 (i) Minimum horizontal distance of any isolated structure on a passenger platform from the edge of coping except Platform Gates

2500 mm

ii) Minimum horizontal distance of any continuous structure on a passenger platform from the edge of coping except Platform Gates

3000 mm



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(b) For Surface and Elevated Stations

- From C.L. of track to 1450 mm 25 mm
- From 1450 mm to 1585 mm 25 mm increasing to 65 mm
- From 1585 mm to 1745 mm 65 mm increasing 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 & CROSSING

- 2.5.1 Maximum clearance of check rail opposite nose of crossing 42 mm
- 2.5.2 Minimum clearance of check rail opposite nose of crossings 36 mm
(Note : Check Rail Clearance has been calculated for the track Gauge 1435 mm +2 / -2 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
Note: Point Machine shall be provided considering the requirement mentioned in para 2.5.6
- 2.5.7 Minimum radius of curvature for slip points, turnouts and crossover roads. 190 metres
- 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 300 m radius
 - b) 1 in 7 type turnout 190 m radius
 - c) Scissors cross-over of 1 in 9 type consisting of 4 turnouts and 1 diamond crossing
 - d) Scissors cross-over of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing
- 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 190 m radius
 - b) Scissors cross-over of 1 in 7 type consisting of 4 turnouts and 1 diamond crossing
 - c) 1 in 7 derailing switches/ 1 in 7 type symmetrical split turnout



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2.5.10 Diamond crossings not to be flatter than 1 in 4.5.

Note:

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

2.5.11 Minimum length of tongue rail: 9000 mm

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 superelevation, calculated for the speed of the fastest train may be reduced by a maximum amount of 85 mm without reducing speed on the main line.

2.6.2 Turnouts:

i) Curves of contrary flexure

The equilibrium superelevation (**s**) in mm should be $= (1510/127)(V^2 / R)$

Where, R = radius of turnout in metres and V is speed on turnout in Km/h.

The permissible negative superelevation on the turnout (which is also the actual superelevation of the main line) may then be = $(85 - s)$ mm

ii) Curves of Similar flexure

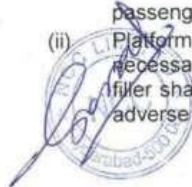
The question of reduction or otherwise of superelevation on the main line must necessarily be determined by the administration concerned. In the case of a reverse curve close behind the crossing of a turnout, the superelevation may be run out at the maximum of 1 mm in 440 mm.

2.7 ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES

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

Note:

- (i) As the minimum radius of horizontal curve for station platform line is 1000 metres, there will be no superelevation and gauge widening at stations on passenger platform lines.
- (ii) Platforms located in curves shall be fitted with a gap filler wherever necessary to maintain the maximum stepping distance of 75 mm. The gap filler shall be of elastic nature and flexible to allow train contact without any adverse effect on passenger safety and stability of trains.



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CHAPTER 3
ROLLING STOCK

3.1 PASSENGER ELECTRIC MULTIPLE UNITS.

1.	(a) Length of the coach body	22010 mm
	(b) The maximum width of the coach body	3200 mm
	(c) Height of the coach body (maximum with pantograph in locked down condition)	4048 mm
2.	(a) Distance between bogie centers	14750±350 mm
	(b) Maximum distance apart between any two adjacent axles	12900 mm

Note:

Fittings on the end of a vehicle, such as step iron, brake/ drainage pipes, electrical connection, cable or boxes, vestibule or gangway, fairings etc. need not be kept within the prescribed maximum permissible length of the car body, but may project beyond the end of body to a reasonable extent.

3. Kinematic Envelope for level tangent track
- | | |
|---|-------------------------|
| (i) For Underground Sections | Figure No. PMWSG-1(TNL) |
| (ii) For Underground section at platform | Figure No PMWSG-1A(TNL) |
| (ii) For At-Grade and Elevated Sections | Figure No. PMWSG-1 |
| (iv) For At-Grade and Elevated Sections at platform | Figure No. PMWSG-1A |
| (v) Same pantograph shall be used for underground and elevated corridors. | |
- 4 (a) Minimum clearances from rail level under Fully loaded condition for bogie mounted equipment in worst condition* (* The worst condition means wheels with maximum tread wear and primary springs with maximum deflection) in static condition.
- 65 mm
- (b) Minimum clearances from rail level under Fully loaded condition for body mounted equipment in worst condition* (* The worst condition means deflated secondary air springs, wheels with maximum tread wear and primary springs with maximum deflection) in static condition.
- 102 mm



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- (c) Minimum clearance from rail level, under dynamic conditions 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 mm

Note:-

A tyre or an attachment to a wheel or sand pipes or Wheel/ Track Lubrication Nozzle and ODD rail guard 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 the wheel.

5.	Incline of Tread / Wheel Profile	RDSO SK 91146
6.	Wheel	
	a) Maximum wheel gauge back to back distance	1360 mm
	b) Minimum wheel gauge back to back distance	1358 mm
7.	a) Maximum diameter on the tread measured at 63.5mm from the wheel gauge face	860 mm
	b) Minimum diameter on the tread measured at 63.5 mm from the wheel gauge face	780 mm
8.	a) Minimum projection for flange of new wheel measured from tread at 63.5 mm from the wheel gauge face for profile as per SK-91146	28.5 (+1/-0) mm
	b) Maximum projection for flange of worn wheel measured from tread at 63.5 mm from the wheel gauge face	34 mm
9.	a) Maximum thickness of flange of wheel measured from wheel gauge face at 13 mm from outer edge of flange.	29.4 mm
	b) Minimum thickness of flange of wheel measured from wheel gauge face at 13 mm from outer edge of flange.	25 mm
10.	Minimum width of wheel	127 mm
11.	Floor Height	
	a) Maximum height above rail level for floor of any unloaded vehicle	1130 mm
	b) Minimum height above rail level for floor of fully loaded normal vehicle	1100 mm
12.	a) Maximum height of centre coupler above rail level for unloaded vehicle	815 mm



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b)	Minimum height of centre coupler above rail level for fully loaded vehicle	740 mm
13.	Maximum length over couplers	23000 mm
14.	Length of rigid wheel base for single bogie	2200 mm to 2600mm

3.2 LOCOMOTIVES 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 Patna Metro System (where these cars would be plying) will conform with the Kinematic Envelope of the Passenger Electric Multiple Units as shown in Figure No PMWSG-1(TNL) for Under Ground sections and Figure No. PMWSG - 1 for Elevated and At-Grade sections.



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CHAPTER 4

OVERHEAD ELECTRIC TRACTION 25 KV AC 50 CYCLES PER SECOND

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

4.1 ELECTRICAL CLEARANCES FOR UNDER GROUND

4.1.1 Minimum height from rail level to the underside of Wearing Copper / Metal Conductor of Rigid OCS (Overhead Contact System) in Tunnel4318 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.

4.1.2 Stagger of Rigid OCS Conductor in Tunnels shall not be more than

- (a) On Straight± 200 mm
- (b) On Curves± 300 mm

4.1.3 Prescribed minimum clearance between live parts of contact lines and earthed bodies of structures.

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

	Condition	Minimum clearance between live parts and structures	Absolute minimum dynamic clearance between live parts and structures
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)

4.1.4 Prescribed minimum clearance between live parts of contact lines and the earthed bodies of vehicles

Minimum Air clearance between bodies of vehicles and the live un-insulated parts of the contact line or feeders for 25 KV AC shall be as below:

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

4.1.5 Maximum width of pantograph – Under dynamic condition:

The Kinematic Envelope for the underground system with Ballastless track is shown in Figure PMWSG-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 fulfill electrical clearance as per item 4.1.3

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

4.2 ELECTRICAL CLEARANCES FOR AT-GRADE AND ELEVATED SECTIONS

4.2.1 Minimum vertical clearance (under worst condition of temperature, wind etc.) between any live part of the overhead equipment or pantograph and parts of any fixed structure (earthed or otherwise) or moving load:

	Condition	For Flexible OHE
(i)	Long duration (Static)	320mm
(ii)	Short Duration (Dynamic)	270mm

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 for ballasted track. Wherever the clearance required for track maintenance exceeds 20 mm, the vertical distance between rolling stock and contact wire shall correspondingly be increased.



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4.2.2 Minimum lateral clearance (under worst condition of temperature, wind etc.) between any live part of the over head equipment or pantograph and parts of any fixed structure (earthed or otherwise) or moving loads:

	Condition	For Flexible OHE
(i)	Long duration (Static)	320 mm
(ii)	Short Duration (Dynamic)	220 mm

4.2.3 Height of contact wire:

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

- i) In tunnel portal to Ramp Area..... 4388 mm
- ii) Under the bridges 4640 mm
- iii) In the open (Elevated & at grade sections) 5000 mm
- iv) At level crossings 5500 mm
- v) In running and carriage sheds wherever staff are expected to work on the roof of rolling stock in depot..... 5500 mm

Note:

- a) 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:

- iv) On straight ± 200mm
- v) On Curves ± 300mm

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

4.2.5 Maximum width of pantograph collector:

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



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Appendix-1

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

(REFERENCE: PARA 1.1)

RADIUS OF CURVE	CANT	MAXIMUM PERMISSIBLE SPEED	MINIMUM DISTANCE BETWEEN ADJACENT TRACKS See note (a)	
			UNDER GROUND	ELEVATED AND AT-GRADE
metres	mm	kmph	mm	mm
3000	0	80	3800	3900
2800	15	80	3800	3900
2400	20	80	3800	3900
2000	20	80	3800	3950
1600	25	80	3800	3950
1500	30	80	3800	3950
1200	35	80	3800	3950
1000	45	80	3850	3950
800	55	80	3850	4000
600	70	80	3900	4000
500	85	80	3950	4050
450	105	80	4000	4100
400	105	80	4000	4100
350	110	75	4050	4150
300	110	70	4050	4200
200	110	55	4150	4300
150	110	50	4250	4400
150	0	30	4200	4300
120	110	45	4400	4500
120	0	30	4300	4400
100	0	25	4400	4500

Notes:

- (a) The track spacing shown in the table above is without any column/structure between two tracks and is with equal cant for both outer and inner tracks.
 (b) Track spacing shown in Table above is not applicable to stations which should be calculated depending on specific requirement, but should not be less than as specified in para 2.1
 (c) Figures for any intermediate radius of curvature may be obtained by adopting the value for sharper curve.
 (d) Cant provided is limited to desirable value of 110 mm
 (e) Maximum cant deficiency is 85 mm.



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APPENDIX-2

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

REFERENCE PARA 1.7.1

RADIUS (metres)	MID-THROW (28500/R) (mm)	NOSING INCLUDED IN K/E/ STRUCTURE GAUGE FOR TANGENT TRACK (mm)	EXTRA GAUGE TOLERANCE ON CURVES (mm)	EXTRA HORIZONTAL ALLOWANCE ON CURVE (mm)	REMARKS
R	(V)	(N)	(G)	(T ₁)	
100	285.0	32.0	9.0	262	
120	237.5	32.0	9.0	215	
150	190.0	32.0	9.0	167	
175	162.9	32.0	9.0	140	
200	142.5	32.0	9.0	120	
250	114.0	32.0	9.0	91	
300	95.0	32.0	9.0	72	
350	81.4	32.0	9.0	58	
400	71.3	32.0	9.0	48	
450	63.3	32.0	9.0	40	
500	57.0	32.0	5.0	30	
600	47.5	32.0	5.0	21	
700	40.7	32.0	5.0	14	
800	35.6	32.0	5.0	9	
900	31.7	32.0	5.0	5	
1000	28.5	32.0	0.0	0	
1200	23.8	32.0	0.0	0	
1500	19.0	32.0	0.0	0	
1600	17.8	32.0	0.0	0	
2000	14.3	32.0	0.0	0	
2400	11.9	32.0	0.0	0	
2600	10.2	32.0	0.0	0	
3000	9.5	32.0	0.0	0	
or more					

(G) EXTRA GAUGE TOLERANCE ON CURVES SHARPER THAN 1000 M RADIUS:
9 mm FOR CURVES WITH RADIUS SHARPER THAN 500 M AND
5mm FOR CURVES WITH RADIUS OF 500 M TO LESS THAN 1000M,
T₁=V-N+G for V EQUAL TO OR GREATER THAN (N) AND
T₁= G for V < (N)

Mid throw (in mm) V = (125 x C²)/R= 28500/R
Where 'C' is the distance between bogie centers = 14.750+0.350+15.100m OR 14.750 - 0.350=14.400 m.
The worst case will be with C=15.100 m
R is the radius of curve in metres.
Mid throw (in mm) V = (125 x C²)/R= 28500/R

OUTSIDE OF CURVE

REFERENCE PARA 1.7.2

RADIUS (metres)	END-THROW (34635/R) (mm)	EXTRA GAUGE TOLERANCE ON CURVES (mm)	EXTRA NOSING DUE TO EXTRA GAUGE TOLERANCE (mm)	EXTRA HORIZONTAL ALLOWANCE ON CURVE (mm)	REMARKS
R	(V _o)	(G)	(EN)	(T ₂)	
100	346.4	9	2.3	356	
120	288.8	9.0	2.3	300	
150	230.9	9.0	2.3	242	
175	197.9	9.0	2.3	209	
200	173.2	9.0	2.3	184	
250	138.5	9.0	2.3	150	
300	115.5	9.0	2.3	127	
350	99.0	9.0	2.3	110	
400	86.6	9.0	2.3	98	
450	77.0	9.0	2.3	88	
500	69.3	5.0	1.3	78	
600	57.7	5.0	1.3	64	
700	49.5	5.0	1.3	56	
800	43.3	5.0	1.3	50	
900	38.5	5.0	1.3	45	
1000	34.6	0.0	0.0	35	
1200	28.9	0.0	0.0	29	
1500	23.1	0.0	0.0	23	
1600	21.6	0.0	0.0	22	
2000	17.3	0.0	0.0	17	
2400	14.4	0.0	0.0	14	
2800	12.4	0.0	0.0	12	
3000	11.5	0.0	0.0	12	
or more					

(G) EXTRA GAUGE TOLERANCE ON CURVES SHARPER THAN 1000 M RADIUS:
9 mm FOR CURVES WITH RADIUS SHARPER THAN 500 M AND
5mm FOR CURVES WITH RADIUS OF 500 M TO LESS THAN 1000M,
T₂=V_o+G+EN
EN=Gx0.25555555

End Throw (in mm) V_o = (125 x C²)/R - (125x C²)/R = 34635/R
Where 'C' is the distance between bogie centers = 14.750+0.350+15.100m OR 14.750 - 0.350=14.400m.
The worst case will be with C=15.100 m
C₁ = 14.750 m
C₂ = 14.400 m
C = 15.100 m
R is the radius of curve in metres.
C₁ = 14.750 m
C₂ = 14.400 m
C = 15.100 m



APPENDIX 3
PATNA METRO
CAST EFFECT ON TANGENT TRACKS HORIZONTAL,
AC, GRADE AND ELEVATED
REFERENCE: PART 1.8.2 FIGURE: PMWSG-2

Height above rail top (m)	Angle	Cast	Dist. =	H= 305			H= 880			H= 1095			H= 1130			H= 2030			H= 3300			H= 3736			H= 6250											
				E ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂	E ₁	F ₁	H ₁	H ₂						
110	4.178	0.023	0.997	0.073	1789	1745	489	231	1903	1834	1072	795	1979	1820	1296	1009	2016	1851	1324	1041	2091	1786	2271	1839	2111	1830	3483	3310	1809	1264	3994	3669	1992	1081	6401	6177
108	3.977	0.076	0.998	0.070	1788	1746	480	234	1860	1838	1083	799	1976	1824	1278	1011	2012	1855	1315	1046	2075	1783	2213	1843	2100	1821	3475	3219	1795	1277	3987	3673	1971	1102	6396	6181
106	3.787	0.084	0.998	0.046	1788	1747	472	238	1808	1841	1085	802	1973	1826	1269	1017	2009	1859	1306	1050	2063	1800	2204	1848	2090	1806	3467	3203	1786	1260	3980	3676	1961	1123	6389	6186
99	3.607	0.083	0.998	0.043	1787	1749	464	241	1855	1844	1046	807	1970	1832	1281	1021	2006	1864	1298	1054	2062	1807	2196	1852	2079	1852	3459	3192	1772	1242	3973	3680	1951	1144	6383	6189
91	3.427	0.080	0.998	0.040	1787	1750	456	244	1903	1848	1027	811	1966	1836	1282	1025	2002	1868	1299	1059	2056	1814	2197	1856	2079	1855	3451	3178	1767	1225	3965	3683	1940	1165	6376	6193
83	3.227	0.084	0.998	0.036	1786	1752	447	248	1850	1851	1029	814	1963	1840	1243	1029	1999	1872	1300	1062	2050	1821	2197	1861	2098	1859	3443	3163	1762	1208	3959	3686	1930	1186	6370	6196
75	3.027	0.081	0.999	0.033	1785	1753	439	251	1947	1854	1020	818	1960	1844	1235	1033	1996	1876	1302	1066	2043	1828	2197	1869	2098	1862	3435	3149	1757	1191	3953	3689	1920	1207	6363	6200
70	2.827	0.080	0.999	0.030	1784	1754	431	255	1945	1857	1011	822	1957	1848	1228	1037	1992	1880	1303	1070	2037	1832	2197	1878	2098	1869	3427	3134	1752	1174	3947	3692	1910	1228	6357	6204
65	2.627	0.084	0.999	0.043	1783	1755	422	258	1942	1861	1003	826	1953	1852	1218	1041	1989	1884	1304	1074	2031	1836	2197	1886	2098	1876	3419	3119	1747	1157	3941	3695	1900	1249	6350	6207
60	2.427	0.083	0.999	0.040	1782	1756	414	261	1940	1864	994	830	1950	1856	1209	1045	1985	1889	1305	1077	2025	1840	2197	1896	2098	1884	3411	3104	1742	1140	3935	3698	1890	1270	6343	6211
55	2.227	0.086	0.999	0.036	1781	1757	406	265	1937	1867	985	834	1947	1859	1200	1049	1982	1892	1306	1080	2018	1843	2197	1906	2098	1892	3403	3089	1737	1123	3929	3701	1880	1291	6336	6214
50	2.027	0.086	0.999	0.036	1781	1759	397	268	1934	1870	977	838	1943	1863	1192	1053	1978	1896	1307	1083	2011	1846	2197	1916	2098	1899	3395	3074	1732	1106	3923	3704	1870	1312	6330	6218
45	1.827	0.090	0.999	0.030	1780	1760	389	272	1932	1873	968	842	1940	1867	1183	1057	1975	1900	1308	1086	2004	1847	2197	1926	2098	1904	3387	3059	1727	1089	3917	3707	1860	1333	6323	6221
40	1.627	0.094	0.999	0.026	1779	1761	381	275	1929	1876	959	846	1937	1870	1174	1061	1971	1904	1309	1089	1997	1848	2197	1936	2098	1910	3379	3044	1722	1072	3910	3710	1850	1354	6316	6224
35	1.427	0.098	0.999	0.022	1778	1762	372	278	1926	1880	951	850	1933	1875	1165	1065	1968	1908	1310	1092	1992	1854	2101	1938	2098	1916	3371	3029	1717	1055	3903	3713	1840	1375	6309	6228
30	1.227	0.102	0.999	0.020	1777	1763	364	282	1923	1883	942	854	1929	1879	1157	1069	1964	1912	1103	1095	1985	1861	2092	2003	2098	1924	3363	3014	1712	1038	3896	3716	1830	1396	6302	6231
25	1.027	0.107	0.999	0.017	1776	1764	356	285	1920	1886	933	858	1926	1882	1148	1072	1961	1916	1104	1107	1976	1868	2094	2007	2098	1931	3355	2999	1707	1021	3889	3719	1820	1417	6295	6235
20	0.827	0.111	0.999	0.015	1775	1765	347	289	1917	1889	924	861	1922	1886	1139	1076	1957	1920	1105	1111	1972	1869	2076	2011	2098	1934	3347	2984	1702	1004	3882	3722	1810	1438	6288	6238
15	0.627	0.116	0.999	0.013	1774	1766	339	292	1914	1891	915	865	1919	1890	1131	1080	1953	1923	1106	1115	1965	1911	2006	2015	2098	1937	3339	2969	1697	987	3875	3725	1800	1459	6281	6241
10	0.427	0.121	0.999	0.011	1773	1767	331	295	1911	1894	906	869	1916	1893	1122	1084	1950	1927	1107	1119	1962	1916	2006	2015	2098	1940	3331	2954	1692	970	3868	3728	1790	1480	6274	6244
5	0.227	0.126	0.999	0.010	1772	1768	322	299	1908	1898	898	873	1912	1897	1113	1088	1946	1931	1114	1123	1952	1925	2048	2023	2098	1943	3323	2939	1683	953	3861	3731	1780	1501	6267	6249
0	0.000	0.000	0.000	0.000	1771	1770	314	302	1906	1901	889	877	1908	1901	1104	1092	1942	1928	1127	1127	1945	1932	2039	2027	2098	1946	3315	2924	1674	934	3854	3734	1770	1522	6260	6246
0	0.000	0.000	0.000	0.000	1771	1771	305	305	1903	1903	880	880	1904	1904	1095	1095	1938	1938	1130	1130	1938	1938	2030	2030	2098	1947	3307	2909	1665	915	3847	3738	1760	1543	6253	6250

REFER TO FIGURE PMWSG-4

$E_1 = (ab-h) \times \tan \alpha + h \times \cos \alpha$
 $F_1 = (ab-h) \times \tan \alpha + h \times \cos \alpha$
 $H_1 = (Ca2)h / \cos \alpha + (Ab-h) \times \tan \alpha \times \sin \alpha$
 $H_2 = (Ca2)h / \cos \alpha + (Ab-h) \times \tan \alpha \times \sin \alpha$

ab=Abc-Distance from center line of canted track to Structure Gauge for Tangent track at height 'h' from rail level
 bc=h x tan α=Lateral increment due to cant (measured along the line parallel to line joining top of rails).

NOTE: Value of Cant effect at any other location will be calculated by the above formula

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APPENDIX 3 (TNL)
 INVAKE METRO
 CANT EFFECT ON STRUCTURE (GAUGE-HORIZONTAL)
 UNDER GROUND SECTIONS (Parangapar Bm Tunnel)
 REFERENCE MARK 1.1.1 SQUARE AND PAVING-37(NL)

Cant	Angle	Sin α	Cos α	tan α	Stn 200			Stn 305			Stn 385			Stn 465			Stn 505			Stn 5130			Stn 5210			Stn 5346			Stn 5378			Stn 4838								
					E	F	H	E	F	H	E	F	H	E	F	H	E	F	H	E	F	H	E	F	H	E	F	H	E	F	H	E	F	H						
110	4.175	0.873	0.937	0.873	1595	1627	270	140	1738	1634	485	234	1909	1780	1568	798	1928	1789	1283	1013	1953	1786	1319	1646	2018	1723	2217	1944	2054	1587	2520	2260	1639	1115	3088	3882	1729	1034	4982	4779
105	3.987	0.870	0.935	0.867	1596	1668	263	142	1738	1630	477	238	1908	1784	1566	802	1928	1773	1274	1016	1950	1792	1311	1646	2012	1720	2206	1946	2054	1578	2517	2305	1647	1127	3075	3885	1724	1031	4975	4783
100	3.797	0.866	0.930	0.864	1595	1669	255	142	1737	1627	469	241	1908	1787	1565	806	1928	1777	1282	1020	1948	1797	1302	1654	2008	1714	2192	1942	2052	1580	2502	2272	1623	1153	3066	3891	1692	1053	4964	4780
95	3.607	0.863	0.925	0.860	1595	1670	247	148	1736	1618	461	244	1907	1786	1564	814	1915	1785	1285	1028	1940	1805	1285	1662	1993	1714	2184	1940	2052	1573	2494	2277	1611	1185	3060	3894	1674	1100	4954	4792
90	3.417	0.860	0.920	0.857	1594	1671	241	154	1735	1610	453	247	1906	1785	1563	822	1904	1784	1294	1036	1932	1809	1277	1670	1987	1706	2172	1934	2051	1574	2486	2282	1599	1178	3053	3897	1651	1155	4951	4795
85	3.227	0.856	0.915	0.854	1594	1672	235	160	1734	1602	445	250	1905	1784	1562	830	1899	1783	1303	1047	1920	1818	1270	1676	1980	1704	2160	1934	2050	1574	2478	2270	1587	1191	3047	3901	1628	1214	4945	4799
80	3.037	0.853	0.910	0.851	1594	1673	229	166	1733	1593	438	254	1904	1783	1561	838	1897	1782	1312	1058	1908	1813	1262	1680	1972	1700	2146	1934	2049	1575	2470	2252	1580	1222	3042	3904	1605	1274	4940	4803
75	2.847	0.850	0.905	0.848	1593	1674	218	174	1732	1582	432	257	1903	1782	1560	846	1895	1781	1321	1070	1892	1817	1254	1682	1964	1706	2130	1934	2048	1576	2462	2234	1572	1254	3037	3907	1581	1334	4935	4807
70	2.657	0.846	0.900	0.844	1593	1675	209	182	1731	1571	425	260	1902	1781	1559	854	1892	1780	1330	1082	1882	1817	1246	1684	1956	1710	2114	1934	2047	1577	2454	2216	1565	1334	3032	3910	1558	1404	4930	4810
65	2.467	0.843	0.895	0.841	1593	1676	203	190	1730	1560	412	263	1901	1780	1558	862	1890	1779	1339	1093	1872	1817	1238	1686	1948	1712	2098	1934	2046	1578	2446	2198	1557	1434	3027	3913	1535	1484	4925	4813
60	2.277	0.840	0.890	0.838	1592	1677	203	197	1729	1549	407	267	1899	1779	1557	870	1888	1778	1348	1104	1864	1817	1230	1688	1930	1714	2082	1934	2045	1579	2438	2180	1550	1504	3022	3916	1514	1554	4920	4817
55	2.087	0.836	0.885	0.834	1592	1678	206	170	1728	1538	395	270	1898	1778	1556	878	1886	1777	1357	1115	1856	1817	1222	1690	1912	1716	2066	1934	2044	1580	2430	2162	1549	1584	3017	3919	1493	1624	4915	4820
50	1.896	0.833	0.880	0.831	1591	1678	278	175	1727	1527	387	273	1897	1777	1555	886	1884	1776	1366	1126	1838	1817	1214	1692	1904	1730	2050	1934	2043	1581	2422	2135	1549	1624	3012	3922	1472	1704	4910	4827
45	1.706	0.830	0.875	0.828	1591	1679	270	178	1726	1516	379	277	1896	1776	1554	894	1882	1775	1375	1136	1820	1817	1206	1694	1896	1732	2034	1934	2042	1582	2414	2117	1549	1664	3007	3925	1451	1784	4905	4834
40	1.516	0.827	0.870	0.825	1590	1679	262	181	1725	1505	372	280	1895	1775	1553	902	1880	1774	1384	1146	1802	1817	1198	1696	1898	1738	2018	1934	2041	1583	2406	2100	1549	1704	3002	3928	1430	1864	4900	4841
35	1.326	0.824	0.865	0.822	1590	1680	255	184	1724	1494	365	283	1894	1774	1552	910	1878	1773	1393	1156	1784	1817	1190	1700	1899	1742	2002	1934	2040	1584	2398	2082	1549	1744	3000	3931	1409	1954	4895	4848
30	1.136	0.820	0.860	0.819	1589	1681	247	184	1723	1483	358	286	1893	1773	1551	918	1876	1772	1402	1166	1766	1817	1182	1702	1902	1746	1986	1934	2039	1585	2390	2067	1549	1784	3000	3934	1388	2044	4890	4851
25	0.946	0.817	0.855	0.816	1588	1682	239	187	1722	1472	348	289	1892	1772	1550	926	1874	1771	1411	1178	1748	1817	1174	1704	1892	1748	1970	1934	2038	1586	2382	2050	1549	1824	3000	3937	1367	2134	4885	4854
20	0.756	0.813	0.850	0.813	1588	1683	231	185	1721	1461	338	293	1891	1771	1549	934	1872	1770	1419	1190	1730	1817	1166	1706	1892	1750	1954	1934	2037	1587	2374	2032	1549	1864	3000	3940	1346	2224	4880	4857
15	0.566	0.810	0.845	0.810	1587	1684	224	182	1720	1450	329	296	1890	1770	1548	942	1869	1769	1426	1202	1702	1817	1158	1708	1892	1752	1934	1934	2036	1588	2366	2015	1549	1904	3000	3943	1325	2314	4875	4860
10	0.376	0.806	0.840	0.806	1587	1685	218	188	1719	1439	320	299	1889	1769	1547	950	1866	1768	1434	1214	1684	1817	1150	1710	1892	1754	1916	1934	2035	1589	2358	2000	1549	1944	3000	3946	1304	2404	4870	4863
5	0.186	0.803	0.835	0.803	1586	1685	208	198	1722	1428	314	302	1888	1768	1546	968	1862	1767	1441	1226	1666	1817	1142	1712	1892	1756	1892	1934	2034	1590	2350	1982	1549	1984	3000	3949	1283	2494	4865	4866
0	0.000	0.800	0.800	0	1585	1685	200	200	1729	1420	305	305	1888	1768	1545	980	1856	1766	1448	1238	1646	1817	1130	1714	1892	1758	1892	1934	2033	1591	2342	1966	1549	2024	3000	3952	1262	2584	4860	4869

REFER TO FIGURE PMS/SG-4
 $E_1 = \text{Cant} \times \sin \alpha$
 $F_1 = \text{Cant} \times \cos \alpha$
 $H_1 = \text{Cant} \times \tan \alpha$
 $H_2 = \text{Cant} \times \tan \alpha \times \tan \alpha$
 $H_3 = \text{Cant} \times \tan \alpha \times \tan \alpha \times \tan \alpha$
 $\text{acc} = \text{Distance from center line of cant track to Structure Gauge for Tangent track at height 'y' from rail level}$
 $\text{bc} = \text{Status} \times \text{Lateral increment due to cant}$ (measured along the line parallel to line joining top of rails).

NOTE: Value of Cant effect at any other location will be calculated by the above formula.



