

Maha Metro



Tender Documents

**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

PART 4 – REFERENCE DOCUMENTS

June 2018

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**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

PART IV – REFERENCE DOCUMENT

Section XIII – Geotechnical Interpretative Report

June 2018

INTERIM DESIGN CONSULTANCY FOR PUNE METRO RAIL PROJECT

Geotechnical Interpretive Report (GIR)

Underground works

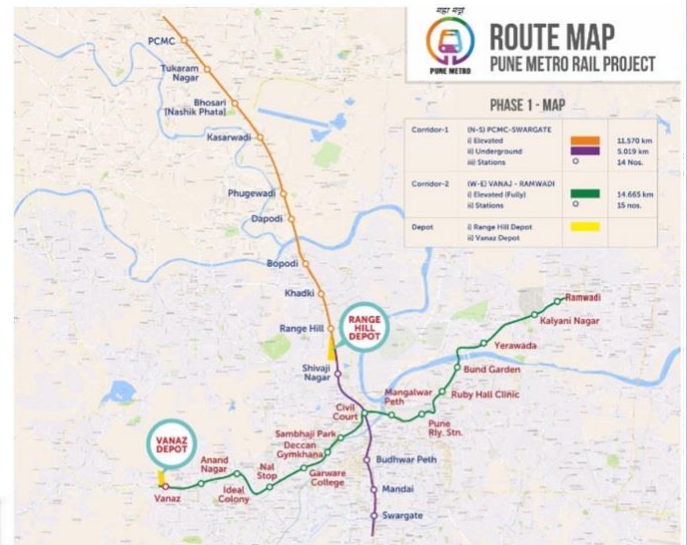


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1. Introduction

Pune is the second largest city in the Indian state of Maharashtra and ninth most populous city of the country. The population of the Pune metro region is more than 6 million. Pune is known as the 'Oxford of the East' due to the presence of several well-known educational institutions in the city. Besides, it is famous for its religious and historical places. Pune city is known in the world map because of its educational, research and development institutions. The district also has an importance as an important military base. Pune is the most industrialized district in western Maharashtra and a famous IT hub in the country. Pune is the cultural capital of Maharashtra.

The existing bus system has a limited capacity to cater the daily needs of the big city. There are many constraints to expand the existing roads, the biggest of which is the unavailability of land. Hence, in order to improve the overall traffic and transportation scenario in Pune Metro region and to cater the future travel needs, the Government of Maharashtra (GOM) has undertaken several studies and has identified that the Metro Rail model as the most efficient, economically viable and Environment friendly mass transport system.

1.1 Project

The first line of the Pune Metro will run from Pimpri-Chinchwad to Swargate. This line will be elevated till Range Hills and then will be underground up to Swargate it is proposed to further extend the line to Nigdi and Katraj/Hadapsar. This route will go via Bhosari, Khadki and Shivaji Nagar.

The concerned underground stretch of 5 Km approximate length lies on the North-south corridor of the proposed metro routes. The corridor is expected to go underground near the intersection of KB Joshi path and Shivaji Nagar railway station road which will further go beneath the Mutha River and will continue till the end of the corridor which will be at Swargate Bus depot. The route will cover the following metro stations:

- Shivaji Nagar Metro station
- Civil Court Metro station
- Budhwar Pet Metro station
- Mandai metro station
- Swargate metro station

1.2 Organization of the Report

The construction of underground part of Pune Metro phase- corridor 1 has been divided into two contract packages. This report has to be treated as a standalone GIR for Under Ground Civil Contract as described in Table 1. The Geotechnical data available from the various investigations carried out till date have been reviewed and analysed to arrive at design parameters for underground Contract.

Table 1 : Project Description

Corridor	Description
North-South Corridor	Interim design consultancy for Underground works (Tunnels & Stations) of length 5.5 Km (approx.) from South ramp (including) to Swargate station (Chainage 10800 to 17000 m) including allied works and 5 Nos. of UG Metro Stations

2. References

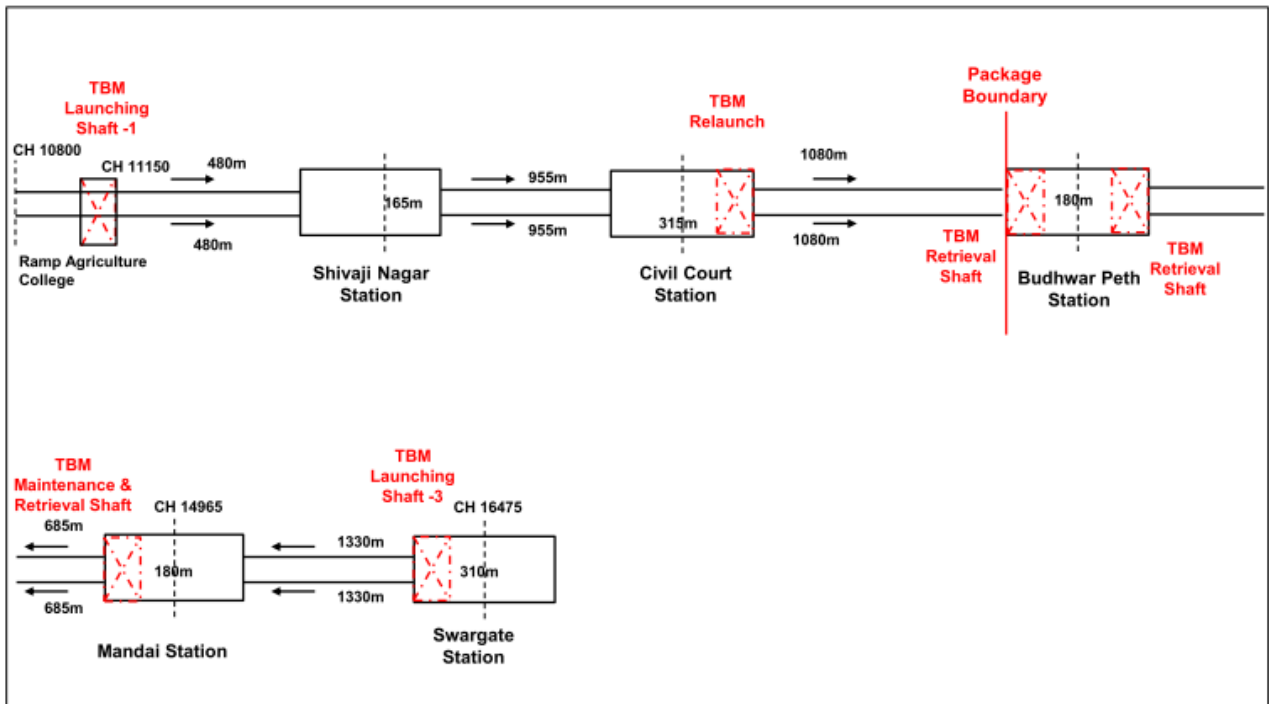
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- Bieniawski, Z.T. 1973. Engineering classification of jointed rock masses. Trans S. Afr. Inst. Civ. Engrs 15, 335-344.
- IS: 13365 (Part 1): 1998. Quantitative classification systems of rock mass – guidelines, further amended in 2008
- IS 13365 (Part 4): Draft, Quantitative classification systems of rock mass – Guidelines Part 4 Geological Strength Index (GSI).

3. Project Information

From Shivaji Nagar to Swargate, the alignment follows north direction for a stretch of 5.5 km. The entire alignment is divided into 2 packages.