000860

APPENDIX-3A

PATNA METRO

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

REF: PARA 1.8.1, FIGURE NO. PMWSG-1

Cant Angle (α)	163		2011		3100		3736		3963		5018	
	E	F	H ₁	H ₂	E	F	H ₁	H ₂	E	F	H ₁	H ₂
140	1.178	0.073	0.897	0.073	1809	1681	1051	806	1829	1669	1276	1020
105	1.197	0.070	0.986	0.07	1806	1684	1052	809	1825	1673	1287	1023
100	1.217	0.065	1.080	0.066	1804	1687	1044	813	1822	1677	1298	1027
95	1.237	0.063	1.173	0.063	1801	1691	1036	816	1819	1681	1309	1031
90	1.257	0.060	1.266	0.06	1799	1694	1028	820	1816	1685	1320	1034
85	1.277	0.056	1.359	0.056	1796	1697	1020	823	1812	1689	1331	1038
80	1.297	0.053	1.452	0.053	1794	1700	1012	827	1809	1693	1342	1041
75	1.317	0.049	1.545	0.049	1791	1704	1004	830	1806	1697	1353	1045
70	1.337	0.046	1.638	0.046	1788	1707	996	833	1802	1701	1364	1048
65	1.357	0.043	1.731	0.043	1786	1710	987	837	1799	1705	1375	1052
60	1.377	0.040	1.824	0.04	1783	1713	979	840	1796	1709	1386	1056
55	1.397	0.036	1.917	0.036	1780	1716	971	844	1792	1712	1397	1060
50	1.417	0.033	2.010	0.033	1778	1719	963	847	1789	1716	1408	1064
45	1.437	0.030	2.103	0.03	1775	1722	955	850	1786	1720	1419	1068
40	1.457	0.026	2.196	0.026	1772	1726	947	854	1782	1724	1430	1072
35	1.477	0.023	2.289	0.023	1769	1729	939	857	1778	1728	1441	1076
30	1.497	0.020	2.382	0.02	1767	1732	930	861	1775	1731	1452	1080
25	1.517	0.017	2.475	0.017	1764	1735	922	864	1771	1735	1463	1084
20	1.537	0.013	2.568	0.013	1761	1738	914	867	1768	1739	1474	1088
15	1.557	0.010	2.661	0.01	1758	1741	906	871	1764	1743	1485	1092
10	1.577	0.007	2.754	0.007	1755	1744	898	874	1761	1746	1496	1096
5	1.597	0.003	2.847	0.003	1752	1747	889	877	1757	1750	1507	1100
0	1.617	0.000	2.940	0	1749	1749	880	880	1753	1753	1518	1104

REFER TO FIGURE PMWSG-4A

$E = [ab - (h \times \tan \alpha)] \times \cos \alpha$
 $F = [ab - (h \times \tan \alpha)] \times \cos \alpha$
 $H_1 = (Ca/2)h / \cos \alpha + (Ab - h \times \tan \alpha) \sin \alpha$
 $H_2 = (Ca/2)h / \cos \alpha - (ab - h \times \tan \alpha) \sin \alpha$
 ab = Distance from center line of vehicle to K.E for Tangent track at height 'h' from rail level
 ac = Distance from center line of canted track to K.E for Tangent track at height 'h' from rail level
 bc = h x tan α = Lateral increment due to cant/measured along the line parallel to line joining top of rails.

NOTE: Value of Cant effect at any other location will be calculated by the above formula

000861

APPENDIX-4
PATNA METRO
LATERAL AND VERTICAL SHIFT OF CENTRE OF CIRCULAR TUNNEL
FOR DIFFERENT CANT VALUES

(WITH $D_1=670$ mm)
REFER TO FIGURE: PMWSG-3 AND PARA NOS 1.7.1 (B)-b AND 1.7.2 (B)-b

All figures are in mm

Cant mm	$\sin \alpha =$ Cant/1510	Angle α Degrees	$\tan \theta =$ (r-D1) / (g/2)	Angle θ Degrees	Lateral shift of tunnel centre=X mm	Vertical shift of tunnel centre=Y mm	REMARKS
110	0.07285	4.1776	2.8212	70.4826	157	49	<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 $X = [(2 \times (r-D_1) \sin \theta) \times \{ \sin \alpha / 2 \}] \times \cos (90 - \theta - \alpha / 2)$</p> <p>(c) 'Y' is the vertical shift of the centre of the tunnel (upwards) $Y = [(2 \times (r-D_1) \sin \theta) \times \{ \sin \alpha / 2 \}] \times \sin (90 - \theta - \alpha / 2)$ where,</p> <p>'r' is internal radius of the circular tunnel=2800 mm D_1 = depth from rail level to invert of circular tunnel=670 mm α = angle of rotation=\sin^{-1} (Cant/g) and θ = angle subtended by line joining top of two rails and the line joining mid point of top of inner rail and the centre of circular Tunnel $= \tan^{-1} [(r-D_1) / (g/2)]$ in degrees= 70.48261451 g= Centre to centre of rails = 1510 mm</p>
105	0.06954	3.9874	2.8212	70.4826	150	47	
100	0.06623	3.7972	2.8212	70.4826	143	45	
95	0.06291	3.6071	2.8212	70.4826	136	43	
90	0.0596	3.417	2.8212	70.4826	128	41	
85	0.05629	3.227	2.8212	70.4826	121	39	
80	0.05298	3.037	2.8212	70.4826	114	37	
75	0.04967	2.847	2.8212	70.4826	107	35	
70	0.04636	2.657	2.8212	70.4826	100	33	
65	0.04305	2.4671	2.8212	70.4826	92	31	
60	0.03974	2.2773	2.8212	70.4826	85	28	
55	0.03642	2.0874	2.8212	70.4826	78	26	
50	0.03311	1.8976	2.8212	70.4826	71	24	
45	0.0298	1.7077	2.8212	70.4826	64	22	
40	0.02649	1.5179	2.8212	70.4826	57	19	
35	0.02318	1.3282	2.8212	70.4826	50	17	
30	0.01987	1.1384	2.8212	70.4826	42	15	
25	0.01656	0.9486	2.8212	70.4826	35	12	
20	0.01325	0.7589	2.8212	70.4826	28	10	
15	0.00993	0.5692	2.8212	70.4826	21	7	
10	0.00662	0.3794	2.8212	70.4826	14	5	
5	0.00331	0.1897	2.8212	70.4826	7	2	
0	0	0	2.8212	70.4826	0	0	



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APPENDIX -3

ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES UNDER GROUND, ELEVATED AND AT GRADE STATIONS

REF: PMAA 2.7

RADIUS	INSIDE OF CURVE						OUTSIDE OF CURVE						
	AT CENTRE LINE OF BOGIES			AT EDGE OF OPEN DOOR NEAREST TO C.L. OF BOGIES			AT END OF COACH			AT EDGE OF OPEN DOOR FARTHEST FROM C.L. OF BOGIES			
MD THRU +2800	MOING	ADDITIONAL CLEARANCE	ADDITIONAL CLEARANCE	THROW	MOING	ADDITIONAL CLEARANCE	ADDITIONAL CLEARANCE	END THROW	MOING	ADDITIONAL CLEARANCE	DIFFERENCE	ADDITIONAL CLEARANCE	ADDITIONAL CLEARANCE
V	N	V-N	V-N	V ₁	N ₁	V ₁ -(N-N ₁)	V ₁ -(N-N ₁)	V ₁	V ₁	V ₁ -(N-N ₁)	N ₁	V ₁ -(N-N ₁)	V ₁ -(N-N ₁)
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
3000	9.5	15.85	-6.4	0	9.5	1.3	-5.1	0	11	6.4	13.9	2.0	4.5
2800	10.2	15.85	-5.7	0	10.2	1.3	-4.4	0	12	6.9	13.9	2.0	4.9
2400	11.9	15.85	-4.0	0	11.9	1.3	-2.7	0	14	8.1	13.9	2.0	6.1
2000	14.3	15.85	-1.6	0	14.2	1.3	-0.3	0	17	9.7	13.9	2.0	7.7
1800	15.8	15.85	0.0	5	15.8	1.3	3.2	5	19	10.7	13.9	2.0	8.8
1600	17.8	15.85	2.0	5	17.8	1.3	3.2	5	21	12.1	13.9	2.0	10.1
1500	19.0	15.85	3.2	5	19.0	1.3	4.4	5	22	12.9	13.9	2.0	10.9
1200	23.8	15.85	7.9	10	23.7	1.3	9.2	10	28	16.1	13.9	2.0	14.1
1000	28.5	15.85	12.7	15	28.5	1.3	13.9	15	34	19.3	13.9	2.0	17.3
800	35.6	15.85	19.8	20	35.6	1.3	21.0	25	42	24.2	13.9	2.0	22.2

NOTES:

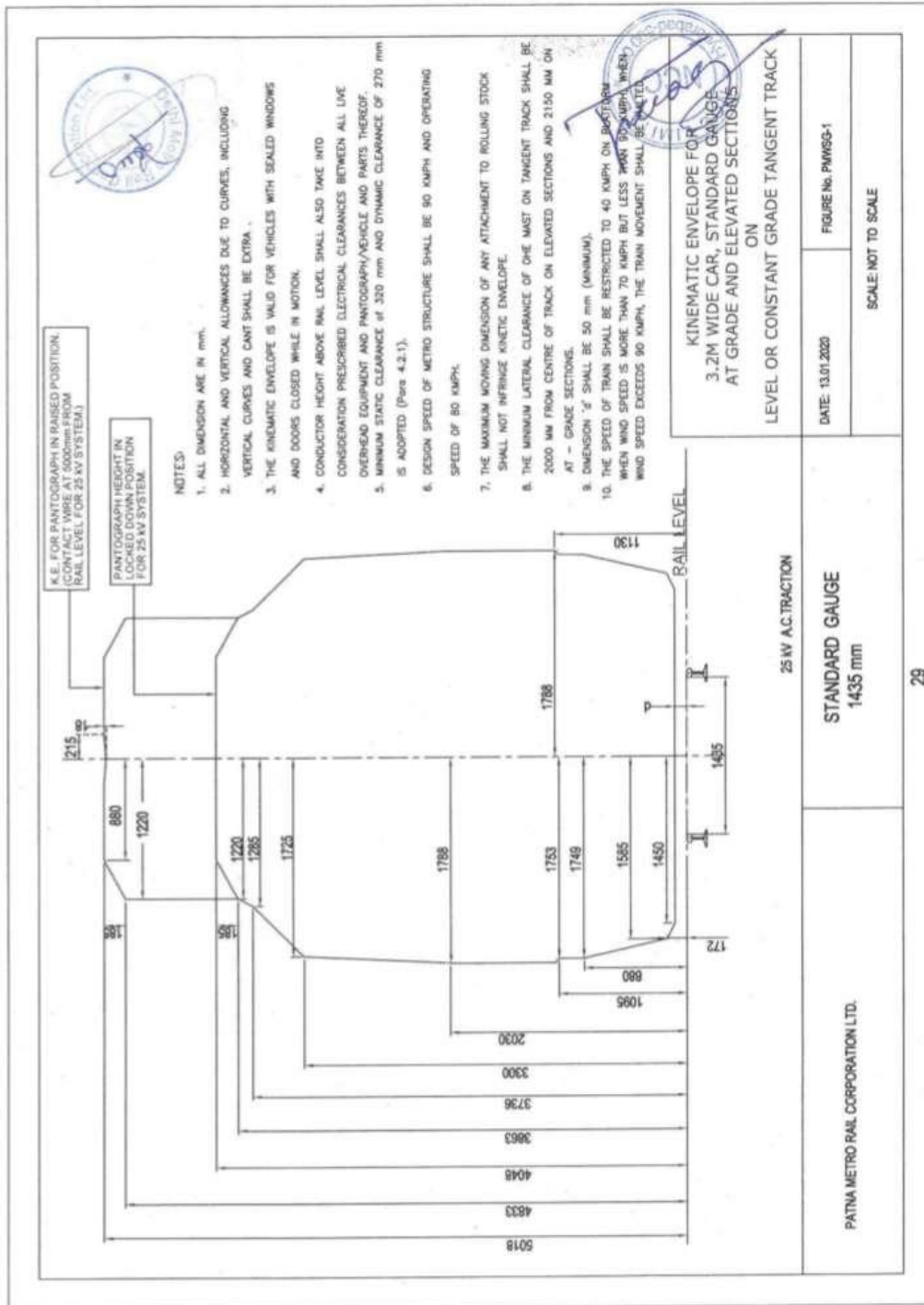
- For outside of curve, the difference between clearance required at coach end that at the farthest door edge is less than 25mm. As half width of coach at ends is at least 25 mm less than that at door locations, additional clearance to be provided is additional clearance required at the farthest door edge (column 15)
- Values of additional clearances (columns 5, 9 and 15) are rounded off to the nearest 5 mm.
- Negative values of additional clearance are taken as Zero in the columns 4 and 8 with rounded off figures.
- Extra clearance for curve:
 - Inside of curve:
 - $V = (125C^2/R) = 28500R$ with $C=15.10$ m for the worst case.
 - $V_1 = ((125C^2/R) - (125C^2/R)) = 28498R$
 - $N_1 = N(X)/(C/2) = 13 \times 0.873/10.97 = 1.03$ mm
 - Minimum distance 'X' for the nearest edge of an open door from centre line of Bogies is 0.873 metre.
 - Higher of (i) column 4 and (ii) column 8 shall be adopted
 - Outside of curve:
 - $V_1 = ((125C^2/R) - (125C^2/R)) = 34635R$ for coach end with $C=14.4$ metres and $C_1=2 \times 10.97$ metres
 - $V_1 = 125 \times (19.18 \times 19.18 - 14.4 \times 14.4) / R = 20064R$ for farthest edge of end door in open position with
 - $C_1 = 2 \times 10.97 = 21.94$ metres and $C = 14.40$ metres for the worst case.
 - $N_1 =$ Nosing at the farthest edge of an open door = $N \times (X)/(C/2) = 13 \times 0.873 / 10.97 = 1.03$ mm
 - $R =$ Radius of curve in metres
 - Maximum distance (X) for the farthest edge of open door from centre line of two Bogies = 9.590 M
- There will be no super-elevation on curves in platform portion.

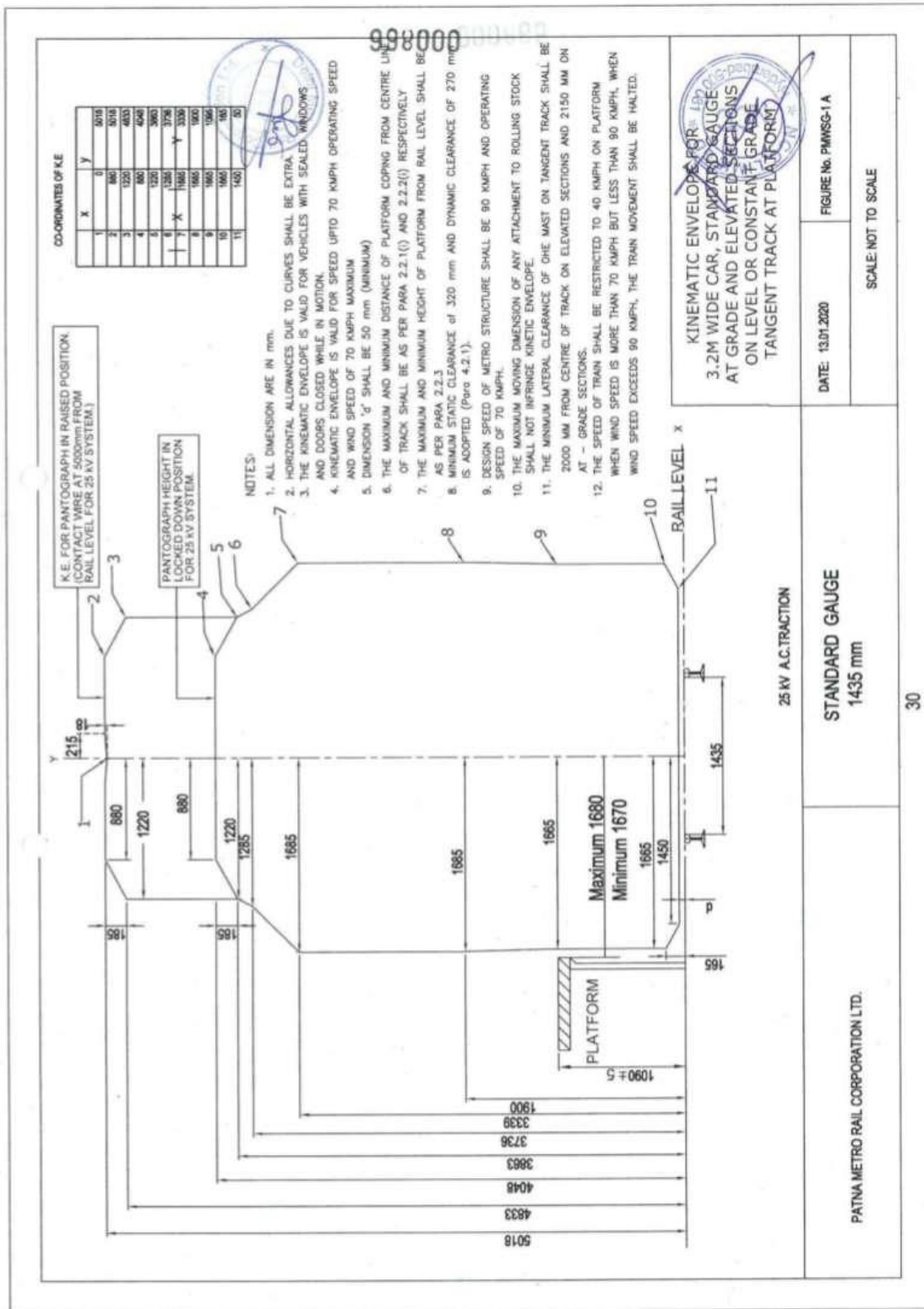


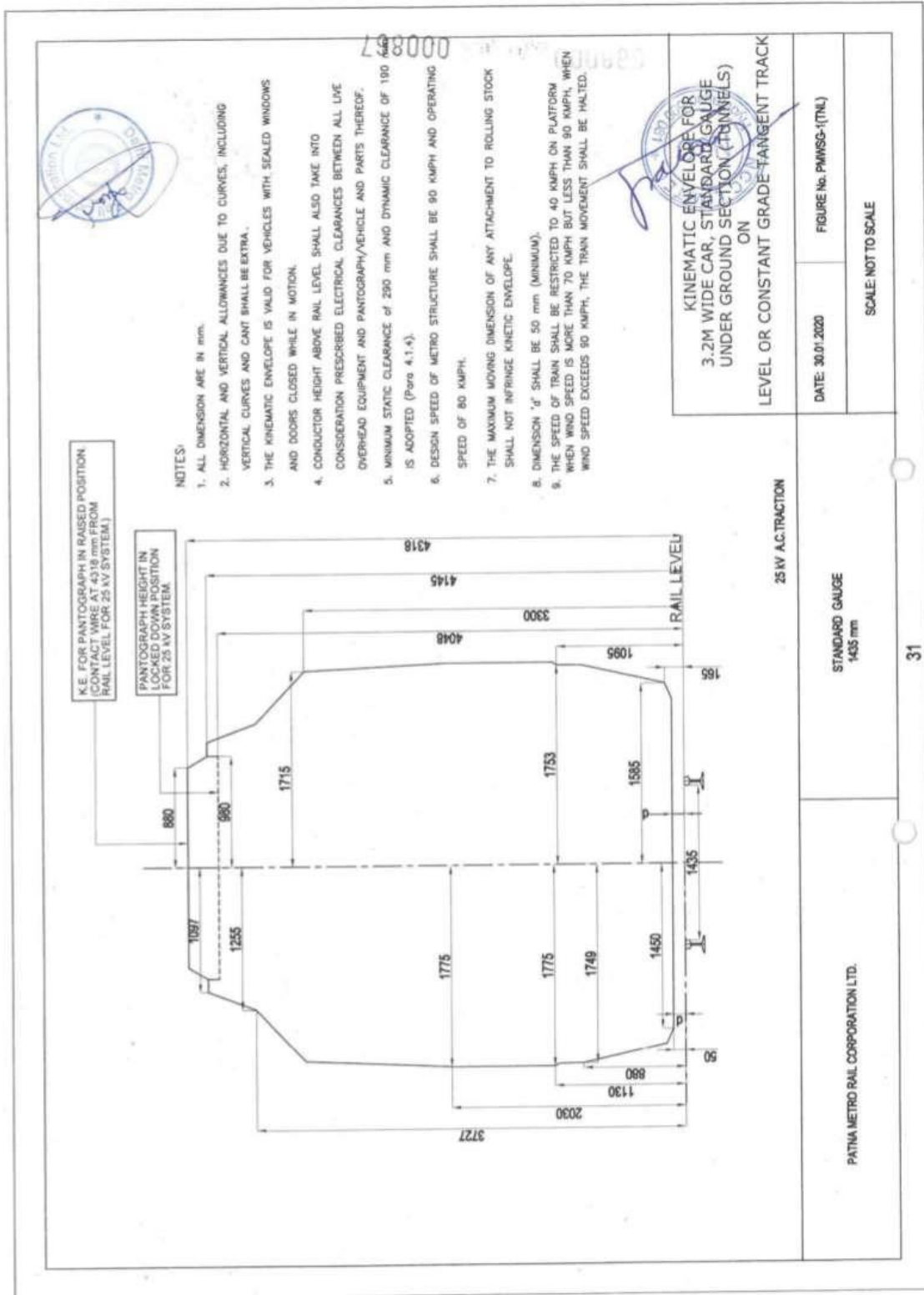
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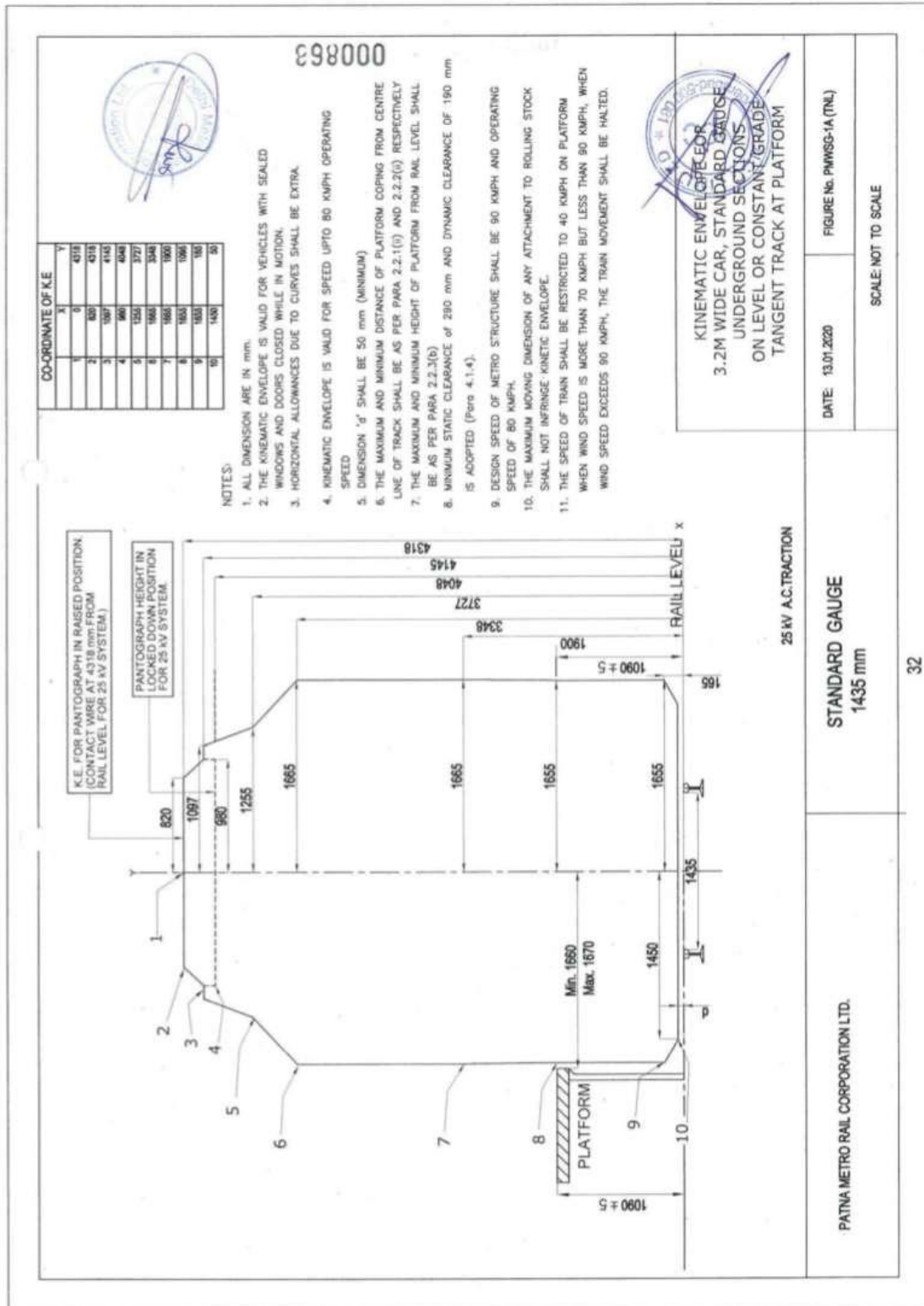


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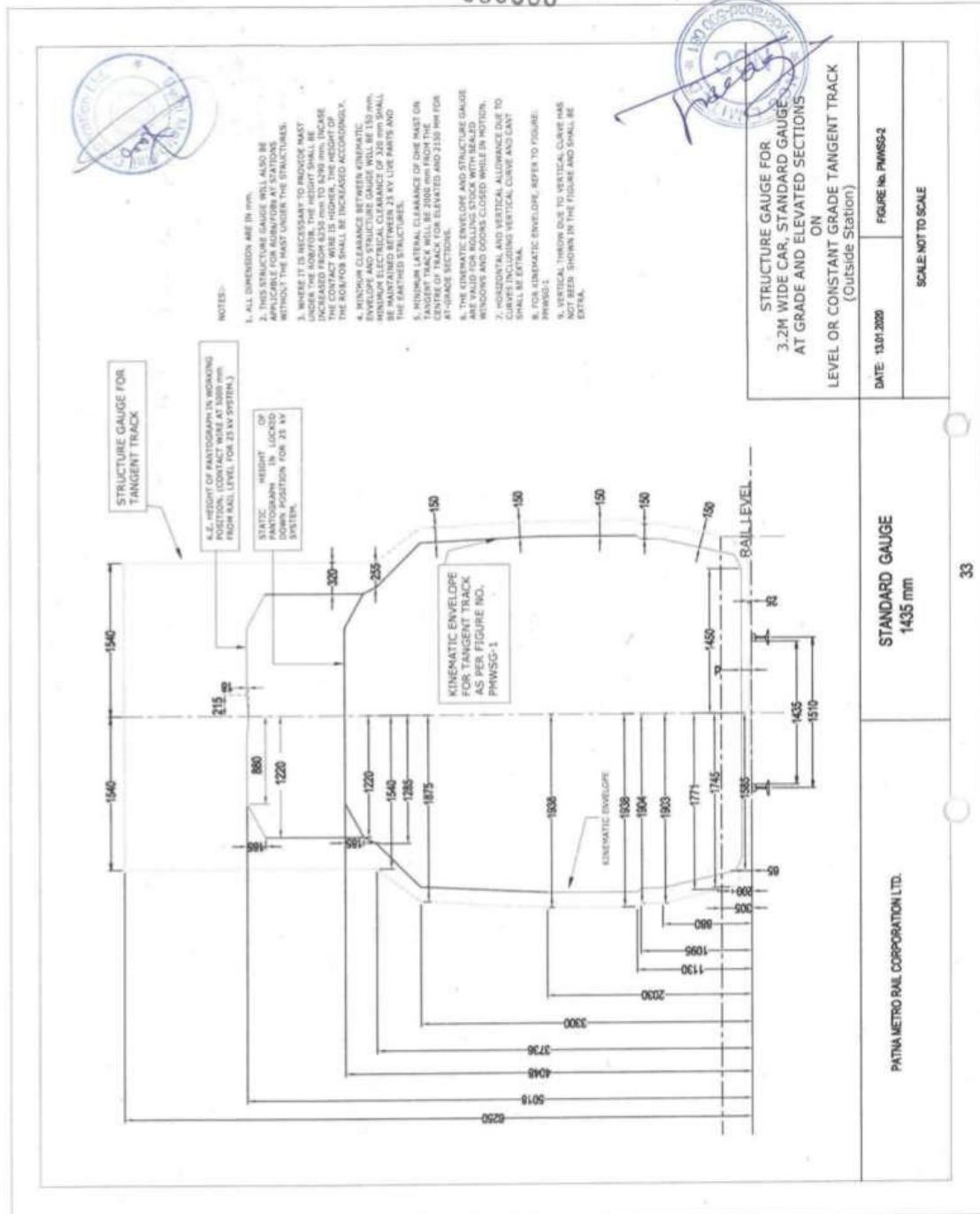








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- NOTES:-
1. ALL DIMENSIONS ARE IN MM.
 2. THIS STRUCTURE GAUGE WILL ALSO BE APPLICABLE FOR AC/25KV AND DC/25KV SYSTEMS WITHIN THE HEIGHT OF THE STRUCTURES.
 3. MINIMUM CLEARANCE BETWEEN CONTACT WIRE AND ROLLING STOCK SHALL BE INCREASED FROM 8250 mm TO 8280 mm, INCREASE THE HEIGHT OF THE ROLLER SHALL BE INCREASED ACCORDINGLY.
 4. MINIMUM CLEARANCE BETWEEN KINEMATIC ENVELOPE AND ROLLING STOCK SHALL BE MAINTAINED BETWEEN 25 KV LIVE PARTS AND THE FINISHED STRUCTURES.
 5. MINIMUM LATERAL CLEARANCE OF ONE METER ON EITHER SIDE OF TRACK FOR ELEVATED AND 2150 MM FOR AT-GRADE SECTIONS.
 6. THE KINEMATIC ENVELOPE AND STRUCTURE GAUGE ARE VALID FOR ROLLING STOCK WITH SEALED WINDOWS AND CLOSED WHEEL NIPPLES.
 7. POSITIVE AND VERTICAL ALLOWANCE DUE TO TRACK CURVATURE AND WIND BLOWING SHALL BE EXTRA.
 8. FOR KINEMATIC ENVELOPE, REFER TO FIGURE PMWSSG-1.
 9. VERTICAL THROW DUE TO VERTICAL CURVE HAS NOT BEEN SHOWN IN THE FIGURE AND SHALL BE EXTRA.

STRUCTURE GAUGE FOR 3.2M WIDE CAR, STANDARD GAUGE ON LEVEL OR CONSTANT GRADE TANGENT TRACK (Outside Station)

DATE: 13/01/2020

FIGURE NO. PMWSSG-2

SCALE: NOT TO SCALE

STANDARD GAUGE 1435 mm

PATNA METRO RAIL CORPORATION LTD.

Attachment 9. Photos of Affected Structures

DPR SIA 2020	Existing Condition as of July 2022
 <p>RK1, Rukanpura</p>	 <p>Latitude: 25.606311 Longitude: 85.072295 Elevation: 55.431 m Accuracy: 9.4 m Time: 07-20-2022 12:25 Note: rukanpura structure 1</p>
<p>RK1 – Affected structure of Rukanpura</p>	<p>RK1 – Affected structure of Rukanpura</p>
 <p>RK2, Residential Property, Rukanpura</p>	 <p>Latitude: 25.606479 Longitude: 85.072554 Elevation: 55.4323 m Accuracy: 43.3 m Time: 07-20-2022 11:54 Note: Rukanpura RK2</p>
<p>RK2 - Affected structure of Rukanpura</p>	<p>RK2 - Affected structure of Rukanpura</p>
 <p>RK3, Rukanpura</p>	 <p>Latitude: 25.6065 Longitude: 85.072563 Elevation: 54.831 m Accuracy: 28.3 m Time: 07-20-2022 12:25 Note: rukanpura structure 4 RK3</p>
<p>RK3 – Affected structure of Rukanpura</p>	<p>RK3 – Affected structure of Rukanpura</p>
 <p>RK1, Commercial Property, Raja Bazar</p>	 <p>Latitude: 25.605269 Longitude: 85.08083 Elevation: 55.521 m Accuracy: 9.5 m Time: 07-20-2022 12:03 Note: Raja bazar structure 2</p>
<p>RB1 – Affected structure of Raja Bazar</p>	<p>RB1 – Affected structure of Raja Bazar</p>

DPR SIA 2020	Existing Condition as of July 2022
 <p>RB2, Raja Bazar</p>	 <p>Latitude: 25.605489 Longitude: 85.081177 Elevation: 55.221 m Accuracy: 9.1 m Time: 07-20-2022 12:04 Note: Raja bazar structure 7</p>
<p>RB2 – Affected structure of Raja Bazar</p>	<p>RB2 – Affected structure of Raja Bazar (gone)</p>
 <p>RB3, Residential Property, Raja Bazar</p>	 <p>Latitude: 25.605421 Longitude: 85.081187 Elevation: 55.3241 m Accuracy: 29.9 m Time: 07-20-2022 12:05 Note: Raja bazar structure 9 rb 3</p>
<p>RB3 – Affected structure of Raja Bazar</p>	<p>RB3 – Affected structure of Raja Bazar</p>
 <p>RB4, SHOP, Raja Bazar</p>	 <p>Latitude: 25.605284 Longitude: 85.081581 Elevation: 55.3241 m Accuracy: 13.8 m Time: 07-20-2022 12:06 Note: Raja bazar structure 9 rb 4</p>
<p>RB4 – Affected structure of Raja Bazar</p>	<p>RB4 – Affected structure of Raja Bazar</p>
 <p>RB5, Milk Parlour, Raja Bazar</p>	 <p>Latitude: 25.605219 Longitude: 85.081775 Elevation: 55.4241 m Accuracy: 15.6 m Time: 07-20-2022 12:07 Note: Raja bazar structure 10 rb 5</p>
<p>RB5 – Affected structure of Raja Bazar</p>	<p>RB5 – Affected structure of Raja Bazar</p>

DPR SIA 2020	Existing Condition as of July 2022
 <p>A shed of Paras Hospital, Raja Bazar</p>	 <p>Latitude: 25.605321 Longitude: 85.082042 Elevation: 55.42±1 m Accuracy: 16.0 m Time: 07-20-2022 12:08 Note: Raja bazar structure 1</p>
<p>RB6 – Affected structure of Raja Bazar</p>	<p>RB6 – Affected structure of Raja Bazar</p>
 <p>MT1 – Affected structure of Mithapur station</p>	 <p>Latitude: 25.587405 Longitude: 85.133968 Elevation: 52.12±1 m Accuracy: 18.9 m Time: 07-18-2022 10:38 Note: mithpura structure 2</p>
<p>MT1 – Affected structure of Mithapur station</p>	<p>MT1 – Affected structure of Mithapur station</p>
 <p>MT2 – Affected structure of Bigrahpur</p>	 <p>Latitude: 25.586174 Longitude: 85.134021 Altitude: -10.4±2 m Accuracy: 76.9 m Time: 07-20-2022 13:09 Note: Mithapur mt2</p>
<p>MT2 – Affected structure of Bigrahpur</p>	<p>MT2 – Affected structure of Bigrahpur</p>
 <p>MT3, Bigrahpur</p>	 <p>Latitude: 25.586566 Longitude: 85.134049 Elevation: 53.62±1 m Accuracy: 21.1 m Time: 07-20-2022 13:14 Note: Mithapur 2 mt3</p>
<p>MT3, Bigrahpur</p>	<p>MT3, Bigrahpur</p>

MT3 – Affected structure of Bigrahpur	MT3 – Affected structure of Bigrahpur
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MT4 – Affected structure of Bigrahpur	MT4 – Affected structure of Bigrahpur
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MT5, MT6, MT7 – Affected structure of Bigrahpur	MT5 - Affected structure of Bigrahpur (gone)
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MT6, MT7 – Affected structure of Bigrahpur	MT6, MT7 – Affected structure of Bigrahpur
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MT8 – Affected structure of Bigrahpur	MT8 – Affected structure of Bigrahpur
<p style="text-align: center;">DPR SIA 2020</p>  <p style="text-align: center;">MT9, Nimbu Mandi, Bigrahpur</p>	<p style="text-align: center;">Existing Condition as of July 2022</p>  <p style="text-align: center;">MT9, Nimbu Mandi, Bigrahpur</p> <p>Latitude: 25.585 Longitude: 85.134818 Elevation: 54.3153 m Accuracy: 3.6 m Time: 07-20-2022 13:23 Note: Mithapur 3 mt9</p>
MT9 – Affected structure of Bigrahpur	MT9 – Affected structure of Bigrahpur
 <p style="text-align: center;">MT10, R+C, Bigrahpur</p>	 <p style="text-align: center;">MT10, R+C, Bigrahpur</p> <p>Latitude: 25.585006 Longitude: 85.135174 Elevation: 52.9152 m Accuracy: 19.8 m Time: 07-20-2022 13:24 Note: Mithapur 3 mt10</p>
MT10 – Affected structure of Bigrahpur	MT10 – Affected structure of Bigrahpur
 <p style="text-align: center;">AK 1, Milk Parlour, Akashwani</p>	 <p style="text-align: center;">AK 1, Milk Parlour, Akashwani</p> <p>Latitude: 25.612971 Longitude: 85.139106 Elevation: 53.652 m Accuracy: 19.7 m Time: 07-20-2022 15:49 Note: Akashwani ak1</p>
AK1 – Affected structure of Akashwani	AK1 – Affected structure of Akashwani



AK2 – Affected structure of Akashwani



AK2 – Affected structure of Akashwani

DPR SIA 2020



AK3 – Affected structure of Akashwani

Existing Condition as of July 2022



AK3 – Affected structure of Akashwani



AK4 – Affected structure of Akashwani



AK4 – Affected structure of Akashwani



AK5 – Affected structure of Akashwani



AK5 – Affected structure of Akashwani



GM1- Affected structure of Gandhi Maidan



GM1- Affected structure of Gandhi Maidan (gone)

DPR SIA 2020



GM2, Milk Booth, Near Bus Stand, Gandhi maidan

Existing Condition as of July 2022





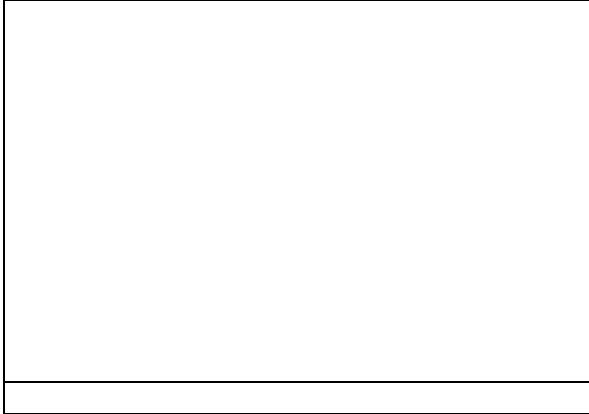

GM2- Affected structure of Gandhi Maidan



GM3-GM6 - Affected structure of Gandhi Maidan



GM3-GM6 - Affected structure of Gandhi Maidan (gone)

 <p>PM1-PM17, Shops, PMCH</p>	 <p>Latitude: 25.619714 Longitude: 85.158468 Elevation: 55.41±1 m Accuracy: 6.8 m Time: 07-20-2022 16:12 Note: pinch 1 to 17</p>
<p>P1-P17 – Affected structure of PMCH</p>	<p>P1-P14 – Affected structure of PMCH (saved)</p>
	 <p>Latitude: 25.619619 Longitude: 85.158835 Elevation: 54.91±1.7 m Accuracy: 6.1 m Time: 07-20-2022 16:15 Note: pinch new 1</p>
<p>P15-17Affected structure of PMCH (to be affected)</p>	<p>P15-17Affected structure of PMCH (to be affected)</p>

<p>DPR SIA 2020</p>	<p>Existing Condition as of July 2022</p>
 <p>RN1, R+C Building with 3 shops, Rajendra Nagar RN2, Commercial Building with</p>	 <p>Latitude: 25.602256 Longitude: 85.161465 Elevation: 54.15±1 m Accuracy: 25.3 m Time: 07-20-2022 14:30 Note: rajendra nagar rn1 to 5</p>
<p>RN1, RN2 – Affected structure of Rajendra Nagar</p>	<p>RN1, RN2 – Affected structure of Rajendra Nagar (saved)</p>
<p>RN1- RN2 are now not affected instead of these 02 structures the alignment is sifted at Rajendra Nagar Railway station.</p>	 <p>Latitude: 25.60237 Longitude: 85.162021 Elevation: 54.35±2 m Accuracy: 6.0 m Time: 07-20-2022 14:32 Note: rajendra nagar shifted</p>
<p>RN- Public land to be affected instead</p>	<p>RN- Public land to be affected instead</p>



ML1 – Affected structure of Malahi Pakri



ML1 – Affected structure of Malahi Pakri (gone)



ML2-21 – Affected structure of Malahi Pakri



ML2-21 – Affected structure of Malahi Pakri (gone)

DPR SIA 2020

ML22-ML41, Malahi Pakri-Photos



ML-22-41– Affected structure of Malahi Pakri

Existing Condition as of July 2022



ML-22-41– Affected structure of Malahi Pakri (gone)

 <p>KC1, Shed, in R+C Building, KhemniChak Crossing</p>	 <p>Latitude: 25.584592 Longitude: 85.158766 Elevation: 52.89±2 m Accuracy: 5.2 m Time: 07-20-2022 13:37 Note: KhemniChak Crossing 5</p>
<p>KC-1 – Affected structure of KhemniChak (side view)</p>	<p>KC-1– Affected structure of KhemniChak (front view)</p>
 <p>KC2, Under construction Building, Khemni Chak</p>	<p>KC 2 is now not affected; the alignment is shifted to protect the structure.</p>
<p>KC-2 – Affected structure of Khemni Chak Crossing</p>	<p>KC-2 – Affected structure of Khemni Chak Crossing (saved)</p>
 <p>KH1, Chicken Shop, Khemni Chak</p>	 <p>Latitude: 25.584587 Longitude: 85.152224 Elevation: 50.08±6 m Accuracy: 12.1 m Time: 07-14-2022 12:49 Note: khemni chuck 5</p>
<p>KH1 – Affected structure of KhemniChak</p>	<p>KH1 – Affected structure of KhemniChak</p>

<p>DPR SIA 2020</p>	<p>Existing Condition as of July 2022</p>
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KH2 – Affected structure of Khemni chak

KH2 – Affected structure of Khemni chak



KH3, KH4 – Affected structure of Khemnichak

KH3, KH4 – Affected structure of Khemnichak



BZ1 – Affected structure of Bhoothnath to Zeromile

BZ1 – Affected structure of Bhoothnath to Zero Mile (gone)



BZ2 – Affected structure of Bhoothnath to Zero Mile

BZ2 – Affected structure of Bhoothnath to Zero Mile (gone)

DPR SIA 2020	Existing Condition as of July 2022
 <p>ZM1 Shop at Zero Mile</p>	 <p>Latitude: 25.585602 Longitude: 85.181946 Elevation: 51.2737 m Accuracy: 4.1 m Time: 07-20-2022 14:02 Note: zero mile 3</p>
<p>ZM1 – Affected structure of Zero Mile</p>	<p>ZM1 – Affected structure of Zero Mile (gone)</p>
 <p>ZM2 Shop at Zero Mile</p>	 <p>Latitude: 25.585678 Longitude: 85.183918 Elevation: 53.1732 m Accuracy: 27.8 m Time: 07-20-2022 14:06 Note: zero mile 5</p>
<p>ZM2– Affected structure of Zero Mile</p>	<p>ZM2– Affected structure of Zero Mile (gone)</p>
 <p>DP1, Residential House Depot</p>	 <p>Latitude: 25.572898 Longitude: 85.191261 Elevation: 51.52221 m Accuracy: 10.5 m Time: 07-19-2022 16:23 Note: depo structure 0</p>
<p>DP1 – Affected structure of Depot</p>	<p>DP1 – Affected structure of Depot</p>
 <p>DP2, Residential House, Depot</p>	 <p>Latitude: 25.572618 Longitude: 85.19085 Elevation: 51.22215 m Accuracy: 40.1 m Time: 07-19-2022 16:21 Note: depo structure 1</p>
<p>DP2 – Affected structure of Depot</p>	<p>DP2 – Affected structure of Depot</p>

Attachment 10. Proposed Monitoring Form

RAP Monitoring Format (Monthly) Monitoring of RAP Implementation for Patna Metro Project

Report for the month of :.....

(For quarterly report, please bind 3 monthly reports, with a summary page on top.)

Part-I: Quantitative monitoring format

Activity	Indicator	Target		Achievement	
		This Month	Cumulative	This Month	Cumulative
Staffing	Number of Metro staff on the project by job function (person)				
	Number of other line agency officials available for tasks (person)				
Land	Area of private land acquired (sqm)				
	Area of Govt. land acquired (sqm)				
Religious, Community, and Government Properties	No. of religious properties relocated				
	No. of community properties relocated				
	No. of Govt. properties relocated				
Verification of impact	No. of project affected households				
	No. of project affected persons				
	No. of households losing residence				
	No. of households losing livelihood				
	No. of households relocated				

Activity	Indicator	Target		Achievement	
		This Month	Cumulative	This Month	Cumulative
Resettlement	No. of households identified at relocated location				
	No. of household heads provided with ID Card as Project Affected Households				
	No. of households received compensation (6. Entitlement (2) a-f)				
Rehabilitation	No. of training agencies identified				
	No. of households undergone skill development training (6. Entitlement (2) g.)				
	No. of households who expressed their willing for assistances listed in 5. Entitlement (1) 2.				
	No. of households the Committee recommended for rehabilitation.				
	No. of households awarded the rehabilitation assistances listed in 5. Entitlement (1) 2.				
Grievance Redressal	Formation of grievance redress committee				
	No. of grievance redress committee meetings conducted				
	No. of grievances received				
	No. of grievances solved				
Review and Monitoring	No. of staff meetings conducted at PIU level				
	Date of appointment of Independent Evaluation Agency (IEA)				
	Frequency of submitting progress reports				
Fund utilization	Funds utilized				

Part-II- Qualitative Monitoring format

1.	Successes, difficulties, lessons learned in identifying the target households
2.	Successes, difficulties, lessons learned in inquiring the needs and requests of target households, and preparing the custom-made micro RAP for the particular household.
3.	Successes, difficulties, lessons learned in making the recommendations by the Committee regarding the provision of compensation and rehabilitations.
4.	Successes, difficulties, lessons learned in paying the compensation and providing assistances.
5.	Type of grievances, its reasons and measures taken to address them.
6.	Type of assistances and trainings the target households selected for rehabilitation.
7.	Successes, difficulties, lessons learned in coordination with other authorities.
8.	Other major issues faced during reporting period and actions taken to resolve it.
9.	Major lessons learned and documented.

Signature

Name and Designation of the Reporting officer

Place:

Date:

Attachment 11. 1st Public Consultation

Minutes of Meeting

Public Consultations Meeting

Date: 27/5/2020 to 30/05/2020

Venue: Rukanpura, Raza Bazar, Gandhi Maidan, Bigrahpur and Zero mile.

Public Consultations meeting was held by DMRC to discuss the draft Environmental Impact Assessment Report and seek opinion and suggestions from key stakeholders on the proposed Corridor-1 and Corridor-2 of Patna Metro Rail Project.

Due to spread of Corona pandemic throughout the country and Patna city, stakeholder meeting was done keeping in view the requirement of social distancing. As large gathering was not allowed during COVID restriction, meeting was arranged at fixed locations easily accessible to Project affected families and other interested stakeholders with small group of PAPs. The meeting was held at 5 different locations i.e Rukanpura, Raza Bazar, Gandhi Maidan, Bigrahpur and Zero mile.

During public consultations, issues related to land acquisition, physical environment like air quality deterioration, noise generation, dust emission, employment generation, information flow, grievance redressal, safety, role of administration etc. were discussed.

Points discussed during the meeting and the opinion/suggestions received are as under:

Sl. no.	Location	Date	Issue discussed	Opinion/suggestions	Remarks
1.	Rukanpura	27/05/2020	Displacement	<ul style="list-style-type: none"> The private land acquisition should be avoided. 	<ul style="list-style-type: none"> Due to site constraints /land constraints, private land acquisition is necessary.
			Dust Generation during construction	<ul style="list-style-type: none"> People expressed that construction may generate dust in atmosphere. How, it will be controlled? 	<ul style="list-style-type: none"> All construction activities shall be carried out within barricaded area. Mist spray gun shall be used for suppression of airborne dust particles. Wheel wash facility will be provided at exit gates. Vehicles carrying construction material will be fully covered. Sprinkling of water shall be done at least thrice a day to suppress dust. Soil, sand, aggregate, debris of any kind and all dust prone materials that is

					<p>stored at site shall be fully covered with tarpaulin or green net so that it does not disperse in the air in any form.</p> <ul style="list-style-type: none"> • Covered storage facility with sprinkling system for sand and aggregate storage shall be provided.
			Noise due to working of Machinery	<ul style="list-style-type: none"> • Heavy machinery will work on the project creating Noise. 	<ul style="list-style-type: none"> • Silent DG set shall be used in the project. • Enclosures for stationary equipment and noise barriers around particularly noisy areas on site depending upon the land use shall be provided. • Timely maintenance as per manufacturer's schedule will be carried out to keep Noise under control. Activities of heavy machinery would be staggered to reduce cumulative impacts. • Use of impact devices, such as jackhammers, and pavement breakers will be minimized. • Noise producing equipment such as jackhammers and pavement breakers will be provided with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise limitations. • Mufflers or shield paneling shall be provided for other equipment, including internal combustion engines,

					recommended by manufacturers thereof.
2.	Raja Bazar	27/05/2020 and 30/05/2020	Dust and Smoke will be there due to the project	<ul style="list-style-type: none"> Participants pointed out that construction may generate dust and smoke in atmosphere. 	<ul style="list-style-type: none"> All construction activities shall be carried out within barricaded area. Mist spray gun shall be used for suppression of airborne dust particles. Wheel wash facility will be provided at exit gates. Vehicles carrying construction material will be fully covered. Sprinkling of water shall be done at least thrice a day to suppress dust. Soil, sand, aggregate, debris of any kind and all dust prone materials that is stored at site shall be fully covered with tarpaulin or green net with proper anchorage so that it does not disperse in the air in any form. Covered storage facility with sprinkling system for sand and aggregate storage shall be provided. Only vehicles having valid PUC will be allowed.
			Displacement	<ul style="list-style-type: none"> Many Participants mentioned that they were having their shops on rent and they will be displaced due to project. 	<ul style="list-style-type: none"> At the time of payment of award money this aspect shall be considered and both owner and tenant will be involved. Compensation will be given as per Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act,


					2013, Bihar Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2014, Bihar State Street Vendors (Protection of Livelihood and Regulation of Trade) Act, 2012.
			Traffic Hinderance	<ul style="list-style-type: none"> Many participants had the fear that project activity may lead to traffic Jams 	<ul style="list-style-type: none"> Project activities in the area will be underground and will be confined to barricaded area and Traffic Management Plan will be in place in consultation with Traffic Police.
3	Gandhi Maidan	29/05/2020	Rehabilitation	<ul style="list-style-type: none"> Mainly discussed social Issues of rehabilitation and alternate land was discussed. 	<ul style="list-style-type: none"> Compensation/ rehabilitation will be done as per Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, Bihar Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2014, Bihar State Street Vendors (Protection of Livelihood and Regulation of Trade) Act, 2012.
			Dust and Smoke will be there due to the project	<ul style="list-style-type: none"> Expressed that there may be dust and smoke in the area. 	<ul style="list-style-type: none"> All construction activities shall be carried out within barricaded area. Mist spray gun shall be used for suppression of airborne dust particles. Wheel wash facility will be provided at exit gates.

					<ul style="list-style-type: none"> • Vehicles carrying construction material will be fully covered. • Sprinkling of water shall be done at least thrice a day to suppress dust. • Soil, sand, aggregate, debris of any kind and all dust prone materials that is stored at site shall be fully covered with tarpaulin or green net with proper anchorage so that it does not disperse in the air in any form. • Covered storage facility with sprinkling system for sand and aggregate storage shall be provided. • Only vehicles having valid PUC will be allowed.
			Traffic Hinderance	<ul style="list-style-type: none"> • They also fear that excavated earth will be lying there blocking pathways. 	<ul style="list-style-type: none"> • There will be instruction to contractor to not allow stacking of excavated earth on pathways and timely removal of all wastes will be in place.
4	Bigrahpur-	29/05/2020	Noise Generation due to Project working	<ul style="list-style-type: none"> • The participants wished that Noise generated during construction and operation should be controlled. 	<ul style="list-style-type: none"> • Silent DG set shall be used in the project. • Enclosures for stationary equipment and noise barriers around particularly noisy areas on site depending upon the land use shall be provided. • Timely maintenance as per manufacturer's schedule will be carried out to keep Noise under control. Activities of heavy machinery would be staggered to reduce cumulative impacts.

					<ul style="list-style-type: none"> • Use of impact devices, such as jackhammers, and pavement breakers will be minimized. • Noise producing equipment such as jackhammers and pavement breakers will be provided with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise limitations. • Mufflers or shield paneling shall be provided for other equipment, including internal combustion engines, recommended by manufacturers thereof.
			The alignment after Mithapur will affect many structures.	<ul style="list-style-type: none"> • Stakeholder suggested to review the alignment. 	<ul style="list-style-type: none"> • Alternatives have been considered and thereafter the route has been finalized.
			Waste dispersal in the area	<ul style="list-style-type: none"> • People fear that even small construction activities lead to debris, such large project will generate huge quantity of wastes. 	<ul style="list-style-type: none"> • Any waste and debris generated will be kept only at designated location with all the required precaution such as covering and etc. • Excavated material will be used for backfilling and surplus will be disposed off to authorized location only. • C&D waste will be reused at site and any surplus will be disposed off to authorized location. • There will be instruction to contractor to not allow

					stacking of excavated earth on pathways and timely removal of all wastes.
5	Zero Mile	28/05/2020	Displacement	<ul style="list-style-type: none"> • Being Kiosks on Govt land they had no major issues. However, asked for consideration for avoiding them from displacement. 	<ul style="list-style-type: none"> • Alternatives have been considered and thereafter the route has been finalized. • If displaced, compensation will be given as per Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, Bihar Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2014, Bihar State Street Vendors (Protection of Livelihood and Regulation of Trade) Act, 2012.
			Dust and Smoke	<ul style="list-style-type: none"> • Participants pointed out that construction may generate dust and smoke in atmosphere. 	<ul style="list-style-type: none"> • All construction activities shall be carried out within barricaded area. • Mist spray gun shall be used for suppression of airborne dust particles. • Wheel wash facility will be provided at exit gates. • Vehicles carrying construction material will be fully covered. • Sprinkling of water shall be done at least thrice a day to suppress dust. • Soil, sand, aggregate, debris of any kind and all dust prone materials that is stored at site shall be fully covered with

					<p>tarpaulin or green net with proper anchorage so that it does not disperse in the air in any form.</p> <ul style="list-style-type: none">• Covered storage facility with sprinkling system for sand and aggregate storage shall be provided.• Only vehicles having valid PUC will be allowed.
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दिल्ली मेट्रो रेल कॉर्पोरेशन लि०
DELHI METRO RAIL CORPORATION LTD.
 (एनटीसी सरकार एवं दिल्ली सरकार का संयुक्त उपक्रम)
 (A JOINT VENTURE OF GOVERNMENT OF INDIA AND GOVT. OF DELHI)

पर्यावरण प्रभाव आंकलन के लिए जन सभा की पूर्व सूचना

कमांक : दिनांक : 01/05/20

सेवा में,
 Shri Havendro Thakur
 Sudha dany
 Gandhi maidan

पूर्व बैठक सूचनार्थ नोटिस

महोदय,

आपको सूचित करना है कि पटना मेट्रो रेल का निर्माण कार्य प्रारम्भ हो रहा है। इस सम्बन्ध में आपको सूचित करना है कि इस परियोजना से प्रभावित व्यक्तियों तथा अन्य हितधारकों कि जनसभा का आयोजन 27, 28, 29 और 30 मई 2020 को करना निर्धारित किया गया है।

कोरोनावायरस समस्या के कारण यह बैठक छोटे समूहों में परियोजना स्थल के निकट आयोजित कि जायेगी। गाँधी मैदान में ये जनसभा 29/05/2020 को बस स्टैंड के समीप टमटमपाड़ा में सुबह 11 बजे की जायेगी।

अतः आपसे अनुरोध है कि आप इस बैठक में सामाजिक दूरी का पालन करते हुए भाग लेना सुनिश्चित करें व अपने सुझाव तथा समस्याओं पर विभागो अधिकारियों के साथ विचार-विमर्श कर निदान प्राप्त करें।


 भवदीय


 Bishu

CIN No. U74899DL 1995GOI068150



दिल्ली मेट्रो रेल कॉर्पोरेशन लि० DELHI METRO RAIL CORPORATION LTD.

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(A JOINT VENTURE OF GOVERNMENT OF INDIA AND GOVT. OF DELHI)

OFFICE OF PROJECT DIRECTOR / PATNA METRO

पर्यावरणीय प्रभाव आकलन के लिए हितधारक परामर्श

उपस्थिति पत्र

दिनांक: 27.05.2020 & 30.05.2020

क्षेत्र: Raja Bazar.

क्रम संख्या	लिंग	नाम	मोबाइल नंबर	हस्ताक्षर
1.	F	श्रीमती शर्मिष्ठा देवी	-	शर्मिष्ठा देवी
2.	M	Dr. Ajay Singh	-	AS
3.	M	Vinay K.	-	विनाय कुमार
4.	M	Subhakar Singh	-	Subhakar Singh
5.	M	Jyoti Kumar Pandey	-	ज्योति कुमार पाण्डेय
6.	M	राहुल राम	-	राहुल राम
7.	M.	रानी कुमार	-	रानी कुमार

कार्यालय : साई कॉरपोरेट पार्क, ब्लॉक-बी, प्रथम तल्ला, रुकनपुरा, पटना-800014 (बिहार)
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OFFICE OF PROJECT DIRECTOR / PATNA METRO

पर्यावरणीय प्रभाव आकलन के लिए हितधारक परामर्श

उपस्थिति पत्र

दिनांक: 29/05/2020

क्षेत्र: Gandhi Maidan.

क्रम संख्या	लिंग	नाम	मोबाइल नंबर	हस्ताक्षर
1.	M.	Bittu Thakur.		Bittu Thakur.
2.	M.	Bindeswar Yadav.		Bindeswar Yadav
3	M	Prakash. Yadav.		Prakash Yadav
4	M	Aadity Raj.		अदीत्य राज
5	M	यशोवन्त राऊ		यशोवन्त राऊ
6	M	Lonu Rai		लोनू राय
7	M	Umesh Rai		umesh Rai
8.	M	Rhem Rai		Rhem Rai

कार्यालय : साई कॉरपोरेट पार्क, ब्लॉक-बी, प्रथम तल्ला, रुकनपुरा, पटना-800014 (बिहार)
Office : Sai Corporate Park, Block-B, 1st Floor, Rukanpura, Patna - 800014 (Bihar)

CIN No. U74899DL 1995GOI068150



दिल्ली मेट्रो रेल कॉर्पोरेशन लि० DELHI METRO RAIL CORPORATION LTD.