Table 2 : Underground Tentative Civil Contract Package I & II

Package	Up line Chainage (m)		Length of Package (including both tunnels as well as stations (Km))
	Start	End	
Package I	10300	14040	3.74
Package II	14040	17000	2.96



3.1 Vertical Alignment

The vertical rail alignment in the proposed underground stretch will go mainly through Amygdaloidal or compact Basalt and will encounter slightly fractured rock at some locations. The soil cover varies from 2 m to 4m in most of the stretch but it dips to a level of 10 to 12 m at some locations after the civil court metro station and again rises to a depth of 3-2 m for the rest of the stretch. Soil is mostly sandy clay or sand with gravels with some portion of silty sand near the Mutha River. The classification of rock based on weathering grade and the geological profile along the alignment is discussed in the report in further sub sections

4. Regional Geology

The entire Project alignment of Pune metro underground section (Sivaji nagar to Swargate metro station) is underlain by Deccan Volcanic Basalts of Upper Cretaceous to Eocene age. The area comprises of various lava flows, which can be classified in the field into two types as simple and compound flows. The compound flows occur at lower elevations whereas the simple flows are confined to the elevation above 680 m. The compound flows although vesicular and amygdaloidal in nature, hard and compact in their middle sections. They are fractured and jointed, and show moderate degree of weathering at places. The middle section of the flow comprises of dark grey to black dense basalt. Since the top portion is of vesicular basalt it is more susceptible to weathering. The individual flows are separated from each other by red bole, which varies in thickness from a few centimeters to more than a meter. These are essentially ferruginous clayey horizons and are useful as marker horizons for flow separation. These red bole horizons are observed at chainage 13525 near the Juna bazar nala in the Pune city. The total thickness of these flows, as observed in and around the city of Pune is of the order of 130 meters. In the riverbed of the Mula Mutha River (18 31': 74 00'), the 'aa' flows occur amidst the pahoehoe flows. In the eastern part of the area on the Pune-Ahmednagar Road and Pune Sholapur Road only pahoehoe flows are seen. The pahoehoe flows are traced up to 724 m msl south of Pune city. At higher levels the aa flows are dominant.

		Group	Sub-groups	Formation	Thickness in meters	Lithology
Upper Cretaceous to Eocene	D E C C A N T R A P	N O R T H S A H Y A D R I	Diveghat	Purandargad	300	Simple flows, aphyric to plagioclase microphyric
				Diveghat	350	Simple/ Aa flows, aphyric.
			Lonavala	Karla	250	Fine grained, aphyric, pahoehoe flows
				Indrayani	125	Aphyric to sparsely phytic flows

4.1 Temperature and Climate

Pune is 560 m above sea level on the western margin of the Deccan plateau. It is on the leeward side of the Sahyadri mountain range, which forms a barrier from the Arabian Sea. It is a hilly city, with its highest hill, Vetal Hill, rising to 800 m above sea level.

Pune has a hot semi-arid climate bordering with tropical wet and dry with average temperatures ranging between 19 to 33 °C. Pune experiences three seasons: summer, monsoon, and winter. In this type of climate and rainfall the area has three types of soils, viz. black-fertile, brown and mixed type. In western region soil, type has brown and low quality while eastern region having fertile and plain type

4.2 Seismicity

Pune lies very close to the seismically active zone around Koyna Dam, about 100 km (62 mi) south of the city, and has been rated in Zone 3 (on a scale of 2 to 5, with 5 being the most prone to earthquakes) by the India Meteorological Department. Pune has experienced some moderate- and many low-intensity earthquakes in its history

5. Geotechnical Investigation

Geotechnical Investigations have been carried out at various locations along the whole alignment, a total of 100 bore holes of 30m drilling depth were suggested and various lab tests like grain size analysis, porosity, specific gravity, dry density etc. were performed on different soil and rock samples, in addition to these tests strength parameter test like UCS were also performed on rock samples, brief summary of which is given below:

5.1.1 Boreholes

A summary of borehole results along alignment is presented in Table 3.