(भारत सरकार एवं दिल्ली सरकार का संयुक्त उपक्रम)

(A JOINT VENTURE OF GOVERNMENT OF INDIA AND GOVT. OF DELHI)

OFFICE OF PROJECT DIRECTOR / PATNA METRO

पर्यावरणीय प्रभाव आकलन के लिए हितधारक परामर्श

उपस्थिति पत्र

दिनांक: २९-०५-२०२०

क्षेत्र: Bighrahar

क्रम संख्या	लिंग	नाम	मोबाइल नंबर	हस्ताक्षर
1.	M.	Sunil Kumar.	-	
2.	M.	Anil Kr. Rai	-	
3	M.	प्रमोद कुमार	-	Pranmod Kumar
4	M.	Chandra Kr. Singh	-	Chandra Kr. Singh
5	M.	Rahul Kumar	-	Rahul Kumar
6	M.	Vijay Sar.	-	Vijay Sar.
7	M.	Ashaji Pr.	-	Ashaji Pr.
8.	M	Dabeu Kr.	-	Dabeu Kr.
9	M	Ashish Kr.	-	Ashish Kr.
10.	M	Arvind Kr.	-	Arvind Kumar.
11.	M	Bablu Kr.	-	Bablu Kumar
12.	M	Chandan. Kr.	-	Chandan. Kumar.
13.	M	Md. Akbar.	-	Md. Akbar
14	M	Rajesh Kr.	-	Rajesh
15.	M.	Syed Ghaseem Hoda	-	S. Hoda
16.	M.	Md. Salauddi	-	Salauddi

कार्यालय : साई कॉर्पोरेट पार्क, ब्लॉक-बी, प्रथम तल्ला, रूकनपुरा, पटना-800014 (बिहार)

Office : Sai Corporate Park, Block-B, 1st Floor, Rukanpura, Patna - 800014 (Bihar)

CIN No. U74899DL 1995GOI068150



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पर्यावरणीय प्रभाव आकलन के लिए हितधारक परामर्श

उपस्थिति पत्र

दिनांक: 28/5/2020

क्षेत्र: ZuoMell

क्रम संख्या	लिंग	नाम	मोबाइल नंबर	हस्ताक्षर
1.	M.	Subject to.	—	Subject to.
2.	M.	Raja to.	—	Raja Kumar
3.	M.	Santosh.	—	संतोष
4.	M.	Mahesh to. Gupta.	—	Sangam Kumar Purohit
5.	M.	Sanga to. Purohit	—	संगम पुरोहित
6.	M.	Anil Purohit	—	अनिल

कार्यालय : साई कॉरपोरेट पार्क, ब्लॉक-बी, प्रथम तल्ला, रुकनपुरा, पटना-800014 (बिहार)

Office : Sai Corporate Park, Block-B, 1st Floor, Rukanpura, Patna - 800014 (Bihar)

Photographs of Stake holder meeting



Public Consultation Meetings



Public Consultation Meetings



Annexure 5 C1**DETAIL OF SPEAKER IN PUBLIC CONSULTATION**

Location: Rukan Pura				
Sl . No.	Name	Gender	Age	Attribute
1.	Md. Alauddin	Male	45	PAP
2.	Sh. Dinesh	Male	34	PAP
3.	Anwar	Male	39	PAP
Location: Raza Bazar				
Sl . No.	Name	Gender	Age	Attribute
4	Smt. Chandrawati devi	Female	32	PAP
5	Dr. Ajay Singh	Male	23	PAP
6	Sh. Sunny Kr.	Male	35	PAP
Location: Gandhi Maidan				
Sl . No.	Name	Gender	Age	Attribute
7	Sh. Billu Thakur	Male	45	PAP
8	Sh. Bindeshwar Yadav	Male	54	PAP
Location: Bigrahpur				
Sl . No.	Name	Gender	Age	Attribute
9	Sh. Sunil Kr.	Male	55	PAP
10	Sh. Amit Kr. Rai	Male	43	PAP
11	Sh. Pramod Kumar	Male	38	PAP
12	Sh. Rahul Kumar	Male	25	PAP
13	Sh. Vijay Sau	Male	40	PAP
14	Sh. Aishwary Rai	Male	60	PAP
15	Sh. Chandan kumar.	Male	58	PAP
Location: Zero mile and Bhootnath		Date: 28.05.2020		
16	Sh. Sujeet Kumar	Male	32	PAP
17	Sh. Raja Kumar	Male	25	PAP

Attachment 12. 2nd Public Consultation

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES		
Title of Meeting : 2 nd Public Consultation		Date of Meeting Monday, 5th September 2022 from 10:00 (AM) to 12:00(PM)
		Venue Khemni Chak Jharokha Banquet
Work Package	ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT	Recorded by Mr. Ankur Agarwal
Name of Organization		Name
Main attendees	PMRCL and DMRC	1. Mr. S. S. Prashad (PMRCL)
		2. Mr. S. N. Pandey (DMRC)
	JICA Study Team and Sub-consultant	3. Mr. Ashish Kumar Singh (JICA study team)
		4. Mr. Ankur Agarwal (Environmental Consultant)
		5. Dr. Shiv Prakash Singh (Environmental Consultant)
Local Participant		Total: 34 persons (32 males and 2 females)
Agenda		Project outline/ Environmental Impact Assessment / Expected impact / Survey / Impact evaluation / Environmental Management and Monitoring Plan
Data/information	Distributed	Presentation slides for the above agendas
	Collected	N/A

No.	Question / Opinion from attendees	Speaker	Response from project proponent
1	Introduction of the Project, and explanation of agenda	Mr. Ankul	
2	My house is just adjacent to the metro path, and the way dust pollution doing on road by their trolleys is not good. This morning I saw that a truck which brushing the road is generating too much dust pollution that no one can stand nearby. They have to spray water before brushing the roads. In today morning the truck carrying the material of metro project causing the too much dust pollution. All the dumpers caring the soil was neither covered nor their tiers cleaned.	Mr. Avinash Anand	Dr. Shiv Prakash replied: we have noted the same, we will take care of it and the same will not repeated in the future.
3	I saw that project was under construction since a long time, specially a single pillar takes the time of 3-4 months. This construction work is too slow its needs to be fast	Mr. Parvat Raj	Dr. Shiv Prakash replied: Okay we have noted the same and look into the matter, work is ongoing and sometimes many problem needs to be faced. We will speed up our work in next 10 days, because there are many factors like weather condition and etc. which cause the delay in work progress. In future we will insure that the work will be done in fast forward mode.

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
4	I have one more question, that due to upcoming metro project the people who were involved in the transportation work like auto, taxi, bus, etc. drivers get unemployed, so do you have any provision for them?	Mr. Parvat Raj	Dr. Shiv Prakash replied; Metro will also generated the employment as well; there is provision in Metro project that on the basis of their capability and skills people get the employment. Recruitment will be done as per the PMRC policy and many Recruitment were already done during this project, in form of casual and technical workers. Employment will be generated for the all the category workers male female as well.
5	Firstly, there is no proper traffic management by PMRC, secondly proper maintenance should be done on passing road. You can come with us and let us know if there any traffic management has been done in nearby area.	Mr. Aviash Anand	Dr. Shiv Prakash replied: We are noting all the points and appropriate action will be taken on it.
6	There is a Turing point (Khemni Chak) near your site and two guards of your facility are stands there. As it is turning point area vehicle comes from all the four directions which cause traffic jam. I have seen that at your site, if any Hydraulic is need to enter at any of your site then one of your guard come and bring it from the yard to the site and block all the public road and after 10 minutes of working again bring that Hydraulic back to the Yard they why you should not keep that Hydraulic on site so it can reused their if needed. Sometime it caused that kind of traffic jam situation that local public has to involved resolve it. Because our society is too cooperative but some educated people will treat others in the different manner, for them your guards have to aside, so how normal citizen can approach them.	Mr. Aviash Anand	Dr. Shiv Prakash replied: We have noted all the points, and will also convey the same to the relevant authority.
7	At many place there are holes on road for the electriciry work. It is already a single sided road but PMRC occupied the portion of the road we can't even park a single vehicle there.	Mr. Roshan Kumar	Dr. Shiv Prakash replied: We have noted all the points, and will also convey the same to the relevant authority.
8	Hello, I am from Patna, I want to ask that after the implementation of metro project what facilities are proposed for the monthly ticket, Just like any arrangement for the monthly passes.	Ms. Mandira	Mr. Ankur Aarwal Replied: Till now nothing has been decided by the Patna metro for the facility like monthly ticket but definitely we will considered your suggestion and forward the same to the company that if any that kind of arrangement can be done by the Patna Metro.
9	I am wandering for the job, I am not getting job at anywhere so I am looking for	Ms. Rinku	Mr. S.S. Prasad immediately responded to get a job as soon as

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
	the job.	Devi	possible and he has already approached immodestly, and after the meeting, he approached to some known person regarding job of Mrs. Rinku Devi and luckily she got the job.
10	<p>Today many good suggestion and complain we have received, we take them all in the positive way and we are sorry for the inconvenience but this program is conducted to understand all such things that what kind of benefits and harms causing due to this project. What do you understand that if in future Patna Metro will implement what kind of benefits and services you get form it? We also consider the same in this Public Hearing. So if any of you thinking the same that what benefits you get by the Patna Metro like it enhance the environment acoustic, transportation facilities, pollution emission form the auto and other vehicle will be reduced which will be beneficial for the environment. If you are thinking that it will reduce the noise and dust emission after implementation. There are two stages; during construction & after construction, and during the construction definitely some inconvenience will be happen but we will try to minimize this inconvenience. We have shown our system here that how we will proceed the project but some time it is possible that some gaps can occur on site but we will take care of them and also increase the monitoring of that location so you not get any inconvenience. So will request that if any of you think that there will be any positive impact in your life standard and environment done by this metro project then please share your positive opinion. As many people have seen in Delhi how metro works. You have question that what kind of benefits provide to the women, so the same kind of benefits will be provided as in Delhi. We have same concept for Patna Metro as Delhi Metro.</p>	Mr. S. N. Pandey (DMRC)	
11	I want to say that, the way Patna-Ganga marine track is developing and the way they inform regarding their progress in development. Patna metro also follow the same method to share all progress report regarding development to the local citizens. All the details like elevation, routs and all development activity should be time to time updated to the local public.	Mr. Parvat Raj	Dr. Shiv Prakash replied: In newspaper time to time information has been published and for this hearing also news advertisement was done. So whatever done by the Patna metro is advertised through the newspaper and different mediums like social media & etc on time to time. You can follow that platform to get update and also you can ask on construction sites for the updates.
12	This metro will provide many benefits to us. Common man is too happy to get	Mr. Roshan	Dr. Shiv Prakash replied: We also trying the same that work is

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
	this metro. We want that this project will completed as soon as possible.	Kumar	completed within the defined framework as soon as possible.
13	Many students comes to study in Patna from outside, so the student get other benefits from Patna Metro rather than the common man or it will be same.	Mr. Roshan Kumar	Dr. Shiv Prakash replied: Till now there is no provision for the same, and PMRC will explore the possibility for the same. But uncle forget that where the metro station develop also bring some employment. In city like Delhi where metro is running there are also auto and taxi driver working and earning. And also in emergency condition auto and taxi is a best transportation option in non-availability of metro. After developing a metro supposed there is 26 metro stations you will get 26 new points for the auto and taxi to get services.
14	So metro will in harm on the employment, running of the auto and taxi remains the same, People just thinking in the wrong way that it will cause unemployment but there will be nothing like this. It will be providing us comfort, it reduced the difference, it save time, it reduces the pollution, reduce the road side accident. Safe for the women transportation.	Mr. Abhishek Kumar Mr. Neeraj Kumar	Dr. Shiv Prakash replied: I request to local police person to share their views. Nitin Kumar, Patna Police: In this Hearing we are here for the arrangements not as public so we can ask or share our views and questions. Mr. Ankur Agarwal: But still if any suggestion from you can share. Nitit Kumar, Patna Police, See if any new project comes it with benefits. All the issue of jam and all will be resolved, it will be beneficial for local people. Dr. Shiv Prakash ended the Hearing with the thanks. Mr. Ankur Agrwal said we kept your point for can forward the same to the higher authority.

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES



Date- 5/9/22

पटना शहर में पटना मेट्रो परियोजना के पर्यावरण प्रभाव आकलन के लिए हितधारकों की बैठक

स्थान:- होटल ज़ोरवा बै-मेट स्टण्ड कॉन्फेरेन्स हॉल
खेमनी चक, पटना

परियोजना प्रस्तावक:- पटना मेट्रो रेल इंफोरेस्टेशन

क्र.सं.	नाम, पिता का नाम	पता	व्यवसाय	फोन नं.	हस्ताक्षर
1	श्री. शशि शर्मा	Patna Metro	Service	767224000	Sharma
2	श्री. शशि				
3	Sandeep	Patna Metro	Office Staff for Empt.	9127101914	Sandeep
4	Suday Kr	Patna Metro	Safety	6208611961	Suday Kr
5	Rohit Tiwari	Patna Metro	Monitoring	6201035500	Rohit
6	Ashok Kr. Chandray	D.C.R. Patna	Magistrate	8709950000	AK
7	Ashish Singh	JICA study team	S.C	956091029	Singh
8	Balbir	milhaker	DRIVER	6202089777	B
9	Anshu Raj	DMRC	Sevi	635207490	AR
10	प्रतिभा			785898003	
11					
12	Sujan Singh	NCC	Service	9643448757	SJ
13	PAWAN KUMAR	DMRC	SE	8434261201	Pawan
14	Abhishek K.	NCC	A.E	7004467213	Abhishek
15	Parvati Raj	Khemichait	Community	9801312899	Parvati
16	B.A. Nandan	NCC	APM	8778174253	Nandan
17	Niraj kumar	Electrician/NCC	Electrician	9693852500	Niraj k.
18	Sandeep Kumar	Supervisor	Supervisor	912009903	Sandeep
19	शशि शर्मा	रेवमन चक			
20	Rohit Pandey	Patna	Job	7301912213	Rohit
21	Pravin Singh	Patna Metro	C-S	7898848830	Singh
22	Mandira Shukla	Patna	Job	9609592649	Mandira
23	Ramprakash	Puithu		9508923121	Ramprakash
24					

रेलमनी चक्र

Date _____
 Page _____

क्रमांक	नाम/पिताका नाम	पता	व्यवसाय	फोन नं०	हस्ताक्षर
25	Suptksham Pr.	line	Police	620421077	Suptksham
26	शिवम-यु शुभा	पुस्तकालय	शिवम	9491462585	शिवम-यु शुभा
27	Santosh Rajat	Police Lin	Police	8340590409	Santosh
28	Mithunkumar	"	"	8340329423	Mithun Pr
29	Mad. Anishu	NCC	NCC	87807835939	Anishu
30	Shambhu S Singh	PMRCL	PMRCL	7992235116	Shambhu
31	S. K. Singh	PMRCL		9990515792	S. K. Singh
32	Anishu Anand	Khemaniat	Business	9123463016	Anishu
33	Raushan kumar	"	Business	9155115843	Raushan
34	ABHIJEETH			9304250349	ABHIJEETH
35	गुणकान्त	कोशीपुर	SI	87094288	गुणकान्त
36	शिवम प्रसाद	पटना	गैस	760066334	शिवम प्रसाद
37	Ankur Agarnal	Patna	Service	7906261352	Ankur
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Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
Title of Meeting		Date of Meeting	
: 2 nd Public Consultation		Monday, 5th September 2022 from 2:00 (PM) to 4:00(PM)	
		Venue	
		New ISBT, Umrao Hotel	
Work Package		Recorded by	
ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT		Mr. Ankur Agarwal	
Name of Organization		Name	
Main attendees	PMRCL and DMRC	1. Mr. S. S. Prashad (PMRCL) 2. Mr. S. N. Pandey (DMRC)	
	JICA Study Team and Sub-consultant	3. Mr. Ashish Kumar Singh (JICA study team) 4. Mr. Ankur Agarwal (Environmental Consultant) 5. Dr. Shiv Prakash Singh (Environmental Consultant)	
Local Participant		Total: 30 persons (30 males and 0 females)	
Agenda		Project outline/ Environmental Impact Assessment / Expected impact / Survey / Impact evaluation / Environmental Management and Monitoring Plan	
Data/information	Distributed	Presentation slides for the above agendas	
	Collected	N/A	

No.	Question / Opinion from attendees	Speaker	Response from project proponent
1	Introduction of the Project, and explanation of agenda	Mr. Ankur	
2	For parking related issues, there will be the provision of underground parking?	Mr. Rishab Singh	Mr. Ankur Agarwal replied: There will be provision for parking at some place but in someplace provision of special parking is there depending on availability.
3	It will be beneficial for the environment, and save time for the employees, provide employment, out comers will be impressed with this project.	Mr. Mohan	
4	This project will bring culture for pollution control board, traffic control board and also sounds good to represent that Patna has its own metro. Also people who don't visit Delhi are able to see metro in Patna also helpful for the tourist for connectivity. It will provide the good connectivity.	Mr. Gaurav Singh	
5	I want to ask that upcoming metro project is not going to any adverse impact? What kind of benefits public gets by metro?	Mr. Satveer	Mr. Ankur Agarwal replied: No any adverse impact done by metro. mostly the path will be above road and underground. It will provide

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
			many benefits like employment, connectivity etc. Increase the small businesses like food stall and all. Dr. Shiv Prakash: This project leads to development like roads, malls, residential and commercial areas near metro like, Noida & Gurgaon developed due to metro projects.
6	Where will be the first metro station?	Mr. Bilal	Mr. Ankur Agarwal replied: Metro Route will be from Patna station to New ISBT, and first station will be installed in ISBT and continued to Patna station. Locations at which the population is danded, there will be provision of underground metro.
7	It is very good thing that Patna getting its metro, it will enhance the business opportunity and connectivity.	Mr. Bilal	S. N. Pandey: If you visit project site you find the difference between others construction and our construction.
8	In private company we observed that they take care of Higgins. They put awareness boards at site.	Mr. Rishab Singh	Dr. Shiv Prakash replied: It will be more beneficial to reduce Noise and Air pollution. It reduces the no. of vehicles on road. In cities like Delhi, Mumbai pollution is big issue, metro project become helpful to reduce pollution. Any other wants know something about this project is free to ask.



Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES



पटना शहर में पटना मेट्रो परियोजना के पर्यावरण प्रभाव
आकलन के लिए हितधारकों की बैठक

स्थान - माती होल सेंटर वैम्बेकर राजा बाजार पटना

परियोजना प्रस्तावक - पटना मेट्रो रेल कारपोरेशन

क्र.सं.	नाम/पिता का नाम	पता	व्यवसाय/पद	मोबा.नं.	हस्ताक्षर
01	Navin kumar	पटना/मिर्जापुर/मिर्जापुर	CS/बिहार	849511954	Navin
02	Ashish K. Singh	patna	senior conductor	9580910229	Ashish
03	wikash kumar	patna	student	834045008	Dubey
04	Chhota	patna	student	3576861000	Chhota
05	Rohit Tiwari	patna	student	6201095223	Rohit
06	Shiv shanker pal	patna	DM/PMRCL	7677241292	sejournal
7	Milind Joshi	Nagpur.	Business	986035244	Milind
8	Rohit Pandey	Patna	STOB	7301812228	Rohit
7	SATISH KUMAR	kankarbagh	कर्मि	860301077L	SATISH
10	Deepshin	Patna	spvt.	9650686979	Deepshin
11	Deepshin	Patna	pub	7544887416	Deepshin
12	Ankur Agrawal	patna	unice	7706221952	Ankur
13	Deepak	Patna		70041855538	Deepak
14	Amresh kumar	patna	Police	8789049630	Amresh
15	Rohit Kapri	Patna	Police	781456107	Rohit
16	राजेश कुमार				
17	Anushka	Patna	Teacher		Anushka
18	S. N Pandey	Patna	DM/RC	9990511598	S. N
19	S b chandra	Patna	Teacher	7352885877	S b
20	Vikas Kumar	Patna	Govt job	700855823	Vikas
21	Anprakash Singh	Assam	student	8099006570	Anprakash
22	Jay prakash singh	Assam	student	8133852439	Jay prakash
23	Sushant	Patna	Police	9199785992	Sushant
24	Charan kumar	Patna	Police	785901930	Charan

क्रमांक	नाम/पिता का नाम	पता	व्यवस्था	मो. नंबर	हस्ताक्षर
25	Avadhokta Gunday	Patna	Job	9336202721	AK Pandey
26	Rita Tiwary				
27	Kundan Pratap S.	Patna	Job	9798569293	K. S. S.
28	Sangeet K. Singh	Patna	Job	948835841	S. S. S.
29	Gabind Pandey			9097905877	
30	Uttam K. S.	Patna	Job	9308102489	U. S. S.
31	Manish Kumar	Patna	Job	8757451938	M. S. S.
32	Sachin Kumar	Patna		8102862736	S. S. S.
33	Punjab	Varanashi	Job	7068583885	P. S. S.
34	Pradeep Kumar			6287022977	P. S. S.
35	Sonu Singh	Patna	Job	8210901115	S. S. S.
36	Rajeev Ranjan S. U. P. S.	FATUHA	Job	6203303461	R. S. S.
37	Ankur Aggarwal	Patna	Job	7706201952	A. S. S.

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
Title of Meeting : 2 nd Public Consultation		Date of Meeting Tuesday, 6 th September 2022 from 10:00 (AM) to 12:00(PM)	
		Venue RPS More, Heritage Garden	
Work Package ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT		Recorded by Mr. Ankur Agarwal	
Name of Organization		Name	
Main attendees	PMRCL and DMRC	1. Mr. S. S. Prashad (PMRCL) 2. Mr. S. N. Pandey (DMRC)	
	JICA Study Team and Sub-consultant	3. Mr. Ashish Kumar Singh (JICA study team) 4. Mr. Ankur Agarwal (Environmental Consultant) 5. Dr. Shiv Prakash Singh (Environmental Consultant) 6. Mr. Milind Joshi (Environmental Consultant)	
Local Participant		Total: 45 persons (43 males and 2 females)	
Agenda		Project outline/ Environmental Impact Assessment / Expected impact / Survey / Impact evaluation / Environmental Management and Monitoring Plan	
Data/information	Distributed	Presentation slides for the above agendas	
	Collected	N/A	

No.	Question / Opinion from attendees	Speaker	Response from project proponent
1	Introduction of the Project, and explanation of agenda	Mr. Ankur	
2	This project is very good, Contribute in the development of Bihar. But problem is that it causes the unemployment for our common man. But those people who used auto, cab, taxi will get affected.	Mr. Ajeet Kumar	Mr. Ankur agarwal reply: No, it will not cause any unemployment although it will generate employments. Mr. Ankur agarwal reply: There will be no change in use of number of cab, auto and taxi. If someone wants to use his vehicle he will use it. Metro is for those who want to use it for short distance of travel from one point to another, rest of all people can use auto cab & taxi and condition remains same. The people who used own vehicle to travel from one place to another, generally those people use metro. Mr. Milind Joshi: After this project you can go from metro where you want to go. Means your number of trips will increase

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
			simultaneously for example if you have to travel from Danapur to Gandhi nagar, so distance you needs to cover-up will get shorter and then you can just go where you want so numbers of trips will increase. Share auto and share rickshaw will remain the same. Metro will impact in distance & time which leads to increase in numbers of trips which leads to increase in earning. Because for which trip you take 1 hour to complete due to traffic jam which will be completed within 15 minutes, for example if you paying 30rs. For some distance, after implementing metro you can cover it in 15-20rs. As due to more number of trips you will earn more. So if you think in this prospective then you understand all the benefits. We are saying on the basis of our survey.
3	You are working as per system. After the metro project some benefits like connectivity improvement, employment generations and some issues like environment pollution, road damage will be observed.	Mr. Ramesh Kumar Singh	Mr. Milind Joshi: Yes to get something new we have to face some small issues, second thing is that direct employment means get employed in metro but it is not for everyone but secondary employment like food stalls below the metro station will be for everyone.
4	Yes, we also have seen that many works have done related to the environment. Also we have observed that many employments get increased.	Mr. Sinu Kumar	Mr. Milind Joshi: Yes as I said that it contributes in Direct and Indirect employment like Delhi, Kanpur, Pune, etc.
5	As Patna Metro is developing there are too many machines are involved which we were never saw before and we never thought we will see it in Patna, before we saw such thing in cities like Delhi, Mumbai. My question is that its okay metro is developing which is good for the environment, for noise pollution & air pollution, but I don't think it will help for the employment for educated people.	Mr. Sinu Kumar	Mr. Milind Joshi: See if for reaching somewhere from home is takes time, so in this time you can do additional work. Direct employment should not be the only source. As I said in secondary employment to do additional work along with your existing work and how can you grab that secondary work, think about that. As situation we have observed in Delhi, Nagpur, Hyderabad, Mumbai, Bangalore situation you will see such things here also.
6	Examples of which cities you are giving is, IT companies are there, and employees of those companies used metro facility regularly. In case of Patna suppose if we have to take a distance of just two stations then we will prefer the E-rickshaw which cost is lesser than the minimum price of Metro.	Mr. Sinu Kumar	Mr. Milind Joshi: Yes as you say you prefer E-rickshaw for short distance, but for the long distance you will use metro. As I said earlier for the short distance like from metro station to somewhere you will use auto & taxi. If supposed due to multiple metro stations, auto and taxi get multiple distribution points. Which is also helpful to distribute the traffic equally. It helps to reduce the business

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
			competition. Suppose if I have to take metro from Gandhipur station to Danapur station then first I take auto from my home to Gandhipur station then I take auto from Danapur station to my office, so in place of taking single auto I will take double auto which leads to increase in indirect employment which increase the no. of trips for the auto drivers.
7	The employment we are getting is can't fulfill the daily needs as things are getting overpriced so you should think about it.	Ms. Neetu Devi	Mr. Milind Joshi: As per govt. of India for the ladies everywhere is 33% of job reservation. Job vacancies will be published in newspaper you will definitely apply for it. Second thing if travel with metro, there is provision of reserve coach and seats for ladies and senior citizen also at metro station there will be provision of rest room for the ladies. In addition of this if you want anything you let us know we record it and pass to the higher authority.
8	Around since 2016, I am listening that Patna will getting metro project. When I see 2 year back the first metro work started and I get happy. It will develop and provide the facilities by getting metro happiness spread in Patna. Congratulation to get Patna Metro, when we get outside we listen that metro is running somewhere, but now we will say that metro running in Patna, we get chance to visit metro also our children utilize the metro. People say's to use that they see metro then we asked to them, How metro looks like and we want to see metro. So now we are getting our own metro.	Mr. Chandan Kumar Gupta	
9	I want to ask that with the development of the metro, plantation will be done as like Delhi.	Mr. Shankar	Mr. Ankur agarwal reply: Yes there will also same kind of plantation will be developed. If metro goes on flyover the green belt will be developed in bottom. As we have represented in the presentation also conservation plan for the plantation will be developed and new plantation will be planted to the nearby areas.
10	We are getting employment. I want to ask that the environment development work will be continued of stop after some period of time.	Mr. Nitish Sharma	Mr. Ankur agarwal reply: Yes the Environment development program will be continued as going on. And we will do all environment related work. Mr. Milind Joshi: Although we also improve the condition of current environment status.

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES



पटना शहर में पटना मेट्रो परियोजना के पर्यावरण प्रभाव
आकलन के लिए हिमदाको की बैठक

स्थान - हेरीवेज गार्डन आरंभिक स्तर मोड़.

परियोजना - प्रस्तावक - पटना मेट्रो रेल कारपोरेशन

क्र.सं.	नाम/पिताका नाम	पता	व्यवसाय	मो. नंबर	हस्ताक्षर
1	Avanish Kumar	PATNA	JOB	9336202721	Avanish Kumar
2	खोटेड खोटेड कुमार	बाटना	प्राइवेट	9851900580	खोटेड कुमार
3	Rohit Tiwari	Patna	Job	6201035223	Rohit
4	पिकु कुमारी	Patna	Job	---	पिकु कुमारी
5	Atitika Kumar	sewara	Job	9544887416	Atitika
6	Sunil Kumar	Donson	Business	963148857	Sunil
7	Anshu Kumar	Patna	DMRC	635207770	A.N.
8	S. N. Pandey	"	"	"	S.N.
9	Ashish K. Singh	Patna	JST	9560910229	Ashish
10	Shiv Shanker Prasad	Patna Metro	D.M./DMRC	7677241142	Shiv Shanker
11	Milind Joshi	Patna	Business	986035244	Milind
12	अजित राय	संगुनामौर	बिजनेस कान्स्टेबल	7492076306	अजित राय
13	दिपक कुमार	सोहगाँव	डाक्टर	9472833386	दिपक कुमार
14	मिश्र लाल चौधरी	पटना	पुलिस	9806005403	मिश्र लाल चौधरी
15	Vijay Kumar Pandey	Patna	Police Vice	7498895736	Vijay Kumar Pandey
16	दीनाराम चौधरी	Patna	कार्पोरेट	9931944038	दीनाराम चौधरी
17	Chander Kir	PATNA	Event	8051907228	Chander Kir
18	Rohit Pandey	Patna	Job	7301812228	Rohit Pandey
19	Rohit Kumar	Patna	Job	9546933706	Rohit Kumar
20	Munna Kumar	Patna	JOB	7498447805	Munna Kumar
21	Sumit Kumar	Patna	Student	7856906763	Sumit Kumar
22	Vikas Kumar	Patna	Student	8540451056	Vikas Kumar

Date _____
Page _____

क्रमांक	नाम/पिता का नाम	पता	व्यवसाय	मो नंबर	एस्टेट
23)	राजेश कुमार	पटना	वाहन	858198583	
24)	राजेश कुमार	पटना	वाहन	773970127	
25)	शंकर कुमार	पटना	वाहन	7292	963396
26)	शंकर कुमार	पटना	वाहन	95087	37436
27)	महेश	पटना	Job	930889467	
28)	महेश कुमार	पटना	वाहन	9955369845	
29)	शंकर कुमार	पटना	A.C.P WORK	954694125	
30)	शंकर कुमार	पटना	B-A-C	629919075	
31)	शंकर कुमार	पटना	Home wife	111	
32)	शंकर कुमार	पटना	Job	980131022	Majid
33)	Shankar Kumar	Patna	Job	821014288	Arif
34)	Sahel Khatun	Patna	Job	8290656244	JK
35)	Nishal Kumar	Patna	Job	8218689135	Vishal
36)	Shankar	Patna	Silinder	7011807	Arif
37)	Shankar Singh	K. Bazar	Chiller	62035048	
38)	Arif Kumar	Patna		8507223322	Arif
39)	Ajay Kumar	Patna	Job	-	Arif
40)	Nitesh Sharma	Patna	Job	7667532991	Nitesh
41)	Antony Ka Singh	Patna	Job	6206542740	Arif
42)	Ram Singh	Patna	Job	876629	GSQ
43)	Shankar Singh	Patna	Job	709124068	
	Ankur Singh	Patna	Job	790626198	

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES		
Title of Meeting	: 2 nd Public Consultation	Date of Meeting Monday, 6th September 2022 from 2:00 (PM) to 4:00(PM)
		Venue Raja Bazaar, Hotel Matri
Work Package	ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT	Recorded by Mr. Ankur Agarwal
	Name of Organization	Name
Main attendees	PMRCL and DMRC	1. Mr. S. S. Prashad (PMRCL) 2. Mr. S. N. Pandey (DMRC)
	JICA Study Team and Sub-consultant	3. Mr. Ashish Kumar Singh (JICA study team) 4. Mr. Ankur Agarwal (Environmental Consultant) 5. Dr. Shiv Prakash Singh (Environmental Consultant) 6. Mr. Milind Joshi (Environmental Consultant)
	Local Participant	Total: 37 persons (34 males and 3 females)
	Agenda	Project outline/ Environmental Impact Assessment / Expected impact / Survey / Impact evaluation / Environmental Management and Monitoring Plan
Data/information	Distributed	Presentation slides for the above agendas
	Collected	N/A

No.	Question / Opinion from attendees	Speaker	Response from project proponent
1	Introduction of the Project, and explanation of agenda	Mr. Ankur	
2	It is a very good project.	Prakash	
3	Suppose if metro is running and suddenly earthquake happens, then what will be the emergency methods to be adopted.	Mr. Surendar Kumar (Patna Police)	Mr. Ankur Agarwal Reply: Patna Metro is using the earthquake resistance technique, if such situation happen metro will stop at its location.
4	So how much time it will take to operation of Patna Metro.	Mr. Chandan Kumar (Patna Police)	Mr. Ankur Agarwal reply: It will accomplished by 2025-26.
5	It is very good thing after it Patna will not lower then Delhi now it's time for Patna after Delhi.	Mr. Anushkha (Teacher)	
6	It is very good thing metro is going to be run in Patna.	Ms. Sumila Devi	

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES



पटना शहर में पटना मेट्रो परियोजना के पर्यावरण प्रभाव
आकलन के लिए हितधारकों की बैठक

स्थान - माती होल सेंटर वैम्बेकर राजा बाजार पटना

परियोजना प्रस्तावक, पटना मेट्रो रेल कारपोरेशन

क्र.सं.	नाम/पिता का नाम	पता	व्यवसाय/पद	मोबा.नं.	हस्ताक्षर
01	Navin kumar	पटना/मिर्जापुर/मिर्जापुर	CS/बिहार	849511954	Navin
02	Ashish k. singh	patna	senior conductor	9580910229	Ashish
03	wikash kumar	patna	student	834045008	Dubey
04	Chhota	patna	student	3576861000	Chhota
05	Rohit Tiwari	patna	student	6201095223	Rohit
06	Shiv shanker pal	Patna	DM/PMRCL	7677241292	sejournal
7	Milind Joshi	Nagpur.	Business	986035244	Milind
8	Rohit Pandey	Patna	STOB	7301812228	Rohit
7	SATISH KUMAR	kankarbagh	कर्मचारी	860301077L	SATISH
10	Deepshin	Patna	spvt.	9650686979	Deepshin
11	Balraj kumar	patna	pub	7544887416	Balraj
12	Ankur Agrawal	patna	unice	7706221952	Ankur
13	Deepak	Patna		7001855538	Deepak
14	Amresh kumar	patna	Police	8789049630	Amresh
15	Rabish Kapri	Patna	Police	781456107	Rabish
16	राजेश कुमार				
17	Anushka	Patna	Teacher		Anushka
18	S. N Pandey	Patna	DM/RC	9990511598	S. N
19	S b chandra	Patna	Teacher	7352885877	S b
20	Vikas Kumar	Patna	Govt job	700855823	Vikas
21	Anprakash Singh	Assam	student	8099006570	Anprakash
22	Jay prakash singh	Assam	student	8133852439	Jay prakash
23	Sushant	Patna	Police	9199785992	Sushant
24	Charan kumar	Patna	Police	785901930	Charan

क्र.सं.	नाम/पिता का नाम	पता	व्यवस्था	मो. नं.	हस्ताक्षर
25	Avadhokta Gunday	Patna	Job	9336202721	AK Pandey
26	Rita Tiwary				
27	Kundan Pratap S.	Patna	Job	9798569293	K. S. S.
28	Sangeet K. Singh	Patna	Job	948835841	S. S. S.
29	Gabind Pandey			9097905877	
30	Uttam K. S.	Patna	Job	9308102489	U. S. S.
31	Manish Kumar	Patna	Job	8757451938	M. S. S.
32	Sachin Kumar	Patna		8102862736	S. S. S.
33	Punjab	Varanashi	Job	7068583885	P. S. S.
34	Pradeep Kumar			6287022977	P. S. S.
35	Sonu Singh	Patna	Job	8210901115	S. S. S.
36	Rajeev Ranjan P. U. P.	FATUHA	Job	6203303461	R. S. S.
37	Ankur Aggarwal	Patna	Job	7706201952	A. S. S.

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
Title of Meeting : 2 nd Public Consultation		Date of Meeting Monday, 7th September 2022 from 2:00 (PM) to 4:00(PM)	
		Venue Patna Station, Samrat International	
Work Package ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT		Recorded by Mr. Ankur Agarwal	
Name of Organization		Name	
Main attendees	PMRCL and DMRC	1. Mr. S. S. Prashad (PMRCL) 2. Mr. S. N. Pandey (DMRC)	
	JICA Study Team and Sub-consultant	3. Mr. Ashish Kumar Singh (JICA study team) 4. Mr. Ankur Agarwal (Environmental Consultant) 5. Dr. Shiv Prakash Singh (Environmental Consultant) 6. Mr. Milind Joshi (Environmental Consultant)	
Local Participant		Total: 50 persons (45 males and 5 females)	
Agenda		Project outline/ Environmental Impact Assessment / Expected impact / Survey / Impact evaluation / Environmental Management and Monitoring Plan	
Data/information	Distributed	Presentation slides for the above agendas	
	Collected	N/A	

No.	Question / Opinion from attendees	Speaker	Response from project proponent
1	Introduction of the Project, and explanation of agenda	Mr. Ankur	
2	Nearby, I am having Liberty shop and a metro station is going to be develop on that location, so I want to know that the barricading will be developed outside the shop?	Mr. Vinod Kumar	Mr. Milind Joshi: No, currently there will be no barricading installed and in future it will be only installed for the construction purpose. After that it will be removed. I going to tell you again that the structures to be affected are Sudha Milk, Paneer Shop, Pann Shop, Liberty fashion shop and Golu. These 5 shops will be affected. Whatever structure will be affected is get prior notice in 2020. After it no any additional structure will be affected. Anything will be disturbed after getting the proper notice. So you don't worry activity will be done outside the barricading. Development will be done within the barricading. Barricading is just for the construction purpose maximum for the period of 1-1.5 year.

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
3			
4	Thank you, we just want to know about that barricading and we are here to support the Patna Metro project.	Mr. Shaukat Ali	Mr Milind Joshi: Yes that's why Public hearing is being conducted so you get clear your all doubts and any kind of miss communication and rumors did not spread. This Public hearing is conducted for your favor.
5	I want to know that what type of issues can be faced. As a shopkeeper what kind of issued will be faced by us during tenure. This work will be limited to the metro station. Yes that's my point, if barricading will be installed then how costumers can approach to the shops.	Mr. Rashid Akhtaquar Mr. Shadique	Mr. Pandey: There will be no such issues, to prevent from the accidents, barricading is being installed so whatever soil will be excavated that will be transported by dumper. And for the traffic control Bihar police will there for the support. Mr. Ankur Agarwal reply: Yes but excavated soil will transport outside. Mr. S.N. Pandey: There will be no disturbance; all the activity will be limited within the barricading. Mr. S.N. Pandey: After considering all the scenarios, we will make sure that your shop not get disturbed and proper arrangements will made against the disturbance. That's why development activity will do in parts.
6	I also want to know that parking facility will be remaining same or it may get changed.	Mr. Shadique	Mr. S.N. Pandey: All the issues you are pointing out will be kept in mind and adequate work will be done so no disturbance will occur. This metro project is for your conveyance, without your support we can't developed the metro project. And we will take care of you all.
7	You are saying, underground metro will be developed then suppose if someone's house above the metro route and if his tubewell and boaring is there than what will happen to it.	Mr. Prem Lal	Mr. S.N. Pandey: Arrangement will be done for such thing and If any obstruction will faced then it will be shifted properly.
8	How much feet underground work will be?	Mr. Shaquat Ali	Mr. S.N. Pandey: 20-30 meter may be very depending on the design.
9	What oppotunities will be developed for the local unemployed citizens?	Mr. Ramanuj	Mr. S.N. Pandey: Time to time on the basis of advertisement and qualification, appointment will be done and local candidates will get preference. If local candidate is not available in that outsider get preference.

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
			<p>It gives employment to the many people. Already 4-5000 employees from Patna are working. Employment will be increase.</p> <p>In case of secondary employment at which location passengers come out from the metro, food stalls and picking points get developed which will be the source of secondary employment. People thinking about primary employment but we also think that which kind of opportunities can be developed other than the primary employment. You also kept it mind that, after this project local's preference also may get changed because by developing the metro standard of living is going to be change.</p>
10	There will be any provision for small shops in metro station and how can we apply for those shops.	Dr. Virendra Trivedy	Mr. S.N. Pandey: Proper tendering will be done and advertisement for the same will be advertised in the newspapers. A proper channel will be follow. Tendering will be done by Patna Metro in form of open tender for everyone.
11	If we have any issue or complain then where we can file our complains? Is there any official number or site?	Dr. Virendra Trivedy	<p>Mr. S.N. Pandey: PMRC Office in Indra Bhawan where you can place your complain. Official number is not generated yet but it will be done soon. PMRC will prepare special committee for that and shortly the helpline numbers will be displayed.</p> <p>Dr. Shiv Prakash: In future note, banner and notice will be paced for the details also in form of media and newspaper.</p>
12	<p>For a nearby area no noticed has been received yet, we have discussed some people saying that it will get affected and some are saying that it will not get affected. Then where are the final details where we can confirm that which place is going to be affected or not.</p> <p>In 2020, saying that planning get finalized and notice circulated to the owners. But till now no notice have been received, but now we get to know that they consider 3 shops which will either affected or demolished. So if notice is not being received then we don't get time to relocate it.</p>	Mr. Shadique	<p>Mr. S.N. Pandey: Whatever get final, then there is procedure that "notice will be forward to the govt. then it is forwarded to the owner. Before finalizing the activity it is not possible to say.</p> <p>Mr. S.N. Pandey: Whatever time is required will be given and second thing that notice will be received from proper channel and discussed with the owner regarding any change. Actually in 2020 there were many structures considered to get affected. So PMRC is trying to minimize the number of structures to be affected to minimize the impact. So we are working on this and those structures are finalized to be affected, we are sending official notice</p>

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES



Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
13	Near bus stand your construction vehicle used for the passing purpose which cause too much traffic jam, so please make an arrangement that passing work will be carried out at non-peak hours. During peak hours it caused too much traffic jam in such case emergency vehicles also may get stucked.	Mr. Vincet (Transporter)	Mr. S.N. Pandey: You are form that place? Okay let us note your number and name, and action will be taken accordingly. We tried that work will be completed within the framework as this works also being done by the DMRC. Bihar govt. gave the contract to the DMRC. If someone has seen the DMRC work then he knows. Its first time in Patna we are doing metro work, some issues has been faced like in Delhi there is too much govt. land but in Patna ratio of private land is higher than the Govt. land. Also the private land is divided in small patched in multiple owners so we are working on it and trying to resolve that issues.
14	We come here for the employment form a far distance, how I can get work here.	Mr. Samsuni Devi	Dr. Shiv Prakash: By upcoming metro project you also get employment.



पटना शहर में पटना मेट्रो परियोजना के पर्यावरण प्रभाव
आकलन के लिए हितधारकों की बैठक

स्थान - होटल समार इंटरनेशनल, पटना स्टेशन, पटना

परियोजना प्रस्तावक - पटना मेट्रो रेल कारपोरेशन

क्रमांक	नाम/पिता का नाम	पता	व्यवसाय/पद	फोन नंबर	हस्ताक्षर
1	Aradhesh K. Pandey	Patna	Job	9836202726	Aradhesh K. Pandey
2	Virendra Pandey	Patna	Job	727744868	Virendra
	Vikas K.	Patna	Student	8840451056	Vikas
3	Bineet K.	Patna	Business	9884123119	Bineet
		Lucky Point Road Station	11		
4	Shakal Ali	Balcony Road Station	11	9334713749	Shakal
5	Rukay K.	Balcony Road Station	11	9431622375	Rukay
6	RASHID AHAM	SKECHERS RADIO STATION	11	7004633731	Rashid
7	Milind Joshi	Nagpur	Business	9860352441	Milind
8	WAJIDA	The Browning Point, Patna Road, Patna	11	7992287763	Wajida
9	Ravi Kant prasad	Patna	Magistrate	8252251711	Ravi Kant
10	राजेश कुमार	पटना	पुलिस	885190058	राजेश कुमार
11	Ashish K. Singh	Patna	IST	9560910229	Ashish
12	Sundara K. Kumar	Patna	constable	620201065	Sundara
13	Vikas K. Verma	Patna	constable	9905705399	Vikas
14	Guddu Kumar	Patna	constable	9507363754	Guddu
15	A.S.J. Lalit Yadav	Patna	A.S.J.	947674552	Lalit
16	Rehit Pandey	Patna	Job	7301812228	Rehit
17	Itabbi K.	Patna	driver	6202059899	Itabbi
18	Rohit Tinkari	Patna	Job	6201095223	Rohit

क्रमांक	नाम/फिरका-नाम	पता	व्यवसाय	मोबा नंबर	संकेत
19	Ankur Agamef	Patna	Job	7906261952	
20	Ujjwal Singh	11	Student	8271490955	
21	S. S. PRASAD	Patna	Drum Patna Metro	7677241292	
22	Ashish Patel	Patna	Job	635207498	
23	Amit Ranjan	Patna	Transport	9803489515	
24	Deomani Prasad	Patna	Translator	9608787920	
25	Ramendra Prasad	Patna	Job	7677734132	
26	Sonni Kumari	Patna			
27	Rasool Kumar	Patna	Business	9334075788	
28	Sajid Farooq	Patna	Business	9334315799	
29	Prakash Chandra	Patna	Business	9835608920	
30	Anil Kumar Saha	Patna	11	9491403392	
31	Pooja Kumari	Patna	Job	8969305448	
32	Md. Riyaz	Patna	Business	7903294490	
33	S. P. Kumar	Patna	Job	9431882712	
34	Prakash K. Saha	Patna	Job	9334102012	
35	Sahib - Smart Network	Patna	Business	9835033786	
36	Birendra Prasad	Patna	Business	9334888856	
37	Prasenjit	Patna	Business	9304424668	
38	Ravi Kumar	Patna	Job	9304226734	
39	Gyanendra Kumar	Patna	Job	9606170711	
40	Prasanna Kumar	Patna	Asst.	9906771739	
41	B. N. Saha	Patna	Job	9334102382	
42	Rajesh Kumar	Patna	Job	8292551559	
43	Akash Kumar	Patna	Job	8434375242	
44	Mohan Kumar	Patna	Job	7070748888	
45	Madan Kumar	Patna	Job	9973899251	
46	Rahul Kumar	Patna	Business	9420082042	
47	S. N. Kumar	Patna	Business	9420082042	

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES		
Title of Meeting : 2 nd Public Consultation		Date of Meeting : Monday, 7 th September 2022 from 10:00 (AM) to 12:00(PM)
Work Package : ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT		Venue : Rajender Nagar, Panasia Hotel
		Recorded by Mr. Ankur Agarwal
Name of Organization		Name
Main attendees	PMRCL and DMRC	1. Mr. S. S. Prashad (PMRCL) 2. Mr. S. N. Pandey (DMRC)
	JICA Study Team and Sub-consultant	3. Mr. Ashihs Singh (JICA study team) 4. Mr. Ankur Agarwal (Environmental Consultant) 5. Dr. Shiv Prakash Singh (Environmental Consultant) 6. Mr. Milind Joshi (Environmental Consultant)
Local Participant		Total: 32 persons (29 males and 3 females)
Agenda		Project outline/ Environmental Impact Assessment / Expected impact / Survey / Impact evaluation / Environmental Management and Monitoring Plan
Data/information	Distributed	Presentation slides for the above agendas
	Collected	N/A

No.	Question / Opinion from attendees	Speaker	Response from project proponent
1	Introduction of the Project, and explanation of agenda	Mr. Ankur	
2	Best of luck you all, you will work in good manner.	Mr. Rakesh Kumar	
3	After getting this project start, I am observing that citizens facing small issues, due to traffic jam but while thinking about future we are thinking that it will develop our future and citizens will get happy. We also hope that after that project citizens will satisfy after getting the development, so I just want to advice that develops this project after keeping in mind what kind of issues may face by the common man.	Mr. Pankaj Singh	
4	It is a big source of employment, environmental friendly and also it is a big thing that this project is Bihar based and due to this project issue faced during the transportation like traffic will be resolved and provide the facility to use metro.	Mr. Kundan Raj	
5	Patna metro is good source of employment; it's safe from traffic and in saving and carbon	Ms. Krati	

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
	emission & environment.		
6	I have a question, that due to this Patna metro project what will be the environmental impact, as you well know about it. So what precaution measures can be taken to prevent from that pollution? There is also trees cutting then how it can be beneficial.	Ms. Swastik Kumar Saini	Mr. S.N. Pandey: In this presentation we have shown the impact and the mitigation methods. Wherever metro work started in Patna, you will observe that at every place barricading is installed. Also we are cleaning the barricading regularly. A person is dedicated for this work. At every site whatever precaution can be taken we taking to mitigate the dust emission. There are sprinklers and machines are installed at site to mitigate the dust pollution. Mr. S.N. Pandey: In Patna metro project no tree cutting is there, as per the Law of Bihar no tree cutting is allowed. If required to cut the tree, we shifted it tree from one place to another. If in case any tree died then in such case for the replacement of one tree we will planted four new trees and it's our promise.
7	This project is beneficial, there will be no issue. In future the environmental issues will be minimized.	Mr. Virendra Pandey	
8	I want to ask that how many days it will take for the developed this project. It will going to be effect on Patna people, like due to metro construction there will be traffic jam issue so what are the provisions for such things.	Mr. Nitish Sigh	Dr. Shiv Prakash: Tentative timeline is given which is 2025 it will also positively impact on traffic because by metro project vehicle movement will be minimized for those who are going to the offices. It is beneficial for all private and govt. employees. Noise generation due to vehicle movement will be minimized due to metro, so it also improves the sound pollution of the area. In case of safety, if ladies want to travel late night then before they have to think that they either takes auto or taxi but after metro it will be more convenient. In future there will be a provision to cover ruler areas as well.
9	Is there any fare discount available for local person of the Patna.	Mr. Nitish Sigh	Dr. Shiv Prakash: No such information we have, but definitely we will propose your question to the further authority. But in Delhi and other places, same arrangements are available for everyone. But for females there is provision for separate seats and coach but not any provision in fares.
10	It will also helpful for the employment? I also want to share the same thing that by having Patna Metro will increase the	Mr. Nitish Sigh	Dr. Shiv Prakash: Yes definitely it will helpful for the employment by different ways like direction employment and indirect employment.

Preparatory Survey on Patna Metro Rail Project in India

MEETING MINUTES			
No.	Question / Opinion from attendees	Speaker	Response from project proponent
	employment, many local people get un-employed and they went to difference states to get employed. This project is very good thing and it will be contribute in development. It is very good for the local Patna citizens. After Metro, Patna also becomes developed like Delhi and Lucknow.		Mr. S.N. Pandey: You have seen that many workers and engineers are working in Patna Metro project, if this project was not there they all have to go outside from Patna to work. I think approximately 5-6000 workers are working and same amount employment will be generated in future.



पटना शहर में पटना मेट्रो परियोजना के पर्यावरण प्रभाव
आकलन के लिए स्तितधारकों की बैठक

स्थान - पनासिया बेंग्वेर राजे-डनगर पटना

परियोजना प्रस्तावक - पटना मेट्रो रेल कारपोरेशन

क्र.सं.	नाम/पिछाका नाम	पता	व्यवसाय/पद	मोबा नंबर	हस्ताक्षर
1-	अमित कुमार	पटौल नगर	JOB	9608970711	अमित
2-	Vinay Kumar Pandey	Patna	Job	7277445650	Vinay
3-	Bobby Kumar	Patna	DRIVER	6202059797	Bobby
4-	Rohit Pandey	Patna	JOB	7301812228	Rohit
5-	Vikash Kumar	Patna	Student	8340451056	Vikash
6-	Chiranjeev Kumar	Patna	Student	9576861008	Chiranjeev
7	Achal K. Pandey	Patna	Student	9336002721	Achal
8	Rohit Tiwari	Patna	Student	6201095223	Rohit
9	Milind Joshi	Nagpur	Business	9860352441	Milind
10	Anshu Rana	Patna	Job	635207498	Anshu
11	Ashish K. Singh	Patna	Senior Coordinator Senior I.T	9560910229	Ashish
12	S. N. Prasad	Patna	DRIVER	9991000000	S.N.
13	S. S. PRASAD	PMRCL/Patna	DRIVER Patna Metro	7677241292	S.S.
14	Sonu Kumar	Patna city	Student	7764912534	Sonu
15	Ramesh K.	Patna	Business	7504262399	Ramesh
16	Rohit Singh	Patna	JDV	7903111959	Rohit
17	Chaitany Kumar	Patna	DOV	9812531587	Chaitany
18	Pankaj Kumar	Patna	Job	9305385728	Pankaj
19	Santosh Kumar	PATNA	Job	7488202697	Santosh
20	अमित कुमार	Patna	DRIVER	9507687611	अमित
21	Ravikumar	Patna	electric	9523262402	Ravikumar
22	अमित कुमार	Patna	electr	7050828772	अमित
23	Banti	Patna		9874453161	Banti

Scanned with CamScanner

Attachment 13. Environment Monitoring Report

ENVIRONMENT MONITORING RESULTS OF PATNA METRO JUNE-2022

Contract PC-01

Ambient Air Monitoring Results

Date of Sampling	Locations	PM10 ($\mu\text{g}/\text{m}^3$)		
		Monitored value	Baseline Value	AAQM Standards
03-Jun-22	Bhootnath	150.49	279.3	100
03-Jun-22	Zero mile	190	210.5	100
04-Jun-22	Malahi Pakri	162.76	191.2	100
04-Jun-22	Khemnichak	154.04	191.3	100
05-Jun-22	New ISBT	167.5	395.8	100
05-Jun-22	Casting yard PC-01	100.32	103.26	100
14-Jun-22	Bhootnath	173.68	279.3	100
14-Jun-22	Zero mile	197.32	210.5	100
15-Jun-22	Malahi Pakri	148.52	191.2	100
15-Jun-22	Khemnichak	136	191.3	100
16-Jun-22	New ISBT	178	395.8	100
16-Jun-22	Casting yard PC-01	96	103.26	100

Ambient Noise Monitoring result

Date	Locations	Day Time Leq dB(A)	Night Time Leq dB(A)	Baseline Day Time Leq dB(A)	Baseline Night Time Leq dB(A)	Day Time Permissible limit Leq dB (A)	Night Time Permissible limit Leq dB (A)
04-Jun-22	Malahi Pakdi	64.1	62.88	78.15	63.43	65	55
10-Jun-22		63.55	60.26	78.15	63.43	65	55
15-Jun-22		63.78	62.51	78.15	63.43	65	55
20-Jun-22		67.17	60	78.15	63.43	65	55
04-Jun-22	Khemni Chak	64.1	63.06	73.7	63.18	65	55
10-Jun-22		63.55	59.11	73.7	63.18	65	55
15-Jun-22		63.78	61.33	73.7	63.18	65	55
20-Jun-22		67.17	61.27	73.7	63.18	65	55
03-Jun-22	Bhootnath	71.27	62.99	82	73.00	65	55
09-Jun-22		68.4	63.39	82	73.00	65	55
14-Jun-22		69.22	64.07	82	73.00	65	55
19-Jun-22		70.14	63.72	82	73.00	65	55
03-Jun-22	Zero Mile	62.03	60.91	75	63.00	65	55
09-Jun-22		67.8	62.38	75	63.00	65	55

14-Jun-22	New ISBT	66.28	62.83	75	63.00	65	55
19-Jun-22		65.93	62.03	75	63.00	65	55
05-Jun-22		72.41	66.2	83.4	67.10	65	55
11-Jun-22		66.68	62.97	83.4	67.10	65	55
16-Jun-22		70.09	66.21	83.4	67.10	65	55
21-Jun-22		71.94	65.82	83.4	67.10	65	55
05-Jun-22	Casting Yard (PC-01)	66.18	57.58	67.61	63.06	75	70
11-Jun-22		69.13	61.04	67.61	63.06	75	70
16-Jun-22		64.88	62.1	67.61	63.06	75	70
21-Jun-22		63.47	59.48	67.61	63.06	75	70

Contract PC-03 (In the Month of June-Baseline value was Monitored)**Ambient Air Monitoring Results**

Location	PM10		PM 2.5	
	Baseline value	AAQM Standard	Baseline value	AAQM Standard
Rajendra Nagar	261	100	132	60
Mouin-ul Haq stadium	248	100	130	60
Patna University	226	100	126	60
PMCH	235	100	124	60
Gandhi Maidan	250	100	123	60
Akashwaani	242	100	127	60

Location	Leq Day(in db(A))		Leq Night(in db(A))	
	Baseline	CPCB	Baseline	CPCB limit
Rajendra Nagar	67.9	50	58.0	40
Moin-UI-Haq	67.5	65	52.8	55
Patna University	66.4	50	51.9	40
PMCH	70.6	50	62.5	40
Gandhi Maidan	66.5	65	57.1	55
Akashvani	66.1	65	51.8	55

Contract PC-04**Ambient Air Monitoring Results**

Date of Sampling	Locations	PM10 ($\mu\text{g}/\text{m}^3$)		
		Monitored value	Baseline Value	AAQM Standards
06-Jun-22	Mithapur	138.63	258.29	100
17-Jun-22	Mithapur	160.12	258.29	100
06-Jun-22	Ram Krishna Nagar	145.00	232.96	100
17-Jun-22	Ram Krishna Nagar	170.03	232.96	100
07-Jun-22	Casting Yard	120.48	150.64	100
18-Jun-22	Casting Yard	132.80	150.64	100
07-Jun-22	Saguna More	157.82	278.00	100

18-Jun-22	Saguna More	183.36	278.00	100			
Ambient Noise Monitoring result							
Date	Locations	Day Time Leq dB(A)	Night Time Leq dB(A)	Baseline Day Time Leq dB(A)	Baseline Night Time Leq dB(A)	Day Time Permissible limit Leq dB (A)	Night Time Permissible limit Leq dB (A)
06-Jun-22	Mithapur	63.48	62.65	64.55	58.61	65	55
12-Jun-22		63.54	62.51	64.55	58.61	65	55
17-Jun-22		68.31	63.34	64.55	58.61	65	55
22-Jun-22		62.38	60.91	64.55	58.61	65	55
06-Jun-22	Ramkrishna Nagar	68.33	65.42	72.45	65.33	65	55
12-Jun-22		72.23	62.27	72.45	65.33	65	55
17-Jun-22		62.43	61.71	72.45	65.33	65	55
22-Jun-22		69.60	65.97	72.45	65.33	65	55
07-Jun-22	Casting yard	61.19	60.14	65.26	60.34	65	55
13-Jun-22		59.30	58.17	65.26	60.34	65	55
18-Jun-22		63.61	62.00	65.26	60.34	65	55
23-Jun-22		64.36	61.42	65.26	60.34	65	55
07-Jun-22	Saguna More	65.86	64.11	68.10	63.28	65	55
13-Jun-22		65.52	64.83	68.10	63.28	65	55
18-Jun-22		68.67	63.79	68.10	63.28	65	55
23-Jun-22		66.31	65.96	68.10	63.28	65	55

JULY-2022**Contract PC-01****Ambient Air Monitoring Results**

Date of Sampling	Locations	PM10 ($\mu\text{g}/\text{m}^3$)		
		Monitored value	Baseline Value	AAQM Standards
06-July-2022	Bhootnath	144.12	279.3	100
06-July-2022	Zero mile	184.65	210.5	100
07-July-2022	Malahi Pakri	177.18	191.2	100
06-July-2022	Khemnichak	128.00	191.3	100
07-July-2022	New ISBT	165.76	395.8	100
07-July-2022	Casting yard PC-01	101.83	103.26	100
17-July-2022	Bhootnath	133.46	279.3	100
17-July-2022	Zero mile	190.23	210.5	100
18-July-2022	Malahi Pakri	168.11	191.2	100
17-July-2022	Khemnichak	122.93	191.3	100
18-July-2022	New ISBT	158.00	395.8	100
18-July-2022	Casting yard PC-01	98.03	103.26	100

Ambient Noise Monitoring result

Date	Locations	Day Time Leq dB(A)	Night Time Leq dB(A)	Baseline Day Time Leq dB(A)	Baseline Night Time Leq dB(A)	Day Time Permissible limit Leq dB (A)	Night Time Permissible limit Leq dB (A)
07-july-2022	Malahi Pakdi	62.62	57.21	78.15	63.43	65	55
12-july-2022		64.57	58.70	78.15	63.43	65	55
18-july-2022		63.28	57.20	78.15	63.43	65	55
24-july-2022		61.36	60.74	78.15	63.43	65	55
06-july-2022	Khemni Chak	61.23	59.76	73.7	63.18	65	55
12-july-2022		63.41	60.47	73.7	63.18	65	55
17-july-2022		61.98	58.73	73.7	63.18	65	55
24-july-2022		62.80	59.20	73.7	63.18	65	55
06-july-2022	Bhootnath	67.45	62.47	82	73.00	65	55
11-july-2022		68.79	61.04	82	73.00	65	55
17-july-2022		69.10	62.07	82	73.00	65	55
23-july-2022		69.50	61.30	82	73.00	65	55
06-july-2022	Zero Mile	67.7	61.65	75	63.00	65	55
11-july-2022		63.47	59.21	75	63.00	65	55
17-july-2022		62.87	60.84	75	63.00	65	55
24-july-2022		68.40	62.59	75	63.00	65	55