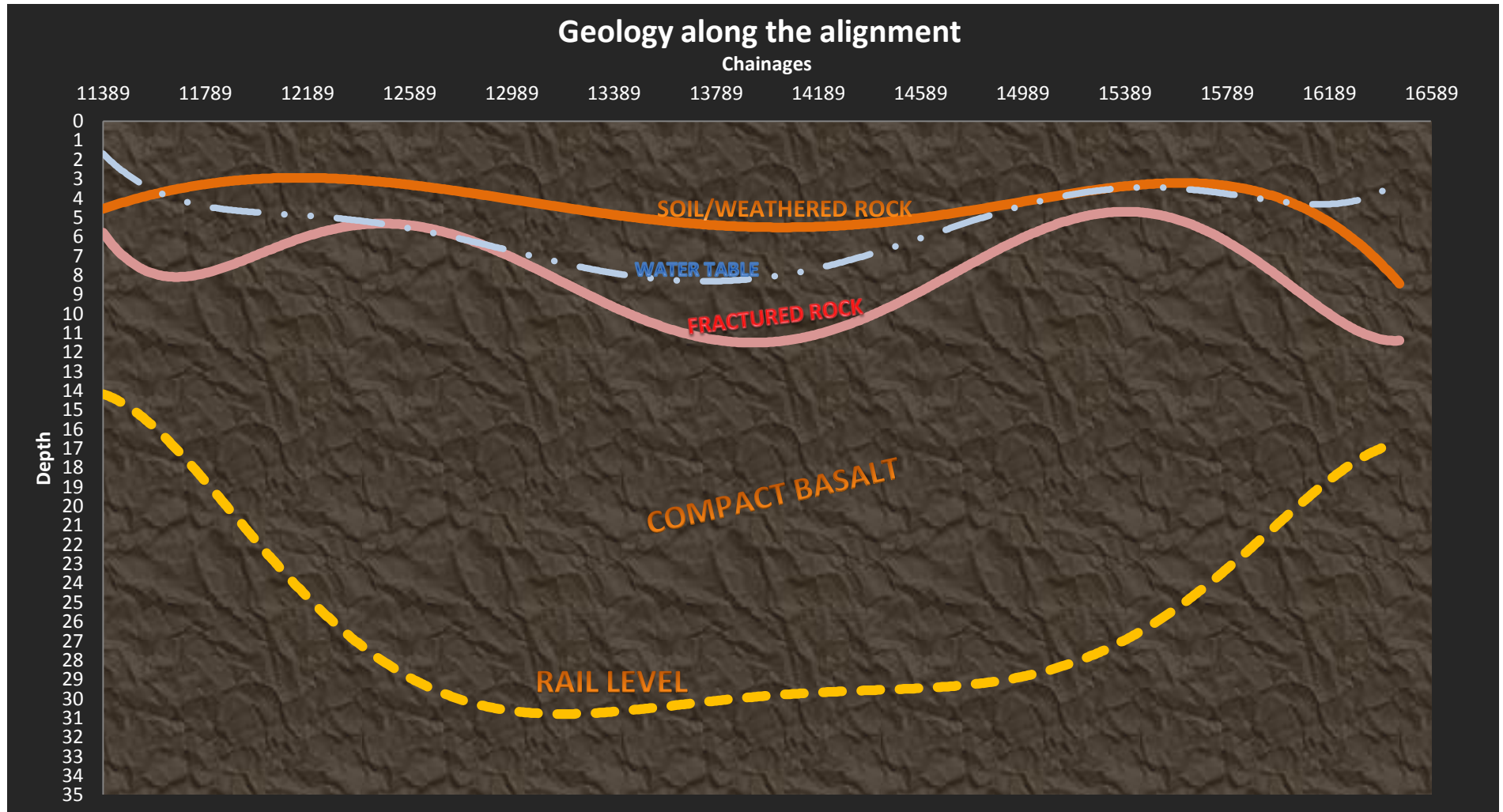
Table 3 : Borehole Details

Sr. No	Location	Chainage	Soil Up to depth	Fractured Rock up to depth	Compact rock up to depth	Total drilling	Tunnel rail level depth	Type of soil cover
1	Open ramp To Shivaji Nagar	11385	2.5	6	30	30	13.58	sandy clay
2		11436	5.7	7	30	30	13.844	sandy clay + gravel
3		11498	3	8	30	30	13.698	clay with gravel
4		11542	2	5	30	30	15.17	sandy clay
5		11597	3	6	30	30	15.588	sand with gravel
6	Shivaji nagar station	11665	4.5	6.8	30	30	16.358	sand with gravel
7		11705	3	7.9	30	30	16.71	sandy clay
8		11742	4.5	6	30	30	16.9	sandy clay /WR
9	Tunnel between Shivaji Nagar to Civil Court Station	11812	4	9	30	30	17.5	sandy clay /WR
10		11896	4	7	30	30	18.975	sandy clay
11		11952	2	3	30	30	21.882	sand with gravel
12		12007	6	11	30	30	22.8	silty clay /WR
13		12054	2	10	30	30	26.2	sand with gravel/WR
14		12105	3	5	30	30	27.28	sand with gravel/WR
15		12139	3.5	8	30	30	28.1	sand with gravel/WR

Sr. No	Location	Chainage	Soil Up to depth	Fractured Rock up to depth	Compact rock up to depth	Total drilling	Tunnel rail level depth	Type of soil cover
16		12190	2	3	30	30	27.5	sandy clay
17		12227	3.8	~	30	30	28.7	fill/WR
18		12278	2	5	30	30	29.3	sandy clay
19		12300	3.5	5	30	30	29.7	sandy clay /WR
20		12338	2	5	30	30	30.4	sandy clay /WR
21		12417	3.8	5	30	30	31	sandy clay /WR
22		12458	3	4.5	30	30	29.2	fill
23		12507	2	9.5	30	30	27.713	sandy clay