07-july-2022	New ISBT	69.21	64.39	83.4	67.10	65	55
13-july-2022		70.46	64.81	83.4	67.10	65	55
18-july-2022		68.20	62.93	83.4	67.10	65	55
25-july-2022		66.59	61.85	83.4	67.10	65	55
07-july-2022	Casting Yard (PC-01)	63.80	60.20	67.61	63.06	75	70
12-july-2022		62.82	57.90	67.61	63.06	75	70
18-july-2022		60.47	59.12	67.61	63.06	75	70
25-july-2022		62.96	60.08	67.61	63.06	75	70

Contract PC-03**Ambient Air Monitoring Results**

Date of Sampling	Locations	PM10 ($\mu\text{g}/\text{m}^3$)			PM2.5 ($\mu\text{g}/\text{m}^3$)		
		Monitored value	Baseline Value	AAQM Standards	Monitored value	Baseline Value	AAQM Standards
09-july-2022	Rajendra Nagar	176.04	261	100	92.47	132	60
22-july-2022	Rajendra Nagar	176.04	261	100	90.43	132	60
09-july-2022	Mouin-ul Haq stadium	148.04	248	100	90.53	130	60
20-july-2022	Mouin-ul Haq stadium	118.37	248	100	78.12	130	60
10-july-2022	Patna University	160.71	226	100	80.39	126	60
23-july-2022	Patna University	146.88	226	100	68.93	126	60
10-july-2022	PMCH	130.42	235	100	72.06	124	60
22-july-2022	PMCH	160.32	235	100	82.02	124	60
10-july-2022	Gandhi Maidan	127.85	250	100	88.16	123	60
22-july-2022	Gandhi Maidan	110.19	250	100	62.00	123	60
11-july-2022	Akashwaani	156.00	242	100	76.23	127	60
23-july-2022	Akashwaani	155.25	242	100	76.23	127	60

Ambient Noise Monitoring result

Date	Locations	Day Time Leq dB(A)	Night Time Leq dB(A)	Baseline Day Time Leq dB(A)	Baseline Night Time Leq dB(A)	Day Time Permissible limit Leq dB (A)	Night Time Permissible limit Leq dB (A)
09-07-2022	Rajendra Nagar	68.20	60.22	67.9	60.22	50	40
15-07-2022		66.18	63.27	67.9	63.27	50	40
22-07-2022		70.79	67.87	67.9	67.87	50	40
29-07-2022		72.37	65.38	67.9	65.38	50	40
09-07-2022		71.25	59.28	67.5	59.28	65	55
15-07-2022		70.57	60.53	67.5	60.53	65	55

Ambient Noise Monitoring result

Date	Locations	Day Time Leq dB(A)	Night Time Leq dB(A)	Baseline Day Time Leq dB(A)	Baseline Night Time Leq dB(A)	Day Time Permissible limit Leq dB (A)	Night Time Permissible limit Leq dB (A)
07-Aug-2022	Mithapur	63.94	57.47	64.55	58.61	65	55
16-Aug-2022		62.14	56.63	64.55	58.61	65	55
24-Aug-2022		62.79	53.42	64.55	58.61	65	55
29-Aug-2022		62.64	54.96	64.55	58.61	65	55
07-Aug-2022	Ramkrishna Nagar	64.95	64.86	72.45	65.33	65	55
16-Aug-2022		68.21	63.98	72.45	65.33	65	55
24-Aug-2022		67.39	61.12	72.45	65.33	65	55
29-Aug-2022		63.99	63.99	72.45	65.33	65	55
07-Aug-2022	Casting yard	62.41	59.76	65.26	60.34	65	55
16-Aug-2022		60.83	58.70	65.26	60.34	65	55
24-Aug-2022		60.25	56.03	65.26	60.34	65	55
29-Aug-2022		-----	-----	65.26	60.34	65	55
07-Aug-2022	Saguna More	67.05	62.99	68.10	63.28	65	55
16-Aug-2022		66.61	61.94	68.10	63.28	65	55
24-Aug-2022		65.34	58.33	68.10	63.28	65	55
29-Aug-2022		64.55	61.48	68.10	63.28	65	55
08-Aug-2022	Batching plant Rupaspur	60.91	55.73	63.74	56.51	65	55
17-Aug-2022		69.32	67.16	63.74	56.51	65	55
25-Aug-2022		59.05	55.49	63.74	56.51	65	55
29-Aug-2022		61.13	55.42	63.74	56.51	65	55



Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160005	Report No.:	VEL/S/2207160005
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	:	Trailer
Sampling Location	:	VEL Representative (Mr. Virendra Pandey)
Sample Collected By	:	Stack Monitoring Kit
Sampling Equipment Used	:	VEL/INS/ENV/SMK/01
Instrument Code	:	Calibrated
Instrument Calibration Status	:	11/07/2022
Date of Monitoring	:	Clear Sky
Meteorological Condition During Monitoring	:	NCC/D.G. - 62.5 KVA -01
Stack Attached To	:	0.101
Stack Diameter (m)	:	9.0
Stack Height (m)	:	MS
Make of Stack	:	38.0
Sampling Duration (Minutes)	:	32.0
Ambient Temperature - Ta (°C)	:	114.0
Temperature of Stack Gases - Ts (°C)	:	7.28
Velocity of Stack Gases (m/sec.)	:	21.0
Flow rate of PM (LPM)	:	2.0
Flow rate of Gas (LPM)	:	Isokinetic
Sampling Condition	:	No
Control Measure	:	IS: 11255 & EPA
Sampling & Analysis Protocol	:	As per Work Order
Parameter Required	:	

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.045	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.172	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	⁸ SOP, SP-194, Issue No. 01:2018	0.118	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.025	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	⁶ SOP, SP-74, Issue No. 01:2018	0.078	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

⁸SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160006	Report No.:	VEL/S/2207160006
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: P-133
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 11/07/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: NCC/D.G. - 62.5 KVA -02
Stack Diameter (m)	: 0.101
Stack Height (m)	: 9.0
Make of Stack	: MS
Sampling Duration (Minutes)	: 49.0
Ambient Temperature - Ta (°C)	: 32.0
Temperature of Stack Gases - Ts (°C)	: 118.0
Velocity of Stack Gases (m/sec.)	: 7.71
Flow rate of PM (LPM)	: 22.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.048	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.179	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.122	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.034	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.083	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

*SOP - Laboratory Standard Operating Procedure.
*ND - Not Detectable.

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160007	Report No.:	VEL/S/2207160007
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: P-57
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 11/07/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: NCC/D.G. - 62.5 KVA -03
Stack Diameter (m)	: 0.101
Stack Height (m)	: 9.0
Make of Stack	: MS
Sampling Duration (Minutes)	: 34.0
Ambient Temperature - Ta (°C)	: 32.0
Temperature of Stack Gases - Ts (°C)	: 120.0
Velocity of Stack Gases (m/sec.)	: 8.00
Flow rate of PM (LPM)	: 21.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.065	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.192	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	^o SOP, SP-194, Issue No. 01:2018	0.133	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.038	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	^o SOP, SP-74, Issue No. 01:2018	0.088	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	^o ND	mg/Nm ³	--

^oSOP - Laboratory Standard Operating Procedure.

^oND - Not Detectable.

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160008	Report No.:	VEL/S/2207160008
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: SP-01, ISBT
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 11/07/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: NCC/D.G. - 62.5 KVA -04
Stack Diameter (m)	: 0.101
Stack Height (m)	: 9.0
Make of Stack	: MS
Sampling Duration (Minutes)	: 33.0
Ambient Temperature - Ta (°C)	: 32.0
Temperature of Stack Gases - Ts (°C)	: 122.0
Velocity of Stack Gases (m/sec.)	: 8.15
Flow rate of PM (LPM)	: 22.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.042	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.150	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	⁸ SOP, SP-194, Issue No. 01:2018	0.123	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.040	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	⁸ SOP, SP-74, Issue No. 01:2018	0.090	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

⁸SOP - Laboratory Standard Operating Procedure.
*ND - Not Detectable.

End of Report



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20-07-2022	Mouin-ul Haq stadium	67.82	61.60	67.5	61.60	65	55
28-07-2022		71.02	61.01	67.5	61.01	65	55
10-07-2022	Patna University	61.53	58.89	66.4	58.89	50	40
16-07-2022		63.78	59.03	66.4	59.03	50	40
23-07-2022		66.87	64.54	66.4	64.54	50	40
28-07-2022		68.38	60.64	66.4	60.54	50	40
10-07-2022	PMCH	69.02	64.93	70.7	64.93	50	40
16-07-2022		71.62	62.80	70.7	62.80	50	40
22-07-2022		67.16	60.22	70.7	60.22	50	40
27-07-2022		71.22	63.45	70.7	63.45	50	40
10-07-2022	Gandhi Maidan	64.30	58.25	66.5	58.25	65	55
15-07-2022		63.17	57.62	66.5	57.62	65	55
22-07-2022		68.31	63.90	66.5	63.9	65	55
27-07-2022		66.70	58.65	66.5	58.65	65	55
11-07-2022	Akashwaani	66.39	61.17	66.1	61.17	65	55
16-07-2022		67.82	60.35	66.1	60.35	65	55
23-07-2022		69.86	65.15	66.1	65.15	65	55
28-07-2022		70.34	60.08	66.1	60.18	65	55

Contract PC-04**Ambient Air Monitoring Results**

Date of Sampling	Locations	PM10 ($\mu\text{g}/\text{m}^3$)		
		Monitored value	Baseline Value	AAQM Standards
07-july-2022	Mithapur	145.52	258.29	100
19-july-2022	Mithapur	134.00	258.29	100
08-july-2022	Ram Krishna Nagar	164.18	232.96	100
19-july-2022	Ram Krishna Nagar	156.25	232.96	100
08-july-2022	Casting Yard	122.17	150.64	100
19-july-2022	Casting Yard	108.00	150.64	100
08-july-2022	Saguna More	135.00	278.00	100
20-july-2022	Saguna More	116.07	278.00	100
09-july-2022	Batching plant rupaspur	180.69	200.79	100
20-july-2022	Batching plant rupaspur	174.52	200.79	100

Ambient Noise Monitoring result

Date	Locations	Day Time Leq dB(A)	Night Time Leq dB(A)	Baseline Day Time Leq dB(A)	Baseline Night Time Leq dB(A)	Day Time Permissible limit Leq dB (A)	Night Time Permissible limit Leq dB (A)
07-july-2022	Mithapur	75.69	67.13	64.55	58.61	65	55
13-july-2022		69.21	66.59	64.55	58.61	65	55
19-july-2022		65.86	57.64	64.55	58.61	65	55
25-july-2022		64.90	60.64	64.55	58.61	65	55
08-july-2022	Ramkrishna Nagar	74.09	67.73	72.45	65.33	65	55
13-july-2022		65.63	64.29	72.45	65.33	65	55
19-july-2022		69.15	66.30	72.45	65.33	65	55
26-july-2022		68.27	66.93	72.45	65.33	65	55
08-july-2022	Casting yard	68.11	65.24	65.26	60.34	65	55
14-july-2022		64.52	59.44	65.26	60.34	65	55
19-july-2022		67.02	59.68	65.26	60.34	65	55
27-july-2022		65.61	57.36	65.26	60.34	65	55
08-july-2022	Saguna More	72.04	66.49	68.10	63.28	65	55
14-july-2022		74.11	69.55	68.10	63.28	65	55
20-july-2022		71.72	66.69	68.10	63.28	65	55
26-july-2022		67.04	65.62	68.10	63.28	65	55
09-july-2022	Batching plant Rupaspur	69.32	67.16	63.74	56.51	65	55
14-july-2022		76.97	75.80	63.74	56.51	65	55
20-july-2022		72.13	69.93	63.74	56.51	65	55
26-july-2022		72.50	65.92	63.74	56.51	65	55

AUGUST-2022**Contract PC-01****Ambient Air Monitoring Results**

Date of Sampling	Locations	PM10 ($\mu\text{g}/\text{m}^3$)		
		Monitored value	Baseline Value	AAQM Standards
03-Aug-2022	Bhootnath	143.05	279.3	100
03-Aug-2022	Zero mile	193.26	210.5	100
04-Aug-2022	Malahi Pakri	152.32	191.2	100
03-Aug-2022	Khemnichak	160.21	191.3	100
04-Aug-2022	New ISBT	186.00	395.8	100
04-Aug-2022	Casting yard PC-01	101.85	103.26	100
18-Aug-2022	Bhootnath	170.74	279.3	100
18-Aug-2022	Zero mile	165.00	210.5	100
19-Aug-2022	Malahi Pakri	140.00	191.2	100
18-Aug-2022	Khemnichak	156.06	191.3	100
19-Aug-2022	New ISBT	197.37	395.8	100
19-Aug-2022	Casting yard PC-01	96.00	103.26	100

Ambient Noise Monitoring result

Date	Locations	Day Time Leq dB(A)	Night Time Leq dB(A)	Baseline Day Time Leq dB(A)	Baseline Night Time Leq dB(A)	Day Time Permissible limit Leq dB (A)	Night Time Permissible limit Leq dB (A)
04-Aug-2022	Malahi Pakdi	62.07	57.84	78.15	63.43	65	55
09-Aug-2022		64.28	58.47	78.15	63.43	65	55
19-Aug-2022		60.74	56.87	78.15	63.43	65	55
26-Aug-2022		60.88	58.26	78.15	63.43	65	55
03-Aug-2022	Khemni Chak	61.63	57.94	73.7	63.18	65	55
09-Aug-2022		63.12	60.19	73.7	63.18	65	55
18-Aug-2022		62.8	58.88	73.7	63.18	65	55
26-Aug-2022		61.1	59.28	73.7	63.18	65	55
03-Aug-2022	Bhootnath	67.6	60.74	82	73.00	65	55
08-Aug-2022		67.46	61.13	82	73.00	65	55
18-Aug-2022		61.53	60.29	82	73.00	65	55
26-Aug-2022		62.67	59.96	82	73.00	65	55
03-Aug-2022	Zero Mile	64.74	58.86	75	63.00	65	55
09-Aug-2022		67.46	61.13	75	63.00	65	55
18-Aug-2022		65.72	62.47	75	63.00	65	55
26-Aug-2022		66.04	60.97	75	63.00	65	55

04-Aug-2022	New ISBT	66.45	63.01	83.4	67.10	65	55
12-Aug-2022		65.75	63.59	83.4	67.10	65	55
19-Aug-2022		64.14	61.47	83.4	67.10	65	55
26-Aug-2022		64.4	62.08	83.4	67.10	65	55
04-Aug-2022	Casting Yard (PC-01)	62.43	59.03	67.61	63.06	75	70
12-Aug-2022		60.81	57.88	67.61	63.06	75	70
19-Aug-2022		61.20	57.96	67.61	63.06	75	70
26-Aug-2022		62.01	58.93	67.61	63.06	75	70

Contract PC-03**Ambient Air Monitoring Results**

Date of Sampling	Locations	PM10 ($\mu\text{g}/\text{m}^3$)			PM2.5 ($\mu\text{g}/\text{m}^3$)		
		Monitored value	Baseline Value	AAQM Standards	Monitored value	Baseline Value	AAQM Standards
05-Aug-2022	Rajendra Nagar	184.31	261	100	95.27	132	60
22-Aug-2022	Rajendra Nagar	191.28	261	100	98.18	132	60
05-Aug-2022	Mouin-ul Haq stadium	145	248	100	80	130	60
21-Aug-2022	Mouin-ul Haq stadium	166.02	248	100	85.17	130	60
06-Aug-2022	Patna University	154.45	226	100	77.04	126	60
21-Aug-2022	Patna University	171.81	226	100	90	126	60
05-Aug-2022	PMCH	133.78	235	100	74.67	124	60
21-Aug-2022	PMCH	146.73	235	100	66.17	124	60
06-Aug-2022	Gandhi Maidan	100.34	250	100	65.12	123	60
22-Aug-2022	Gandhi Maidan	115.41	250	100	79.28	123	60
06-Aug-2022	Akashwaani	177.22	242	100	82.68	127	60
22-Aug-2022	Akashwaani	150.07	242	100	87.59	127	60

Ambient Noise Monitoring result

Date	Locations	Day Time Leq dB(A)	Night Time Leq dB(A)	Baseline Day Time Leq dB(A)	Baseline Night Time Leq dB(A)	Day Time Permissible limit Leq dB (A)	Night Time Permissible limit Leq dB (A)
05-08-2022	Rajendra Nagar	65.93	57.85	67.9	60.22	50	40
12-08-2022		66.57	57.23	67.9	63.27	50	40
22-08-2022		65.69	54.57	67.9	67.87	50	40
27-08-2022		61.82	56.10	67.9	65.38	50	40
05-08-2022		64.65	50.93	67.5	59.28	65	55
13-08-2022		62.62	51.75	67.5	60.53	65	55

21-08-2022	Mouin-ul Haq stadium	66.35	50.42	67.5	61.60	65	55
27-08-2022		64.47	49.46	67.5	61.01	65	55
06-08-2022	Patna University	65.98	50.87	66.4	58.89	50	40
13-08-2022		63.54	50.33	66.4	59.03	50	40
21-08-2022		62.74	50.53	66.4	64.54	50	40
28-08-2022		64.61	48.37	66.4	60.54	50	40
05-08-2022	PMCH	67.44	61.30	70.7	64.93	50	40
13-08-2022		67.43	60.54	70.7	62.80	50	40
21-08-2022		67.46	61.97	70.7	60.22	50	40
28-08-2022		65.40	60.15	70.7	63.45	50	40
06-08-2022		61.21	57.00	66.5	58.25	65	55
14-08-2022	Gandhi Maidan	60.59	56.73	66.5	57.62	65	55
22-08-2022		65.96	56.76	66.5	63.9	65	55
28-08-2022	Akashwaani	63.58	56.51	66.5	58.65	65	55
06-08-2022		64.6	49.57	66.1	61.17	65	55
14-08-2022		64.28	50.86	66.1	60.35	65	55
22-08-2022		64.41	49.89	66.1	65.15	65	55
28-08-2022		62.22	48.84	66.1	60.18	65	55

Contract PC-04**Ambient Air Monitoring Results**

Date of Sampling	Locations	PM10 ($\mu\text{g}/\text{m}^3$)		
		Monitored value	Baseline Value	AAQM Standards
07-Aug-2022	Mithapur	179.13	258.29	100
24-Aug 2022	Mithapur	137.93	258.29	100
07-Aug-2022	Ram Krishna Nagar	144.16	232.96	100
24-Aug 2022	Ram Krishna Nagar	130.42	232.96	100
07-Aug-2022	Casting Yard	127.08	150.64	100
24-Aug 2022	Casting Yard	104.67	150.64	100
08-Aug-2022	Saguna More	194.61	278.00	100
24-Aug 2022	Saguna More	160.53	278.00	100
08-Aug-2022	Batching plant rupaspur	164.42	200.79	100
25-Aug 2022	Batching plant rupaspur	158.06	200.79	100



Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number: VEL/W/03
Issued To: M/s Montecarlo Limited
Montecarlo House,
Sindhu Bhavan Road, Bodakdev,
Ahmedabad, Gujarat, India - 380058

Report No.: VEL/W/2208310005
Format No.: 7.8 F-03
Party Reference No.: 15047806
Date: 21.05.2022
Reporting Date: 06/09/2022
Period of Analysis: 31/08/2022 to 06/09/2022
Receipt Date: 31/08/2022
Sampling Date: 26.08.2022
Sampling Quantity: 5 Ltrs. + 250 ml
Sampling Type: Grab
Preservation: Ice Box
Parameter Required: As per Work Order

Name & Address of the Project: 3320 - M/s Patna Metro Rail Project
Montecarlo Limited 170 Ward No. 38,
Ranjan Yadav Path, Near Maruti Alankar
Service Center, Danapur, Patna, Bihar,
India - 801503

Sample Description: Ground Water Sample
Location: Mithapur
Sample Collected By: VEL Representative (Mr. Rohit Tiwari)
Sampling and Analysis Protocol: APHA 23rd Edition 2017 & IS: 3025

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25 °C)	APHA, 4500 H B, Electrometric Method	7.66	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ (**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ (**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	310.00	mg/l.	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA, 3500 Ca B, EDTA Titrimetric Method	68.68	mg/l.	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	261.90	mg/l.	200	600
9.	Chloride as Cl	APHA, 4500 Cl B, Argentometric Method	34.33	mg/l.	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	20.73	mg/l.	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	257.04	mg/l.	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	11.28	mg/l.	200	400
13.	Fluoride as F	APHA, 4500 F D, SPADNS Method	0.43	mg/l.	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	3.08	mg/l.	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	0.11	mg/l.	1.0	No Relaxation

(Checked By)
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TECHNICAL MANAGER



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
 ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEI/W/03		Report No.: VEI/W/2208310005				
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
16.	Aluminium as Al	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-08)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification,
 *Amendment No 1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No 3 in Feb. 2021 (Limit of Mineral Oil)

End of Report

(Checked By)
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 L.C. TECHNICAL MANAGER

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 [Signature]
 08/07/2022

(Approved By)
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Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
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Test Report

Sample Number:	VEL/S/2207160010	Report No.:	VEL/S/2207160010
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: Steel Yard, Malahi Pakari
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 11/07/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: NCC/D.G. - 125 KVA -06
Stack Diameter (m)	: 0.101
Stack Height (m)	: 9.0
Make of Stack	: MS
Sampling Duration (Minutes)	: 43.0
Ambient Temperature - Ta (°C)	: 32.0
Temperature of Stack Gases - Ts (°C)	: 138.0
Velocity of Stack Gases (m/sec.)	: 9.98
Flow rate of PM (LPM)	: 21.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.087	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.197	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	⁵ SOP, SP-194, Issue No. 01:2018	0.151	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.083	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	⁵ SOP, SP-74, Issue No. 01:2018	0.099	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

⁵SOP - Laboratory Standard Operating Procedure.
*ND - Not Detectable.

End of Report



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ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160011	Report No.:	VEL/S/2207160011
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	:	P-33
Sampling Location	:	VEL Representative (Mr. Virendra Pandey)
Sample Collected By	:	Stack Monitoring Kit
Sampling Equipment Used	:	VEL/INS/ENV/SMK/01
Instrument Code	:	Calibrated
Instrument Calibration Status	:	12/07/2022
Date of Monitoring	:	Clear Sky
Meteorological Condition During Monitoring	:	NCC/D.G. - 25 KVA -08
Stack Attached To	:	0.101
Stack Diameter (m)	:	9.0
Stack Height (m)	:	MS
Make of Stack	:	30.0
Sampling Duration (Minutes)	:	33.0
Ambient Temperature - Ta (°C)	:	108.0
Temperature of Stack Gases - Ts (°C)	:	6.73
Velocity of Stack Gases (m/sec.)	:	21.0
Flow rate of PM (LPM)	:	2.0
Flow rate of Gas (LPM)	:	Isokinetic
Sampling Condition	:	No
Control Measure	:	IS: 11255 & EPA
Sampling & Analysis Protocol	:	As per Work Order
Parameter Required	:	

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.022	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.056	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as IIC)	^o SOP, SP-194, Issue No. 01:2018	0.064	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.015	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	^o SOP, SP-74, Issue No. 01:2018	0.041	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	^o ND	mg/Nm ³	--

^oSOP - Laboratory Standard Operating Procedure.

^oND - Not Detectable.

End of Report



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ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number: VEL/S/2207160012 Report No.: VEL/S/2207160012
Name & Address of the Party: M/s NCC Limited Format No.: 7.8 F-03
(Formerly Nagarjuna Construction Company Limited) Party Reference No.: NCC/MRTS/2020-
MRTS Project Office, Patna 2021/WO/16
D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020 Reporting Date: 21/07/2022
Period of Analysis: 16/07/2022-21/07/2022
Receipt Date: 16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information : Casting Yard
Sampling Location : VEL Representative (Mr. Virendra Pandey)
Sample Collected By : Stack Monitoring Kit
Sampling Equipment Used : VEL/INS/ENV/SMK/01
Instrument Code : Calibrated
Instrument Calibration Status : 12/07/2022
Date of Monitoring : Clear Sky
Meteorological Condition During Monitoring : NCC/D.G. - 200 KVA -10
Stack Attached To : 0.101
Stack Diameter (m) : 9.0
Stack Height (m) : MS
Make of Stack : 44.0
Sampling Duration (Minutes) : 33.0
Ambient Temperature - Ta (°C) : 140.0
Temperature of Stack Gases - Ts (°C) : 9.72
Velocity of Stack Gases (m/sec.) : 22.0
Flow rate of PM (LPM) : 2.0
Flow rate of Gas (LPM) : Isokinetic
Sampling Condition : No
Control Measure : IS: 11255 & EPA
Sampling & Analysis Protocol : As per Work Order
Parameter Required :

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.122	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.200	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	² SOP, SP-194, Issue No. 01:2018	0.176	gm/kw-hr	Not Specified
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.109	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	² SOP, SP-74, Issue No. 01:2018	0.102	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

²SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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Test Report

Sample Number:	VEL/S/2207160013	Report No.:	VEL/S/2207160013
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	:	Casting Yard
Sampling Location	:	VEL Representative (Mr. Virendra Pandey)
Sample Collected By	:	Stack Monitoring Kit
Sampling Equipment Used	:	VEL/INS/ENV/SMK/01
Instrument Code	:	Calibrated
Instrument Calibration Status	:	12/07/2022
Date of Monitoring	:	Clear Sky
Meteorological Condition During Monitoring	:	NCC/D.G. - 200 KVA -11
Stack Attached To	:	0.101
Stack Diameter (m)	:	9.0
Stack Height (m)	:	MS
Make of Stack	:	46.0
Sampling Duration (Minutes)	:	33.0
Ambient Temperature - Ta (°C)	:	148.0
Temperature of Stack Gases - Ts (°C)	:	10.13
Velocity of Stack Gases (m/sec.)	:	22.0
Flow rate of PM (LPM)	:	2.0
Flow rate of Gas (LPM)	:	Isokinetic
Sampling Condition	:	No
Control Measure	:	IS: 11255 & EPA
Sampling & Analysis Protocol	:	As per Work Order
Parameter Required	:	

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.134	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.204	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	^S SOP, SP-194, Issue No. 01:2018	0.179	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.113	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	^S SOP, SP-74, Issue No. 01:2018	0.105	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

^SSOP - Laboratory Standard Operating Procedure.
*ND - Not Detectable.