24		12550	2	4.5	30	30	27.2	sand with gravel
25		12715	3	12	30	30	26.592	Sandy clay /WR
26		12762	2	6	30	30	25	sand with gravel
27	Civil Court metro station	12814	3	8.5	30	30	20.3	FILL
28		12855	3	4.5	30	30	20	Sand with gravel
29		12908	4.3	9	30	30	18.224	Silty sand
30	Civil Court to Budhwarpet station	12951	0.5	6	30	30	19.6	Fractured rock
31		12992	10	12	30	30	25.8	Sandy clay/Sand with gravel
32		13003	9	10.5	30	30	25.29	Sandy clay/WR
33		13113	4.5	9	30	30	20.08	Sand with gravel/WR
34		13269	9.5	12	30	30	25	Sandy clay/sand with gravel
35		13411	5	6.5	30	30	26	WR
36		13454	10.5	-	30	30	24	WR
37		13509	6	9.5	30	30	24	Clay with gravel
38		13558	2	6.5	30	30	23	Sandy clay
39		13617	3.5	8	30	30	23.2	WR
40		13663	5.5	6.5	30	30	23	Sandy clay/WR
41		13834	2	6.5	30	30	22	Fill
42		13897	8	-	30	30	23	WR
43	Budhwar Pet	14043	9	10.5	30	30	25	Sandy Clay/WR
44	Tunnel between Budhwar and Mandai	14040	3.5	9.5	30	30	26.7	Fill/WR
45		14239	4	9	30	30	26	Sandy clay
46		14756	1.5	8	30	30	19.7	Sand with gravel
47		14863	5	7.5	30	30	19.3	Sandy Clay/WR
48	Mandai station	14971	4	8	30	30	20.2	Sandy clay /WR
49	Tunnel between Mandai and Swargate	15075	4	12.5	30	30	21.069	Sand with gravel/WR
50		15146						
51		15185	3.8	5	30	30	21.297	Sandy clay/WR
52		15260	3.5	5	30	30	21.342	Sandy clay/WR
53		15300	4	5	30	30	21.81	fill/WR
54		15365	2	4.5	30	30	21.456	fill
55		15400	3.8	6.8	30	30	21.591	fill/WR