End of Report



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ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160014	Report No.:	VEL/S/2207160014
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	:	
Sampling Location	:	Casting Yard
Sample Collected By	:	VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	:	Stack Monitoring Kit
Instrument Code	:	VEL/INS/ENV/SMK/01
Instrument Calibration Status	:	Calibrated
Date of Monitoring	:	12/07/2022
Meteorological Condition During Monitoring	:	Clear Sky
Stack Attached To	:	NCC/D.G. - 200 KVA -12
Stack Diameter (m)	:	0.101
Stack Height (m)	:	9.0
Make of Stack	:	MS
Sampling Duration (Minutes)	:	35.0
Ambient Temperature - Ta (°C)	:	33.0
Temperature of Stack Gases - Ts (°C)	:	150.0
Velocity of Stack Gases (m/sec.)	:	11.52
Flow rate of PM (LPM)	:	21.0
Flow rate of Gas (LPM)	:	2.0
Sampling Condition	:	Isokinetic
Control Measure	:	No
Sampling & Analysis Protocol	:	IS: 11255 & EPA
Parameter Required	:	As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.140	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.223	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.200	gm/kw-hr	<4.0
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.119	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.115	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

*SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160015	Report No.:	VEL/S/2207160015
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	:	
Sampling Location	:	Casting Yard
Sample Collected By	:	VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	:	Stack Monitoring Kit
Instrument Code	:	VEL/INS/ENV/SMK/01
Instrument Calibration Status	:	Calibrated
Date of Monitoring	:	12/07/2022
Meteorological Condition During Monitoring	:	Clear Sky
Stack Attached To	:	NCC/D.G. - 15 KVA -14
Stack Diameter (m)	:	0.101
Stack Height (m)	:	9.0
Make of Stack	:	MS
Sampling Duration (Minutes)	:	31.0
Ambient Temperature - Ta (°C)	:	33.0
Temperature of Stack Gases - Ts (°C)	:	110.0
Velocity of Stack Gases (m/sec.)	:	6.23
Flow rate of PM (LPM)	:	22.0
Flow rate of Gas (LPM)	:	2.0
Sampling Condition	:	Isokinetic
Control Measure	:	No
Sampling & Analysis Protocol	:	IS: 11255 & EPA
Parameter Required	:	As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.023	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.046	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	² SOP, SP-194, Issue No. 01:2018	0.045	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.027	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	² SOP, SP-74, Issue No. 01:2018	0.066	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

²SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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Test Report

Sample Number:	VEL/S/2207160016	Report No.:	VEL/S/2207160016
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: P-100
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 12/07/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: NCC/D.G. - 125 KVA -17
Stack Diameter (m)	: 0.101
Stack Height (m)	: 9.0
Make of Stack	: MS
Sampling Duration (Minutes)	: 36.0
Ambient Temperature - Ta (°C)	: 33.0
Temperature of Stack Gases - Ts (°C)	: 124.0
Velocity of Stack Gases (m/sec.)	: 8.85
Flow rate of PM (LPM)	: 22.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.098	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.202	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	² SOP, SP-194, Issue No. 01:2018	0.167	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.100	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	³ SOP, SP-74, Issue No. 01:2018	0.081	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

²SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160017	Report No.:	VEL/S/2207160017
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	:	Steel Yard, ISBT
Sampling Location	:	VEL Representative (Mr. Virendra Pandey)
Sample Collected By	:	Stack Monitoring Kit
Sampling Equipment Used	:	VEL/INS/ENV/SMK/01
Instrument Code	:	Calibrated
Instrument Calibration Status	:	13/07/2022
Date of Monitoring	:	Clear Sky
Meteorological Condition During Monitoring	:	NCC/D.G. - 62.5 KVA -26
Stack Attached To	:	0.101
Stack Diameter (m)	:	9.0
Stack Height (m)	:	MS
Make of Stack	:	39.0
Sampling Duration (Minutes)	:	33.0
Ambient Temperature - Ta (°C)	:	116.0
Temperature of Stack Gases - Ts (°C)	:	7.15
Velocity of Stack Gases (m/sec.)	:	21.0
Flow rate of PM (LPM)	:	2.0
Flow rate of Gas (LPM)	:	Isokinetic
Sampling Condition	:	No
Control Measure	:	IS: 11255 & EPA
Sampling & Analysis Protocol	:	As per Work Order
Parameter Required	:	

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.041	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.067	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	⁵ SOP, SP-194, Issue No. 01:2018	0.079	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.036	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	⁵ SOP, SP-74, Issue No. 01:2018	0.061	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

⁵SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160018	Report No.:	VEL/S/2207160018
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: Casting Yard
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 13/07/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: NCC/D.G. - 125 KVA -27
Stack Diameter (m)	: 0.101
Stack Height (m)	: 9.0
Make of Stack	: MS
Sampling Duration (Minutes)	: 44.0
Ambient Temperature - Ta (°C)	: 33.0
Temperature of Stack Gases - Ts (°C)	: 142.0
Velocity of Stack Gases (m/sec.)	: 9.07
Flow rate of PM (LPM)	: 22.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.084	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.177	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	⁶ SOP, SP-194, Issue No. 01:2018	0.130	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.031	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	⁶ SOP, SP-74, Issue No. 01:2018	0.089	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

⁶SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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Test Report

Sample Number:	VEL/S/2207160019	Report No.:	VEL/S/2207160019
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	:	P-33
Sampling Location	:	VEL Representative (Mr. Virendra Pandey)
Sample Collected By	:	Stack Monitoring Kit
Sampling Equipment Used	:	VEL/INS/ENV/SMK/01
Instrument Code	:	Calibrated
Instrument Calibration Status	:	13/07/2022
Date of Monitoring	:	Clear Sky
Meteorological Condition During Monitoring	:	NCC/D.G. - 125 KVA -28
Stack Attached To	:	0.101
Stack Diameter (m)	:	9.0
Stack Height (m)	:	MS
Make of Stack	:	31.0
Sampling Duration (Minutes)	:	33.0
Ambient Temperature - Ta (°C)	:	138.0
Temperature of Stack Gases - Ts (°C)	:	8.52
Velocity of Stack Gases (m/sec.)	:	22.0
Flow rate of PM (LPM)	:	2.0
Flow rate of Gas (LPM)	:	Isokinetic
Sampling Condition	:	No
Control Measure	:	IS: 11255 & EPA
Sampling & Analysis Protocol	:	As per Work Order
Parameter Required	:	

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.106	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.185	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	⁶ SOP, SP-194, Issue No. 01:2018	0.135	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.042	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	⁶ SOP, SP-74, Issue No. 01:2018	0.092	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

⁶SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2207160020	Report No.:	VEL/S/2207160020
Name & Address of the Party:	M/s NCC Limited (Formerly Nagarjuna Construction Company Limited) MRTS Project Office, Patna D-24, P.C. Colony, Kankarbagh, Patna, Bihar - 800020	Format No.:	7.8 F-03
		Party Reference No.:	NCC/MRTS/2020-2021/WO/16
		Reporting Date:	21/07/2022
		Period of Analysis:	16/07/2022-21/07/2022
		Receipt Date:	16/07/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: Casting Yard
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 13/07/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: NCC/D.G. - 125 KVA -30
Stack Diameter (m)	: 0.101
Stack Height (m)	: 9.0
Make of Stack	: MS
Sampling Duration (Minutes)	: 32.0
Ambient Temperature - Ta (°C)	: 33.0
Temperature of Stack Gases - Ts (°C)	: 140.0
Velocity of Stack Gases (m/sec.)	: 8.76
Flow rate of PM (LPM)	: 21.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.109	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.192	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.147	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.048	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.094	gm/kw-hr	<3.5
6.	Lead (as Pb)	APHA, 3 rd Edition 303 A (Page-365):2017	*ND	mg/Nm ³	--

*SOP - Laboratory Standard Operating Procedure.

*ND - Not Detectable.

End of Report



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ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2206270008	Report No.:	VEL/S/2206270008
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: Gandhi Maidan
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 24/06/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: D.G. Set - 1 (62.5 KVA)
Make of Stack	: MS
Sampling Duration (Minutes)	: 36.0
Ambient Temperature - Ta (°C)	: 34.0
Temperature of Stack Gases - Ts (°C)	: 113.0
Velocity of Stack Gases (m/sec.)	: 19.40
Flow rate of PM (LPM)	: 27.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.051	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.175	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.121	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.027	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.082	gm/kw-hr	<3.5

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Test Report

Sample Number:	VEL/S/2206270009	Report No.:	VEL/S/2206270009
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information

Sampling Location	: Gandhi Maidan
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 24/06/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: D.G. Set - 2 (125 KVA)
Make of Stack	: MS
Sampling Duration (Minutes)	: 40.0
Ambient Temperature - Ta (°C)	: 34.0
Temperature of Stack Gases - Ts (°C)	: 118.0
Velocity of Stack Gases (m/sec.)	: 20.24
Flow rate of PM (LPM)	: 25.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.054	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.168	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.127	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.032	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.078	gm/kw-hr	<3.5

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Test Report

Sample Number:	VEL/S/2206270010	Report No.:	VEL/S/2206270010
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: Moin Ul Haq Stadium
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 24/06/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: D.G. Set - 3 (62.5 KVA)
Make of Stack	: MS
Sampling Duration (Minutes)	: 35.0
Ambient Temperature - Ta (°C)	: 33.0
Temperature of Stack Gases - Ts (°C)	: 112.0
Velocity of Stack Gases (m/sec.)	: 19.49
Flow rate of PM (LPM)	: 28.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.060	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.151	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.130	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.036	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.080	gm/kw-hr	<3.5

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Test Report

Sample Number:	VEL/S/2206270011	Report No.:	VEL/S/2206270011
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information

Sampling Location : Moin Ul Haq Stadium
Sample Collected By : VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used : Stack Monitoring Kit
Instrument Code : VEL/INS/ENV/SMK/01
Instrument Calibration Status : Calibrated
Date of Monitoring : 24/06/2022
Meteorological Condition During Monitoring : Clear Sky
Stack Attached To : D.G. Set - 4 (125 KVA)
Make of Stack : MS
Sampling Duration (Minutes) : 38.0
Ambient Temperature - Ta (°C) : 33.0
Temperature of Stack Gases - Ts (°C) : 117.0
Velocity of Stack Gases (m/sec.) : 18.20
Flow rate of PM (LPM) : 26.0
Flow rate of Gas (LPM) : 2.0
Sampling Condition : Isokinetic
Control Measure : No
Sampling & Analysis Protocol : IS: 11255 & EPA
Parameter Required : As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.049	gm/kw-hr	<0.2
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.166	gm/kw-hr	<4.0
3.	Total Hydrocarbon (as HC)	^a SOP, SP-194, Issue No. 01:2018	0.133	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.039	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	^a SOP, SP-74, Issue No. 01:2018	0.068	gm/kw-hr	<3.5

^aSOP - Laboratory Standard Operating Procedure.



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Test Report

Sample Number:	VEL/S/2206270012	Report No.:	VEL/S/2206270012
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: Moin Ul Haq Stadium
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 24/06/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: D.G. Set - 5 (7.5 KVA) (LM-03)
Make of Stack	: MS
Sampling Duration (Minutes)	: 41.0
Ambient Temperature - Ta (°C)	: 34.0
Temperature of Stack Gases - Ts (°C)	: 118.0
Velocity of Stack Gases (m/sec.)	: 18.92
Flow rate of PM (LPM)	: 24.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.056	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.174	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.125	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.028	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.066	gm/kw-hr	<3.5

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Test Report

Sample Number:	VEL/S/2206270014	Report No.:	VEL/S/2206270014
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information

Sampling Location	: Malahi Pakari
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 24/06/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: D.G. Set - 7 (7.5 KVA) (LM-02)
Make of Stack	: MS
Sampling Duration (Minutes)	: 43.0
Ambient Temperature - Ta (°C)	: 30.0
Temperature of Stack Gases - Ts (°C)	: 117.0
Velocity of Stack Gases (m/sec.)	: 15.87
Flow rate of PM (LPM)	: 23.04
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.055	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.179	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.137	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.043	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.077	gm/kw-hr	<3.5

*SOP - Laboratory Standard Operating Procedure.



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 ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/S/2206270015	Report No.:	VEL/S/2206270015
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information

Sampling Location : Rajendra Nagar
Sample Collected By : VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used : Stack Monitoring Kit
Instrument Code : VEL/INS/ENV/SMK/01
Instrument Calibration Status : Calibrated
Date of Monitoring : 25/06/2022
Meteorological Condition During Monitoring : Clear Sky
Stack Attached To : D.G. Set - 8 (7.5 KVA) (LM-05)
Make of Stack : MS
Sampling Duration (Minutes) : 43.0
Ambient Temperature - Ta (°C) : 31.0
Temperature of Stack Gases - Ts (°C) : 118.0
Velocity of Stack Gases (m/sec.) : 16.81
Flow rate of PM (LPM) : 23.0
Flow rate of Gas (LPM) : 2.0
Sampling Condition : Isokinetic
Control Measure : No
Sampling & Analysis Protocol : IS: 11255 & EPA
Parameter Required : As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.064	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.165	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.123	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.052	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.067	gm/kw-hr	<3.5

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Test Report

Sample Number:	VEL/S/2206270017	Report No.:	VEL/S/2206270017
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information

Sampling Location	: Patna University
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 25/06/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: D.G. Set - 10 (10 KVA) (LM-07)
Make of Stack	: MS
Sampling Duration (Minutes)	: 42.0
Ambient Temperature - Ta (°C)	: 33.0
Temperature of Stack Gases - Ts (°C)	: 114.0
Velocity of Stack Gases (m/sec.)	: 19.40
Flow rate of PM (LPM)	: 24.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.078	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.158	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.136	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.041	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.058	gm/kw-hr	<3.5

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Test Report

Sample Number:	VEL/S/2206270018	Report No.:	VEL/S/2206270018
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: Akashwani
Sample Collected By	: VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/01
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 25/06/2022
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: D.G. Set - 11 (7.5 KVA) (LM-08)
Make of Stack	: MS
Sampling Duration (Minutes)	: 41.0
Ambient Temperature - Ta (°C)	: 36.0
Temperature of Stack Gases - Ts (°C)	: 118.0
Velocity of Stack Gases (m/sec.)	: 16.89
Flow rate of PM (LPM)	: 24.0
Flow rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Control Measure	: No
Sampling & Analysis Protocol	: IS: 11255 & EPA
Parameter Required	: As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.075	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.156	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.143	gm/kw-hr	
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.050	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.063	gm/kw-hr	<3.5

*SOP - Laboratory Standard Operating Procedure.



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Test Report

Sample Number:	VEL/S/2206270019	Report No.:	VEL/S/2206270019
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAFS
		Reporting Date:	30/06/2022
		Period of Analysis:	27/06/2022-30/06/2022
		Receipt Date:	27/06/2022

Sample Description: STACK EMISSION MONITORING

General Information

Sampling Location : Rajiv Nagar DG Room
Sample Collected By : VEL Representative (Mr. Virendra Pandey)
Sampling Equipment Used : Stack Monitoring Kit
Instrument Code : VEL/INS/ENV/SMK/01
Instrument Calibration Status : Calibrated
Date of Monitoring : 25/06/2022
Meteorological Condition During Monitoring : Clear Sky
Stack Attached To : D.G. Set - 12 (62.5 KVA)
Make of Stack : MS
Sampling Duration (Minutes) : 36.0
Ambient Temperature - Ta (°C) : 37.0
Temperature of Stack Gases - Ts (°C) : 120.0
Velocity of Stack Gases (m/sec.) : 19.30
Flow rate of PM (LPM) : 27.0
Flow rate of Gas (LPM) : 2.0
Sampling Condition : Isokinetic
Control Measure : No
Sampling & Analysis Protocol : IS: 11255 & EPA
Parameter Required : As per Work Order

S. No.	Test Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1), Gravimetric Method, RA: 2003	0.070	gm/kw-hr	<0.3
2.	Oxide of Nitrogen (as NO _x)	IS: 11255 (P-7), Colorimetric Method, RA: 2012	0.171	gm/kw-hr	<4.7
3.	Total Hydrocarbon (as HC)	*SOP, SP-194, Issue No. 01:2018	0.138	gm/kw-hr	<4.7
4.	Sulphur Dioxide (as SO ₂)	IS: 11255 (P-2), Titrimetric Method, RA: 2003	0.057	gm/kw-hr	Not Specified
5.	Carbon Monoxide (as CO)	*SOP, SP-74, Issue No. 01:2018	0.079	gm/kw-hr	<3.5

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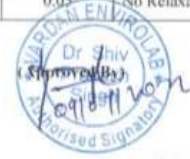
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Test Report

Sample Number: VEL/W/2207010003 Report No.: VEL/W/2207010003
Name & Address of the Party: M/s Larsen & Toubro Construction Limited Format No.: 7.8 F-03
Patna U.G. Metro-PC-03 Project Office, Party Reference No.: LE21MAF5
2nd Floor, Muratli Prakash Tower, Reporting Date: 09/07/2022
Veer Kunwar Singh Chowk, Period of Analysis: 01/07/2022 to 09/07/2022
Keshri Nagar, Nalapar, Patna, Bihar Receipt Date: 01/07/2022
Pin Code - 800024 Sampling Date: 27/06/2022
Sample Description: Ground Water Sample Sampling Quantity: 2 Ltrs. + 2 Ltrs. + 1 Ltrs. + 250 ml
Location: Moin Ul Haq Stadium Sampling Type: Grab
Sample Collected By: VEL Representative (Mr. Awadesh) Preservation: Ice Box
Sampling and Analysis Protocol: APHA 23rd Edition 2017 & IS: 3025 Parameter Required: As per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H'B, Electrometric Method	7.64	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	381.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA, 3500 Ca B, EDTA Titrimetric Method	71.26	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	267.25	mg/L	200	600
9.	Chloride as Cl	APHA, 4500 Cl B, Argentometric Method	62.14	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	27.16	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	289.56	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	15.48	mg/L	200	400
13.	Fluoride as F	APHA, 4500 FD, SPADNS Method	0.34	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	16.89	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	0.21	mg/L	1.0	No Relaxation
16.	Aluminium as Al	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.05	No Relaxation



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Test Report

Sample No.: VEL/W/2207010003			Report No.: VEL/W/2207010003			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

*Amendment No 1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No.3 in Feb. 2021 (Limit of Mineral Oil)

End of Report



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Test Report

Sample Number:	VEL/W/2207010004	Report No.:	VEL/W/2207010004
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
		Sampling Date:	27/06/2022
Sample Description:	Ground Water Sample	Sampling Quantity:	2 Ltrs. + 2 Ltrs. + 1 Ltrs. + 250 ml
Location:	Patna University	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Awadesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H'B, Electrometric Method	7.12	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	396.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA, 3500 Ca B, EDTA Titrimetric Method	76.47	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	258.47	mg/L	200	600
9.	Chloride as Cl ⁻	APHA, 4500 Cl B, Argentometric Method	58.74	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	16.00	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	256.62	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	12.23	mg/L	200	400
13.	Fluoride as F	APHA, 4500 FD, SPADNS Method	0.28	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	14.52	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	0.18	mg/L	1.0	No Relaxation
16.	Aluminium as Al	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.05	No Relaxation



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Test Report

Sample No.: VEL/W/2207010004			Report No.: VEL/W/2207010004			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185-2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185-2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

*Amendment No 1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No 3 in Feb. 2021 (Limit of Mineral Oil)

End of Report



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Test Report

Sample Number: VEL/W/2207010005
Name & Address of the Party: M/s Larsen & Toubro Construction Limited
Patna U.G. Metro-PC-03 Project Office,
2nd Floor, Muratlal Prakash Tower,
Veer Kunwar Singh Chowk,
Keshri Nagar, Nalapar, Patna, Bihar
Pin Code - 800024

Report No.: VEL/W/2207010005
Format No.: 7.8 F-03
Party Reference No.: LE21MAF5
Reporting Date: 09/07/2022
Period of Analysis: 01/07/2022 to 09/07/2022
Receipt Date: 01/07/2022
Sampling Date: 27/06/2022
Sampling Quantity: 2 Ltrs. + 2 Ltrs. + 1 Ltrs. + 250 ml
Sampling Type: Grab
Preservation: Ice Box
Parameter Required: As per Work Order

Sample Description: Ground Water Sample
Location: Gandhi Maidan
Sample Collected By: VEL Representative (Mr. Awadesh)
Sampling and Analysis Protocol: APHA 23rd Edition 2017 & IS: 3025

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H'B, Electrometric Method	7.69	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	387.65	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca -	APHA, 3500 Ca B, EDTA Titrimetric Method	68.28	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	265.25	mg/L	200	600
9.	Chloride as Cl	APHA, 4500 ClB, Argentometric Method	42.36	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	19.66	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	251.28	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	13.27	mg/L	200	400
13.	Fluoride as F	APHA, 4500 F D, SPADNS Method	0.52	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	22.63	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65); 2014 (RA:2019)	0.32	mg/L	1.0	No Relaxation
16.	Aluminium as Al	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.05	No Relaxation



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEL/W/2207010005			Report No.: VEL/W/2207010005			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

*Amendment No 1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No 3 in Feb. 2021 (Limit of Mineral Oil)

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/W/2207010006	Report No.:	VEL/W/2207010006
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
Sample Description:	Ground Water Sample	Sampling Date:	27/06/2022
Location:	Akashwani	Sampling Quantity:	2 Ltrs. + 2 Ltrs. + 1 Ltrs. + 250 ml
Sample Collected By:	VEL Representative (Mr. Awadesh)	Sampling Type:	Grab
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Preservation:	Ice Box
		Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H'B, Electrometric Method	7.84	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	368.54	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA, 3500 Ca B, EDTA Titrimetric Method	55.92	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	248.46	mg/L	200	600
9.	Chloride as Cl	APHA, 4500 Cl B, Argentometric Method	54.53	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	26.07	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	246.82	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	18.61	mg/L	200	400
13.	Fluoride as F	APHA, 4500 FD, SPADNS Method	0.47	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	18.24	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	0.26	mg/L	1.0	No Relaxation
16.	Aluminium as Al	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.05	No Relaxation



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEL/W/2207010006			Report No.: VEL/W/2207010006			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN ⁻	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

^aAmendment No 1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No 3 in Feb. 2021 (Limit of Mineral Oil).

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/W/2207010007	Report No.:	VEL/W/2207010007
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
Sample Description:	Ground Water Sample	Sampling Date:	27/06/2022
Location:	Rajendra Nagar	Sampling Quantity:	2 Ltrs. + 2 Ltrs. + 1 Ltrs. + 250 ml
Sample Collected By:	VEL Representative (Mr. Awadesh)	Sampling Type:	Grab
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Preservation:	Ice Box
		Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H ⁷ B, Electrometric Method	7.14	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	318.54	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA, 3500 Ca B, EDTA Titrimetric Method	62.24	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	223.38	mg/L	200	600
9.	Chloride as Cl	APHA, 4500 Cl B, Argentometric Method	74.28	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	18.51	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	231.45	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	20.52	mg/L	200	400
13.	Fluoride as F	APHA, 4500 FD, SPADNS Method	0.23	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	20.27	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	0.38	mg/L	1.0	No Relaxation
16.	Aluminium as Al	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.05	No Relaxation



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Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEL/W/2207010007			Report No.: VEL/W/2207010007			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA. 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

^a Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No.3 in Feb. 2021 (Limit of Mineral Oil).

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/W/2207010008	Report No.:	VEL/W/2207010008
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
Sample Description:	Ground Water Sample	Sampling Date:	27/06/2022
Location:	PMCH	Sampling Quantity:	2 Ltrs. + 2 Ltrs. + 1 Ltrs. + 250 ml
Sample Collected By:	VEL Representative (Mr. Awadesh)	Sampling Type:	Grab
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Preservation:	Ice Box
		Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H ⁺ B, Electrometric Method	7.58	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	362.34	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA, 3500 Ca B, EDTA Titrimetric Method	78.36	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	241.57	mg/L	200	600
9.	Chloride as Cl	APHA, 4500 Cl B, Argentometric Method	61.82	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	18.70	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	272.48	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	27.53	mg/L	200	400
13.	Fluoride as F	APHA, 4500 FD, SPADNS Method	0.16	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	18.32	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65); 2014 (RA:2019)	0.17	mg/L	1.0	No Relaxation
16.	Aluminium as Al	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.05	No Relaxation



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEL/W/2207010008			Report No.: VEL/W/2207010008			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

*Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No.3 in Feb. 2021 (Limit of Mineral Oil).

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/W/2207010009	Report No.:	VEL/W/2207010009
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
Sample Description:	Drinking Water Sample	Sampling Date:	27/06/2022
Location:	Gandhi Maidan	Sampling Quantity:	2 Ltrs. + 2 Ltrs. + 1 Ltrs. + 250 ml
Sample Collected By:	VEL Representative (Mr. Awadesh)	Sampling Type:	Grab
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Preservation:	Ice Box
		Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H'B, Electrometric Method	7.32	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	122.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA, 3500 Ca B, EDTA Titrimetric Method	18.69	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	88.44	mg/L	200	600
9.	Chloride as Cl ⁻	APHA, 4500 Cl B, Argentometric Method	15.50	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	12.54	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	98.22	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	*BLQ(**LOQ-5.0)	mg/L	200	400
13.	Fluoride as F	APHA, 4500 F D, SPADNS Method	*BLQ(**LOQ-0.2)	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	*BLQ(**LOQ-1.0)	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	1.0	No Relaxation
16.	Aluminium as Al	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.05	No Relaxation



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEL/W/2207010009			Report No.: VEL/W/2207010009			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

*Amendment No 1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No.3 in Feb. 2021 (Limit of Mineral Oil)

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/W/2207010010	Report No.:	VEL/W/2207010010
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
Sample Description:	Drinking Water Sample	Sampling Date:	27/06/2022
Location:	Labour Camp	Sampling Quantity:	2 Ltrs. + 2 Ltrs. + 1 Ltrs. + 250 ml
Sample Collected By:	VEL Representative (Mr. Awadesh)	Sampling Type:	Grab
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Preservation:	Ice Box
		Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H'B, Electrometric Method	7.37	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	323.52	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca-	APHA, 3500 Ca B, EDTA Titrimetric Method	65.27	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	251.36	mg/L	200	600
9.	Chloride as Cl	APHA, 4500 ClB, Argentometric Method	57.92	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	24.72	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	264.57	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	15.48	mg/L	200	400
13.	Fluoride as F	APHA, 4500 F D, SPADNS Method	0.46	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	15.42	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	0.36	mg/L	1.0	No Relaxation
16.	Aluminium as Al	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.05	No Relaxation



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ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEL/W/2207010010			Report No.: VEL/W/2207010010			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428/IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

^oAmendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No.3 in Feb. 2021 (Limit of Mineral Oil).

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/AW/2207010001	Report No.:	VEL/AW/2207010001
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
		Sampling Date:	27/06/2022
Sample Description:	Waste Water Sample (Bio Toilet)	Sampling Quantity:	2 Ltrs.
Location:	Moin Ul Haq Stadium	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Awadesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards as per The Environment (Protection) Rules, 1986		
					Inland Surface Water	Public Sewers	Land for Irrigation
1.	pH (at 25°C)	APHA, 4500 H ⁺ B, Electrometric Method	7.67	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	APHA, 2540 D, Gravimetric Method	24.84	mg/L	100	600	200
3.	Oil & Grease	APHA, 5520 B, Partition Gravimetric Method:2017	0.80	mg/L	10	20	10
4.	BOD (5 Days @20°C)	APHA, 5210 C, Ultimate BOD Test:2017	19.00	mg/L	30	350	100
5.	COD	APHA, 5220 B, Open Reflux Method:2017	78.29	mg/L	250	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As per The Environment (Protection) Rules, 1986 [SCHEDULE - VI] (See Rule 3A)

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/WW/2207010002	Report No.:	VEL/WW/2207010002
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
		Sampling Date:	27/06/2022
Sample Description:	Waste Water Sample (Bio Toilet)	Sampling Quantity:	2 Ltrs.
Location:	Patna University	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Awadesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards as per The Environment (Protection) Rules, 1986		
					Inland Surface Water	Public Sewers	Land for Irrigation
1.	pH (at 25°C)	APHA, 4500 H'B, Electrometric Method	7.30	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	APHA, 2540 D, Gravimetric Method	27.00	mg/L	100	600	200
3.	Oil & Grease	APHA, 5520 B, Partition Gravimetric Method:2017	0.45	mg/L	10	20	10
4.	BOD (5 Days @20°C)	APHA, 5210 C, Ultimate BOD Test:2017	16.00	mg/L	30	350	100
5.	COD	APHA, 5220 B, Open Reflux Method:2017	65.43	mg/L	250	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As per The Environment (Protection) Rules, 1986 [SCHEDULE - VI] (See Rule 3A)

End of Report



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Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
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Test Report

Sample Number:	VEL/WW/2207010003	Report No.:	VEL/WW/2207010003
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
Sample Description:	Waste Water Sample (Bio Toilet)	Receipt Date:	01/07/2022
Location:	Gandhi Maidan	Sampling Date:	27/06/2022
Sample Collected By:	VEL Representative (Mr. Awadesh)	Sampling Quantity:	2 Ltrs.
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Sampling Type:	Grab
		Preservation:	Ice Box
		Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards as per The Environment (Protection) Rules, 1986		
					Inland Surface Water	Public Sewers	Land for Irrigation
1.	pH (at 25°C)	APHA, 4500 H ⁺ B, Electrometric Method	7.35	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	APHA, 2540 D, Gravimetric Method	21.73	mg/L	100	600	200
3.	Oil & Grease -	APHA, 5520 B, Partition Gravimetric Method:2017	0.65	mg/L	10	20	10
4.	BOD (5 Days @20°C)	APHA, 5210 C, Ultimate BOD Test:2017	18.54	mg/L	30	350	100
5.	COD	APHA, 5220 B, Open Reflux Method:2017	72.00	mg/L	250	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As per The Environment (Protection) Rules, 1986 [SCHEDULE - VI] (See Rule 3A)

End of Report



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Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VELWW/2207010004	Report No.:	VELWW/2207010004
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
		Sampling Date:	27/06/2022
Sample Description:	Waste Water Sample (Bio Toilet)	Sampling Quantity:	2 Ltrs.
Location:	Akashwani	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Awadesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards as per The Environment (Protection) Rules, 1986		
					Inland Surface Water	Public Sewers	Land for Irrigation
1.	pH (at 25°C)	APHA, 4500 H ⁺ B, Electrometric Method	7.44	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	APHA, 2540 D, Gravimetric Method	26.61	mg/L	100	600	200
3.	Oil & Grease	APHA, 5520 B, Partition Gravimetric Method:2017	0.76	mg/L	10	20	10
4.	BOD (5 Days @20°C)	APHA, 5210 C, Ultimate BOD Test:2017	12.87	mg/L	30	350	100
5.	COD	APHA, 5220 B, Open Reflux Method:2017	45.63	mg/L	250	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As per The Environment (Protection) Rules, 1986 [SCHEDULE - VI] (See Rule 3A)

End of Report



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Test Report

Sample Number:	VEL/WW/2207010005	Report No.:	VEL/WW/2207010005
Name & Address of the Party:	M/s Larsen & Toubro Construction Limited Patna U.G. Metro-PC-03 Project Office, 2 nd Floor, Muratlal Prakash Tower, Veer Kunwar Singh Chowk, Keshri Nagar, Nalapar, Patna, Bihar Pin Code - 800024	Format No.:	7.8 F-03
		Party Reference No.:	LE21MAF5
		Reporting Date:	09/07/2022
		Period of Analysis:	01/07/2022 to 09/07/2022
		Receipt Date:	01/07/2022
		Sampling Date:	27/06/2022
Sample Description:	Waste Water Sample (Bio Toilet)	Sampling Quantity:	2 Ltrs.
Location:	PMCH	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Awadesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards as per The Environment (Protection) Rules, 1986		
					Inland Surface Water	Public Sewers	Land for Irrigation
1.	pH (at 25°C)	APHA, 4500 H'B, Electrometric Method	7.19	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	APHA, 2540 D, Gravimetric Method	25.00	mg/L	100	600	200
3.	Oil & Grease	APHA, 5520 B, Partition Gravimetric Method:2017	0.85	mg/L	10	20	10
4.	BOD (5 Days @20°C)	APHA, 5210 C, Ultimate BOD Test:2017	15.72	mg/L	30	350	100
5.	COD	APHA, 5220 B, Open Reflux Method:2017	60.37	mg/L	250	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As per The Environment (Protection) Rules, 1986 [SCHEDULE - VI] (See Rule 3A)

End of Report



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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number: VE1AV/01 Report No.: VE1AV/2208310003
 Issued To: M/s Montecarlo Limited Format No.: 7.8 F-03
 Montecarlo House, Party Reference No.: 15047806
 Sindhu Bhavan Road, Bodakdev, Date : 21.05.2022
 Ahmedabad, Gujarat, India - 380058 Reporting Date: 06/09/2022
 Name & Address of the Project: 3320 - M/s Patna Metro Rail Project Period of Analysis: 31/08/2022 to 06/09/2022
 Montecarlo Limited 170 Ward No. 38, Receipt Date: 31/08/2022
 Ranjan Yadav Path, Near Maruti Alankar Sampling Date: 25.08.2022
 Service Center, Danapur, Patna, Bihar, Sampling Quantity: 5 Ltrs. + 250 ml
 India - 801503 Sampling Type: Grab
 Sample Description: Ground Water Sample Preservation: Ice Box
 Location: Saguna More Parameter Required: As per Work Order
 Sample Collected By: VEI Representative (Mr. Rohit Tiwari)
 Sampling and Analysis Protocol: APHA 23rd Edition 2017 & IS: 3025

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA. 4500 H B. Electrometric Method	7.39	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA. 2120 B. Visual Comparison Method	*BLQ (**1.0Q-1.0)	Hazen	5	15
3.	Turbidity	APHA. 2130 B. Nephelometric Method	*BLQ (**1.0Q-1.0)	NTU	1	5
4.	Odour	APHA. 2150 B. Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA. 2160 B. Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA. 2540 C. Gravimetric Method	356.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA. 3500 Ca B. EDTA Titrimetric Method	87.99	mg/L	75	200
8.	Total Alkalinity as CaCO ₃	APHA. 2320 B. Titrimetric Method	257.05	mg/L	200	600
9.	Chloride as Cl	APHA. 4500 Cl B. Argentometric Method	55.46	mg/L	250	1000
10.	Magnesium as Mg	APHA. 3500 Mg B. Calculation Method	18.11	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA. 2340 C. EDTA Titrimetric Method	294.52	mg/L	200	600
12.	Sulphate as SO ₄	APHA. 4500 E. Turbidimetric Method	20.87	mg/L	200	400
13.	Fluoride as F	APHA. 4500 F D. SPADNS Method	0.35	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34). Chromotropic Method	3.09	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	0.15	mg/L	1.0	No Relaxation

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Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEL/W/01		Report No.: VEL/W/2208310003				
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
16.	Aluminium as Al	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
19.	Phenolic Compounds (C ₆ H ₅ OH)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428 IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.4	0.3
25.	Selenium as Se	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation

Table 3 Parameters Concerning Toxic Substances

26.	Cadmium as Cd	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65); 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation

Table 4 Bacteriological Quality of Drinking Water

31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

*Amendment No 1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept. 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No 3 in Feb. 2021 (Limit of Mineral Oil)

End of Report

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08/09/2022



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Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/W/02	Report No.:	VEL/W/2208310004
Issued To:	M/s Montecarlo Limited Montecarlo House, Sindhu Bhavan Road, Bodakdev, Ahmedabad, Gujarat, India - 380058	Format No.:	7.8 F-03
		Party Reference No.:	15047806
		Date:	21.05.2022
		Reporting Date:	06/09/2022
Name & Address of the Project:	3320 - M/s Patna Metro Rail Project Montecarlo Limited 170 Ward No. 38, Ranjan Yadav Path, Near Maruti Alankar Service Center, Danapur, Patna, Bihar, India - 801503	Period of Analysis:	31/08/2022 to 06/09/2022
		Receipt Date:	31/08/2022
		Sampling Date:	25.08.2022
Sample Description:	Ground Water Sample	Sampling Quantity:	5 Ltrs. + 250 ml
Location:	Batching Plant (Rukanpura)	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Rohit Tiwari)	Preservation:	Ice Box
Sampling and Analysis Protocol:	APHA 23 rd Edition 2017 & IS: 3025	Parameter Required:	As per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	pH (at 25°C)	APHA, 4500 H B, Electrometric Method	7.84	--	6.5 to 8.5	No Relaxation
2.	Colour	APHA, 2120 B, Visual Comparison Method	*BLQ(**LOQ-1.0)	Hazen	5	15
3.	Turbidity	APHA, 2130 B, Nephelometric Method	*BLQ(**LOQ-1.0)	NTU	1	5
4.	Odour	APHA, 2150 B, Threshold Odour Method	Agreeable	--	Agreeable	Agreeable
5.	Taste	APHA, 2160 B, Threshold Test Method	Agreeable	--	Agreeable	Agreeable
6.	Total Dissolved Solids	APHA, 2540 C, Gravimetric Method	424.00	mg/l	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Calcium as Ca	APHA, 3500 Ca B, EDTA Titrimetric Method	90.14	mg/l	75	200
8.	Total Alkalinity as CaCO ₃	APHA, 2320 B, Titrimetric Method	291.00	mg/L	200	600
9.	Chloride as Cl	APHA, 4500 Cl B, Argentometric Method	66.02	mg/L	250	1000
10.	Magnesium as Mg	APHA, 3500 Mg B, Calculation Method	23.31	mg/L	30	100
11.	Total Hardness as CaCO ₃	APHA, 2340 C, EDTA Titrimetric Method	321.30	mg/L	200	600
12.	Sulphate as SO ₄	APHA, 4500 E, Turbidimetric Method	18.62	mg/L	200	400
13.	Fluoride as F	APHA, 4500 F D, SPADNS Method	0.56	mg/L	1.0	1.5
14.	Nitrate as NO ₃	IS: 3025 (P-34), Chromotropic Method	3.20	mg/L	45	No Relaxation
15.	Iron as Fe	IS: 3025 (P-65): 2014 (RA:2019)	0.18	mg/L	1.0	No Relaxation

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Vardan EnviroLab

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Haryana)
 ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample No.: VEI/W/02		Report No.: VEI/W/2208310004				
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable) Limit	Permissible Limit in the Absence of Alternate Source
16.	Aluminium as Al	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
17.	Boron as B	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
18.	Total Chromium as Cr	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
19.	Phenolic Compounds (C ₁₂ H ₁₀ O ₂)	APHA, 5530 C, Chloroform Extraction Method	*BLQ(**LOQ-0.0004)	mg/L	0.001	0.002
20.	Mineral Oil	Clause 6 of IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L	1.0	No Relaxation
21.	Anionic Detergents as MBAS	Annex K, IS: 13428:IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
22.	Zinc as Zn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0
23.	Copper as Cu	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
24.	Manganese as Mn	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
25.	Selenium as Se	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
Table 3 Parameters Concerning Toxic Substances						
26.	Cadmium as Cd	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
27.	Lead as Pb	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
28.	Cyanide as CN	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
29.	Arsenic as As	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
30.	Mercury as Hg	IS: 3025 (P-65): 2014 (RA:2019)	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
Table 4 Bacteriological Quality of Drinking Water						
31.	Total Coliform	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	
32.	E. coli	IS: 15185:2016	Absent	Per 100ml	Shall not be detectable in any 100 ml sample	

Note:- *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.
 *Amendment No 1 in June 2015 (Limits of Iron & Arsenic) and Amendment No 2 in Sept 2018 (Limit of Boron & IS Method of Total Coliform & E. coli) & Amendment No 3 in Feb. 2021 (Limit of Mineral Oil)

End of Report

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Attachment 14. Interview Survey Results

SURVEY RESULTS OF QUESTIONNAIRE OF SOCIAL SURVEY

Land Use and Utilization of Natural Resources:

Question No.6.1	No. of Respondents	Responses in Percentage (%)		Remarks
		YES	NO	
Are there any loss of local resources by the project implementation: Local Crop and fruit, water Reservoir?	240	--	100%	During the survey it was obtained that all the 240 respondents opined that there shall be no loss of local crop and fruit, reservoir by the project.

Water Usage:

Question No.6.2	No. of Respondents	Responses in Percentage (%)		Remarks
		YES	NO	
Do you use nearby river water or lake water for fishing, fishery, washing for laundries and dishes etc.in your daily life?	240	--	100%	All the respondents have told that they use water supplied through Tap water provided by Patna Municipal Corporation for daily usage and there is no use of nearby river water or lake water for fishing, fishery, washing for laundries and dishes etc.in the daily life. Among the 240 respondents no one was involved in the fishing activity.

Existing Social Infrastructure and Services

Question No.6.3- Could you give us the names of Clinics, Hospitals, schools, Kindergartens and religious facilities in your community?

During the Survey and interview with the 240 respondents in the study area it was obtained that there are following Clinics, Hospitals, Schools, Kindergartens and Religious Facilities in the study area.

Location	Existing Social Infrastructure and Services			
	Hospital	Schools/Educational Institution	Offices/ Community Hall, Academy	Religious Places
Danapur	Kusum Hospital, Danapur Sub-Divisional Hospital,	Kendriya Vidhyalaya, Government School Tara Chak, St. Xavier School	--	--
Shaguna More	Government Hospital, Hi-Tech Emergency Hospital, Dr.Bindu Hospital, CISRO Hospital, Keshav Hospital, Dr. Vivek Clinic	Sainik School, DAV Public School, S.G Public School, Patna Doon Public School, Rastriya Madh Vidhyalaya	--	Hanuman Temple, Shiv Mandir
RPS More	J.D Eye Hospital, Dental Hospital, R.A.K Gupta Eye Hospital, Vishal Homeo Clinic,	Doon Public School, Impact College	--	Arya Samaj Mandir
Patliputra	--	Amity University	--	Hanuman Temple
Raja Bazar	Paras Hospital	Public School, B.V. College	--	Shiv Temple, Mazjid
Patna Zoo	--	Public School	--	Zoo
Vikas Bhawan	Sadar Hospital	Kendriya Vidhyalaya, Shri Paroga Prasad High School	Panchayati Raj Department, National Informatics Centre, Pant Bhawan, Public Health Department	Panchmukhi Hanuman Temple, Durga Mata Mandir
Vidyut Bhawan	--	Patna Mahila Mahavidhyalaya	--	Vidhyut Bhawan, Niyojan Bhawan, Patna Museum
Mithapur	Swastik Hospital, Girija Hospital	Chandragupt Institute of management, Chanakya Institute of Law, Persian College, Aryabhata College, IGNOU Regional Centre	--	Radhe Krishna Temple

Location	Existing Social Infrastructure and Services			
	Hospital	Schools/Educational Institution	Offices/ Community Hall, Academy	Religious Places
Ramkrishna Nagar	Ramastha Multi specialist Hospital, Patna Central Hospital	Shyam Convent, ITI college, Ramkrishna Dwarika College	--	Shiv mandir
Jaganpura	Patna Central Hospital, Pulse hospital, SRL Diagnostic centre	Patna Central School	Maruti Suzuki Showroom	Shiv mandir, Rameshwar Mahadev Temple
Patna Station	Central Super Speciality Hospital, Railway Hospital, General Hospital, Ishwar Memorial Hospital	Bihar Examination Board	--	Hanuman Temple, Buddha Smriti Park, Mosque
Akashvani	Wells Hospital, Rainbow Emergency Hospital,	Vidhya Niketan School, Modern Sainik School, Little Flower School, St.Xavier School,	--	--
Gandhi Maidan	Multispeciality Hospital	Magadh Mahila University	Sri Krishna Memorial Hall, Patna	--
PMCH	Government Medical Hospital	Government Medical College	--	Mosque, Radha Krishna Temple
University	PMCH (600 Meters)	Patna University, Science College, Coaching Institutes and Classes	Anjuman Ismania Hall	Hanuman Temple
Moin Ul Haq Stadium	Dr. Arun Kumar Agrawal Hospital(Private Clinic), Dr. Khan Clinic	DAV Vidhyalaya, Bihar Sangeet Natak academy, Premchand Rangshala, Rajkiya Balak Vidhyalaya	Community Hall, Bihar Cricket Academy	--
Rajendra Nagar	Heart Hospital, Private Hospitals, ENT Specialist, Aastha Lok Hospital, Dental	Kendriya Vidhyalaya, Patliputra University, College of Arts, Commerce and Science	--	--
Malahi Pakri	Niramay Blood Bank, Orchid Hospital, Patna Heart Hospital, Endocrinology, Pathology Centre, Gastro Clinic	New Era Public School, AISECT Research Centre	--	--
Khemni Chak	Kritika Dental Clinic, Ford Hospital, Medwin Hospital, Parasmani Hospital	Patna Central School	Vishal Mega Mart, Jharokha Banquet Hall	Durga Devi Temple(around 2 km from the Metro Station)
Bhoot Nath	Jeevan Deep Hospital, Sanford Hospital, Vinayak Hospital, Gangotri Hospital, Emergency Hospital, Ankita Hospital, Mithila Hospital	Vistar Management College	--	--
Zero Mile	Earth Hospital	--	Automobile and Transport Shops	--
ISBT	Shanti Navjeevan Hospital, Nalanda Hospital	RPS public School	--	--

Cultural Heritage

Question No.6.4	No. of Respondents	Responses in Percentage (%)		Remarks
		YES	NO	
Could you give us the name of cultural properties, historic and archaeological site, church, cemetery in your community?	240	4.9%	95.9%	The 230 respondents said that cultural properties, historic and archaeological site is not existing in the area coming under the Metro location. While the 10 respondents from Gandhi Maidan station opined that there is Church located near to the Gandhi Maidan Station and Gandhi Maidan Park itself is a Historical place.

Natural Disaster

Question No.6.5	No. of Respondents	Responses in Percentage (%)		Remarks
		YES	NO	
Have u ever affected any impacts of natural disaster such as Cyclone, Flood, Earth Quake etc.	240	3%	97%	233 respondents said that no natural disaster such as Flood, earthquake and cyclone is experience by the people in the study area. While 7 respondents of Raja Bazar, Patna Zoo, Vidyut Bhawan, Vikas Bhawan, Jaganpura and Moil Ul-Haq Stadium area opined that not exactly the flood occurs in the area but there is water logging which is experienced by the people which is caused due to improper drainage system in the city and due to the heavy rainfall in the monsoon season.

Child Labour

Question No.6.6	No. of Respondents	Responses in Percentage (%)		Remarks
		YES	NO	
Is Child Labour customary in your community? (Yes/No)	240	--	100%	All 240 respondents opined that no child labour is experienced in the community.
Are there any obstacles for access to clinics hospitals, schools, Kindergarten and religious facilities in your community?	240	100%	--	All 240 respondents opined that they experience the issue of Heavy traffic causing traffic accidents in the city.

Infectious Diseases such as HIV/ AIDS

Question No.6.7	No. of Respondents	Responses in Percentage (%)		Remarks
		YES	NO	
What kind of Epidemic Infectious disease have you had?	240	--	100%	No respondent was obtained during the survey having Epidemic Infectious disease among the 240 respondents.

Gender Equity (Only for Female)

Question No.6.8	No. of Respondents	Responses in Percentage (%)		Remarks
		YES	NO	
What kind of measures do you think female passengers need to take a train with comfort? Ex. Installing of Priority Seat, Female only Car, Breast Feeding room at Station etc.	120	100%	--	Female respondents are positive towards the project and 75% are demanding that there should separate Female coach in the Metro train, about 25% wanted special seat for women in general coaches/ Installing of Priority Seat.

Ecosystem Services

Question No.6.9	No. of Respondents	Responses in Percentage (%)		Remarks
		YES	NO	
What kind of ecosystem services are you offered in your daily life? Ex. Danapur cantonment, Patna Zoo, other crops and cultivated product in Patna etc.	240	18 %	82 %	198 respondents said that no ecosystem services in the study area. While 42 respondents of Danapur, Saguna More, R.P.S. More, Raja Bazar, Patna Zoo, Vidyut Bhawan, Vikas Bhawan, Patna station, Moil Ul-Haq Stadium, Khemni Chak, and New ISBT area opined that they received Ecosystem services from Danapur cantonment, Patna Zoo, other crops and cultivated product in Patna.

Attachment 15. Construction Speed and Required TBM Units

Construction speed highly depends on TBM works in the case of underground railway projects as the TBM system is the most expensive unit out of all kinds of equipment, and TBM construction limits access to the site (the launching shaft is the only entry point). In contrast, if required, the contractor can hurry the progress to deploy more machines for other construction activities.

Table 1 Key Dates relating to TBM Works of PC-03

Key Date	Event	Weeks after LOA	Weeks after NTP
02	Submission of the copy of the agreement/ LOA/ purchase order for purchase of TBM or a proof of availability of TBM for ready deployment. This period will include two weeks for design review by the Engineer.	6	N/A
06	Start of Initial Drive of TBM No. 1 from the first launching shaft and also start of initial drive of TBM No. 2 from the second launching shaft	N/A	35
07	Start of Initial Drive of TBM No. 3 from the first launching shaft and start of initial drive of TBM No. 4 from the second launching shaft.	N/A	45
08	Completion of Track way Basic structure for designated contractor access- track way, including construction of cross passages, 1st stage track bed concrete including drainage for 1st block section (both tunnels)	N/A	90
22	Completion of Track way Basic structure for designated contractor access- track way, including construction of cross passages, 1st stage track bed concrete including drainage for last block section (both tunnels)	N/A	140

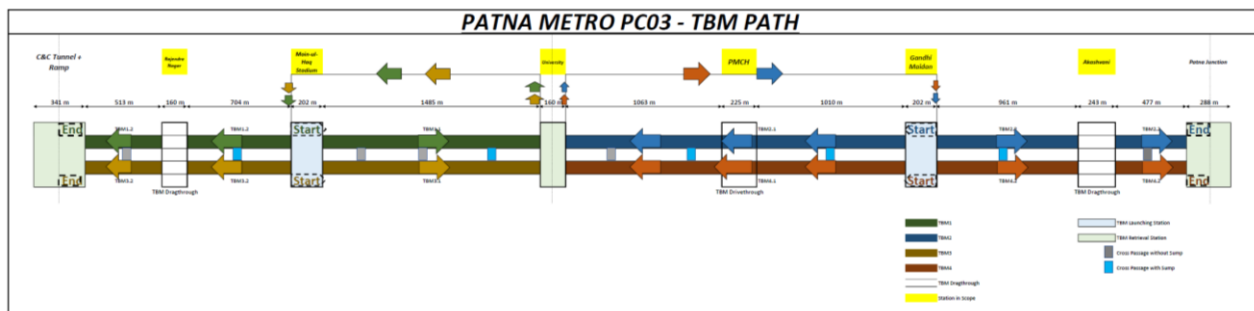
Source: PMRCL

The master schedule for the Patna Metro Project defines 42 months construction period for every underground contract, PC-03, 05, and 06. Let's review PC-03 contract requirements with the contractor's actual TBM construction plan.

1. Review of PC-03 TBM program

The Employer's requirement of the PC-03 contract indicates Key Dates in Appendix 2B. To shorten the construction period, the Contractor must carry out various desk works and site surveys, like ordering TBM and conducting a building condition survey immediately after the issue of the Letter of Acceptance. Then the Contractor should meet the Key date of launching the first two TBMs **35 weeks** after the Notice to Proceed (NTP) is rendered. Followingly, they should launch the rest of the two TBMs by **45 weeks** after NTP. The Contractor must complete works to hand the site to track contractors for the first section by **90 weeks** and the entire area by **140 weeks** after NTP.

The following chart shows the TBM work sequence of the PC-03 contractor. The PC-03 contract has 6841 meters of the TBM section. Based on the station location, they split the entire TBM section into two, 2862 and 3979 meters. To meet the first milestone, handing over the first section to the track contractor, they have to proceed with TBM at 1485 meters and install three cross-passages and the first stage bed concrete.



Source: PC-03 Contractor

Figure 1 TBM Construction Sequence of PC-03

The contractor should build cross-passages per the National Building Code of India (NBC) 2016. Sub-clause K-4.1.5 of NBC specifies the following requirements:

- First cross-passage shall be provided not farther than 500 m from the end of the platform of an enclosed station or from the tunnel portal or from a mid-tunnel exit way
- Distance between any two cross-passageways shall not be more than 250 m

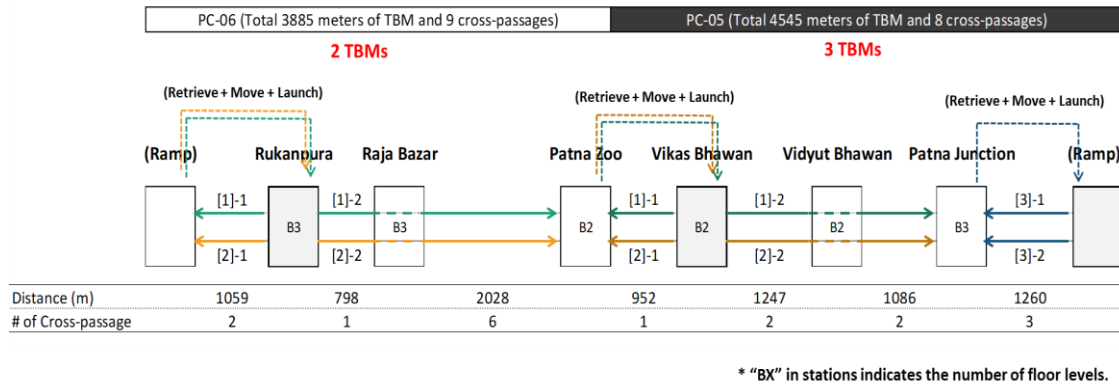
Suppose three cross-passage construction needs three months, and the first stage bed concrete for 1485 meters needs an additional one month. The Contractor should complete TBM excavation within 39 weeks ($=90 - 35 - 4 \times 4$), meaning the TBM should run at 38 meters per week or **163 meters per month**. On the other hand, to finish the entire tunneling work before 140 weeks, the contractor should complete the section of 3979 m, where the fourth TBM runs within 95 weeks. Even if the contractor allocates seven months to activities except for TBM boring, the balance is 67 weeks ($=95 - 4 \times 7$), and the contractor should run TBM at a speed of **255 meters per month**.

The PC-03 Contractor said, during an interview, that they planned the speed of 230-250 meters per month, including the initial drive. As the progress rate gets faster after the initial drive, the longer the section, the quicker the speed. The 255 meters per month above will be a decent and achievable target, and the contractor can accomplish the Key Date without damaging other contractors' schedules.

2. Application to PC-05 TBM program

The JST checks the number of required TBM for PC-05 and 06 under the same Key Dates condition as PC-03 since the duration of civil contraction works is 42 months and the same for three U/G packages. Based on the requirements above, while the PC-03 contractor must build a total of ten cross-passage, PC-05 and PC-06 contractors do eight and nine cross-passages, respectively.

First, since PMRCL/DMRC do not finalize the TBM working sequence for PC-05 and 06, the JST drafts it based on (1) the accessibility of equipment and materials and (2) the availability of a construction yard. The proposal is as follows.



Source: JST

Figure 2 Proposal on TBM Working Sequence for PC-05 and 06

For PC-06, from the null point (the point where the rail level crosses the ground surface) at the side of Danapur station to the eastern edge of Patna Zoo station, the TBM will be launched from the shaft at Rukanpura station to both eastern and western direction. Whereas for PC-05, from the east edge of Patna Zoo station to the null point at the side of Mithapur, the JST proposes Vikas Bhawan station and a ramp near the null point as the launching shaft.

To meet the first Key Date to hand over the site, TBM ideally passes the shorter section, from Rukanpura station to a ramp for PC-06 and from Vikas Bhawan to Patna Zoo for PC-05. Each running distance is 1059 and 952 meters, respectively, which is less than 1485 meters in the case of PC-03. Therefore, both PC-05 and 06 contractors can meet the first Key Date.

The length of aggregated TBM section in PC-06 is 3885 meters and shorter than the 3979 meters of the most extended section in PC-03. Two TBM sets can also satisfy the second Key Date in PC-06. However, PC-05 has 4545 meters of TBM section in total, and the contractor would need to proceed with TBM at nearly 300 meters per month ($= 255 \times 4545 / 3979$) if they deploy only two sets of TBM. That rate is so demanding that **the PC-05 Contractor should deploy three sets of TBM in total.**

The JST proposal for the PC-05 TBM sequence considers live railway lines between Patna Junction station and the ramp. That is, the contractor should pay special attention to live railway lines by closely monitoring the deformation while TBM crosses the section. The rate of TBM excavation should be subject to various factors, and this section should be independent from other sections. Hence, two sets of TBM will start from Vikas Bhawan station in both directions, and the last one will do from the ramp. Patna Junction station is located on a very congested and not wide road, so the contractor can retrieve TBM but not launch it. When the PC-05 contractor uses three sets of TBM, each TBM runs 3285, 3285, and 2520 meters, which is shorter than 3979 meters and allows the Contractor to meet the second Key Date for handing over the site to the track contractor.

In conclusion, deploying three sets and two sets of TBM for PC-05 and PC-06, respectively, can achieve critical Key Dates and the 42 months construction period.

Attachment 16. Construction Safety Management under JSSS

PMRCL agreed to utilize JICA Standard Safety Specification (JSSS). On the other hand, PMRCL uses DMRC's safety manual called Conditions of Contract on Safety & Health and Environment (CCSHE), May 2019, for the non-JICA portion. Here, the JST compares JSSS with CCSHE to figure out what additional functions PMRCL should arrange under JSSS.

First, it is about the priority across contract documents. According to Sub-clause 1.5 [Priority of Documents] of General Condition of Contract (GCC) PMRCL uses for non-JICA portion, the order list has no specific description of CCSHE. Hence, CCSHE can be categorized as the lowest rank or "any other documents." CCSHE describes, in Provision 5.0 [Designer's Role], the importance of design to reduce the incidence risk. However, the Contractor may face difficulty modifying the design in safety terms as the priority order in the contract documents puts a higher rank on Drawings the Employer attaches.

CCSHE does not envisage engaging General Consultant or project management consultant in construction safety management partly because DMRC does not always need to hire them. Apart from this base, there are several deviations in the safety management between CCSHE and JSSS, as below.

- i) Employer's engagement: JSSS needs the engagement of the Engineer or the Employer to manage the construction safety, like weekly joint site safety inspection with the Engineer, while CCSHE expects the Contractor to do it per the document.
- ii) Scoring system: CCSHE utilizes a scoring system to monitor the Contractor's safety management. The Employer might suspend the payment if the score is lower than the defined level. Manipulation would happen with unprofessional manners under no official monitoring.
- iii) Chairperson of Committee: Both documents demand the personnel dedicated to the construction safety management and the safety committee. CCSHE appoints the project manager as the chairperson of the committee. At the same time, JSSS renders the chairperson's role to the chief safety officer called Health and Safety Officer (HSO).
- iv) Training: CCSHE includes a provision on training for manageable personnel, while both documents refer to training for laborers.
- v) Stress on electrical safety: CCSHE highlights electrical safety while specifying monthly electrical safety audits. That makes sense as the quality of electrical equipment varies, and the severe natural climate may damage this equipment more challenging in India.
- vi) Minimum wage and Provident Fund (PF): CCSHE refers to the minimum wage and PF relating to local labor laws, whereas JSSS counts on local regulations regarding these issues.

CCSHE cares more about local challenges than JSSS, which is a good point. However, the required input from the Employer and Engineer is relatively silent in CCSHE.

Since JICA published JSSS in February 2021, it is a relatively new specification, and there should not be many projects to utilize JSSS. For instance, the JST compared JSSS with the Safety, Health and Environmental (SHE) requirements for Dedicated Freight Corridor (DFC) Phase-2 Project, JICA funded project, as below.

The JST observes that JSSS demands more resources for safety management, especially in training and committee meetings chaired by the Engineer and the Employer. In short, The Contractor should establish a Health Safety Officer (HSO) team with staff and a budget sufficient to deal with such extra activities. In contrast, the Employer must maintain a capable team with the Engineer too, and PMRCL should establish a capable team to follow JSSS accordingly.

Table 2: Comparison between JSSS and SHE Requirements for DFC (Phase2)

S.No.	Comparison Points	JICA Standard Safety Specification (JSSS)	SHE Requirements for DFC Phase-2, DFCCIL
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1	Safety Declaration	The Contractor shall submit Safety declaration (Bidder's commitment and obligation) with the bid by Adopting the slogan SAFETY FIRST with proactively aiming to achieve "Zero Accident".	This requirement is not clearly mentioned but according to the SHE Requirements (DFCCIL), the Contractor shall formulate a SHE policy (Contractor's Commitment) with a statement of organization & arrangement for SHE, training & education, Safety equipment, etc. to achieve "Zero Accident."
2	Risk Assessment	JSSS specifies key steps of Risk Assessment and the hierarchy of the control measures.	Although key steps of Risk assessment and their control procedures are not specified in the SHE Requirements (DFCCIL) but this is standard practice and followed by the Contractor for all routine and non-routine activity.
3	Contractor's Method Statements	The Contractor shall prepare Method Statements, including risk assessment for all parts of the work, including temporary works, with details of the arrangements and methods the Contractor proposes to adopt for execution.	This requirement is not clearly specified in the SHE Requirements (DFCCIL) but specified in other contract documents.
4	Skill Training	JSSS states that the Contractor shall ensure that all Contractor's Personnel shall be qualified, skilled & trained. The Contractor shall recruit candidates in the Country and train them to provide the skill required to perform their assignments.	Skill training requirements are weak and need to be strengthened as per JSSS.
5	HSO Scope of Duties and Authority	The duties and authorities of the Health & Safety Officer (HSO) are defined in the JSSS.	The duties and authorities of Safety personnel are not clearly defined in the SHE Requirements (DFCCIL)
6	Joint Site Safety Inspection	HSO shall conduct regular joint site safety inspections with the Engineer at least once a week. The Contractor shall prepare a joint inspection report and submit it to the Engineer within seven days after the inspection.	Planned general inspections are performed at predetermined intervals, usually involving the contractor and the Employer/engineer representatives.

7	Engineer's Regular Safety Meeting	The Engineer will arrange and host a regular safety meeting to be attended by representatives of the Employer and the Contractor to share information regarding health and safety management among the representatives of the Employer and the Contractor.	This requirement is not explicit in the SHE Requirements (DFCCIL) but is indirectly implied. It requires strengthening as per JSSS.
8	Project Safety Committee	On larger Projects with multiple contract packages, if so, as stated in the Particular Safety Specification, the Employer shall create and Project Safety Committee to ensure mutual understanding and effective implementation of health and safety management of the entire Project. The Employer shall be the chairperson of the safety committee.	This requirement is not explicit in the SHE Requirements (DFCCIL). It requires strengthening as per JSSS to have more Employer involvement.
9	Health & Safety Incentive Scheme	The Contractor shall describe the proposed health and safety incentive scheme in the Safety Plan and inform the Employer and Engineer about the progress and achievement of such schemes through their Monthly Safety Report.	The Health and Safety incentive scheme proposal is not specified in the SHE Requirements (DFCCIL). It requires strengthening as per JSS specification.
10	Design & Management of Temporary Works	The Contractor is required to comply with Sections 1 and 2 of BS5975 [Code of Practice for Temporary Works Procedures and the Permissible Stress Design of Falsework] as management standard for the design, erection, use, and dismantling of Temporary Works.	This requirement is not clearly specified in the SHE Requirements (DFCCIL) but is specified in other contract documents.

Source: JST