Sr. No	Location	Chainage	Soil Up to depth	Fractured Rock up to depth	Compact rock up to depth	Total drilling	Tunnel rail level depth	Type of soil cover
56		15450	2	3	30	30	21.343	Silty sand
57		15500	2	3.8	30	30	21.406	sandy clay
58		15550	3.8	6.4	30	30	21.3	Sandy clay
59		15600	3	6	30	30	22.025	silty sand /WR
60		15650	3.8	5.8	30	30	22.465	silty sand /WR
61		15700	3.8	5	30	30	23.45	silty sand /WR
62		15750	0.5	5	30	30	21.6	Sandy clay
63		15800	2	4	30	30	22.115	Fill
64		15840	2	3.8	30	30	22.023	Silty sand
65		15875	5	6.5	30	30	22.8	Fill
66		15925	7	11.5	30	30	22.7	sandy clay/gravel/WR
67		15975	4	7	30	30	23.2	Clay with gravel/WR
68		16025	3	7	30	30	23.8	Clay with gravel/WR
69		16078	3.8	6.5	30	30	24	Clay with gravel/WR
70		16125	3	7.5	30	30	24.22	Clay with gravel/WR
71		16168	6	15.8	30	30	24.055	Clay with gravel/WR
72		16200	12	16.3	30	30	23.8	Sand with gravel
73		16275	8	10.3	30	30	23.23	sand with gravel/WR
74		16285	6	9	30	30	24.37	Sandy clay
75		16383	5	-	30	30	23.334	Silty sand/Gravel/WR
76	Swargate station and ahead	16495	6	16	30	30	22.2	silty sand/WR
77		16544	6	12	30	30	26.839	silty sand/WR
78		16600	18	22.5	30	30	26.9	Gravel/WR
79		16628	15.5	17	30	30	25	Silty Sand/WR
80		16793	8	11	30	30	26	Fill/WR
81		16877	7	6	30	30	26	Fill/WR

*WR - Weathered Rock, The classification given in the factual geotechnical report is reproduced here as it is. There is no specific code that classifies rock in this fashion.



6. Tests and Results

This section contains the interpretation of test results and derivation of design parameters. The geotechnical parameters described in the sections below are derived based on available data from the investigation reports.

6.1 Laboratory Test Results

The following laboratory tests were performed to identify the properties of rock and soil samples:

- (1) Grain size analysis
- (2) Atterberg's limit tests
- (3) Dry density test
- (4) Porosity
- (5) Specific gravity
- (6) Chemical analysis of water samples
- (7) Uniaxial compressive strength (UCS) test

Since most of the alignment passes through a hard stratum with average soil cover of 3-4 m, Even at shallow depths SPT value of 100 was observed. The soil properties are not going to affect much the design of the tunnels, but to get a generalized overview of the type and characteristics of soil various laboratory tests were performed on the soil samples.

The grain size distribution analysis indicates predominant presence of Sandy clay with some portion of silty sand near the Mutha River, also at some other locations sand with gravel is obtained. Specific gravity ranges from 2.5 to 2.7 and Porosity varies between 1 to 7 %.

Vast majority of samples scheduled for Atterberg Limits were deemed to be Non Plastic and few samples were "Low to medium Plastic". Plasticity Index values range from approximately 5.0% to 30%, also 42% at very few locations and Liquid Limit generally ranges from 10% to 20% indicating the material to be mainly sand & silt with low to medium plasticity.

Design of underground structures will be carried out in accordance with relevant Standards on resistance to attack by ingress of sulphate and chloride.

Chemical analyses of soil-water extracted samples indicate that the pH value of water is in the range of 7 to 8. Sulphate content is in the range of 14 to 16 mg/l and chloride content is in the range of 55 to 60 mg/l. The Soil and ground water is observed to be non-aggressive based on the lab test results.

The rock type encountered is mostly basaltic along the alignment. Uniaxial compressive strength test were performed on the rock samples showing that the range of UCS varies from 30 Mpa to 80 Mpa along the stretch. Plots of UCS along the alignment for all the rock samples are presented in APPENDIX 1

Field Test Results

6.1.1 Permeability Test Results

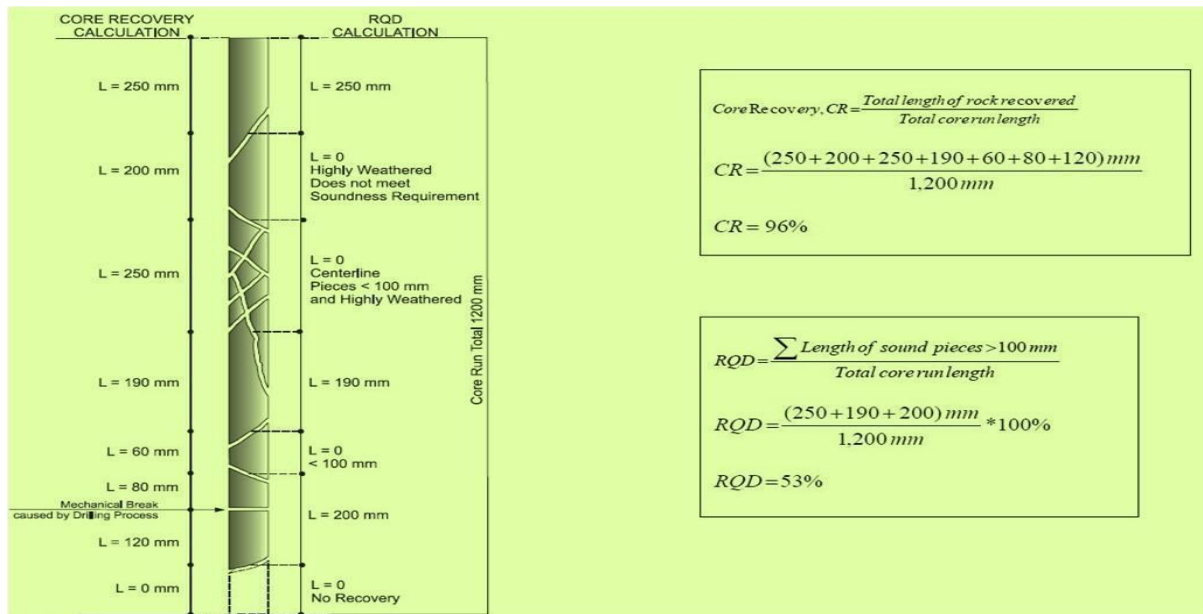
Field permeability tests were carried out to determine the permeability of rock. Based on the field test results average permeability values for the different rock layers are summarized in the Table 4 below:

Table 4 : Permeability values for soil layers based on Test Results

Rock Type	Range of Coefficient of Permeability (m/sec)	Design Coefficient of Permeability (m/sec)
Fractured Rock	1.94×10^{-6} to 4.3×10^{-6}	3.12×10^{-6}
Compact Rock	8.84×10^{-8} to 3.84×10^{-7}	2.36×10^{-7}

6.1.2 RQD Test

The RQD values provide a basis for making preliminary design and constructability decisions involving excavation of tunnels. The RQD values were calculated using standard method by using core recovery boxes. RQD sample calculation is shown below:



RQD values vary from 30 to 60 for fractured rock and 70 to 100 for the compact rock along the alignment. (Refer Appendix 1). Few core box pictures of different borehole locations are attached below:



Chainage 14100



Chainage 13525



Chainage 15875



Chainage 16850



Chainage 13475

6.1.3 Pressure meter Test

PMT test were performed in 5 bore holes in order to determine the in-situ deformation modulus of rock using an expanding probe (dilatometer) to exert pressure on the wall of a drill hole. The resulting diametric hole expansion (dilation) was determined from measurements of the volumetric expansion of the probe with the help of the test deformability characteristics of the rock mass at the dilatometer location were calculated.

The Modulus of Elasticity, E as well as Shear Modulus, G values for the various depths of boreholes are tabulated in Annexure I. The Modulus of elasticity, E value ranges from $7.33 \times 10^5 \text{ kg/cm}^2$ to $1.05 \times 10^5 \text{ kg/cm}^2$ (Average Value $1.10 \times 10^5 \text{ kg/cm}^2$) and Shear Modulus, G values ranges from $6.80 \times 10^4 \text{ kg/cm}^2$ to $1.24 \times 10^4 \text{ kg/cm}^2$ (Average Value $4.22 \times 10^4 \text{ kg/cm}^2$).

Sr No	Chainage Number	Depth, m Below FL	Modulus of Elasticity, E		Shear Modulus, G	Limit Pressure, P_l
			Mpa	kg/cm^2	kg/cm^2	kg/cm^2
1	Ch. 15700	6.00	10456.06	$1.05\text{E}+05$	$4.02\text{E}+04$	175
2	Ch.15400	6.00	7327.12	$7.33\text{E}+04$	$2.82\text{E}+04$	200
3	Ch.11950	7.00	3218.29	$3.22\text{E}+04$	$1.24\text{E}+04$	120
4	Ch.13375	12.00	17692.74	$1.77\text{E}+05$	$6.80\text{E}+04$	185
6	Ch.16500	13.00	16114.15	$1.61\text{E}+05$	$6.20\text{E}+04$	200

7. OBSERVATIONS

7.1 In-situ Conditions

On the basis of the core samples intercepted from the boreholes drilled along the project alignment, Soil and rock has been identified and described in the following paragraphs.

Soil Types: - The soils of the area are the product of weathering of basalts controlled by climate. In general they are clayey loam in texture and fairly high in calcium carbonate, high porosity but moderate to low permeability. In view of this, the soils from study area can be classified from low to moderate infiltration capacity. Based on physical characteristics the soils of the area have been classified into three major groups. They are as follows:

- Medium black soil.
- Red Sandy soils
- Shallow black soils

The Red Sandy soils are developed in western and central part of Pune and covers major part of the area. The shallow black soils have developed in the eastern part, whereas medium black soils are developed along the minor drainage courses in the south and south-eastern parts of the Pune.

Rock Types: - At the top portion intercepted rock type along the Project alignment is vesicular and amygdaloidal in nature they are fractured and jointed, and show moderate degree of weathering at places. The middle section of the flow comprises of dark grey to black dense basalt. Based on the textural and physical characteristics rock types are classified as:

- Vesicular Basalt
- Amygdaloidal basalt
- Compact Basalt



Vesicular Basalt: A volcanic rock texture characterized by a rock being pitted with many cavities (known as vesicles) at its surface and inside. This texture is common in aphanitic or glassy, igneous rock that have come to the surface of the earth, a process known as extrusion. As magma rises to the surface the pressure on it decreases. When this happens gases dissolved in the magma are able to come out of solution, forming gas bubbles inside it. When the magma finally reaches the surface as lava and cools, the rock solidifies around the gas bubbles and traps them inside, preserving them as holes filled with gas called vesicles.



Amygdaloidal basalt:-This is basalt, a dark coloured volcanic rock formed from a magma of basic composition erupted on the Earth's surface. Magmas generally contain dissolved gas, which can form bubbles in the magma as the pressure is released on eruption. These bubbles can get trapped in the solidified rock. After some time, groundwater or hot solutions connected with the volcanic activity pass through the porous lava and deposit crystals in the open cavities, which gradually fill up with quartz, calcite (calcium carbonate) or other minerals called zeolites. Filled cavities in lavas are called *amygdales*, and a rock full of them can be called *amygdaloidal*. The amygdales are usually white in colour.



Compact basalt:-Light to dark coloured, hard, massive Basaltic rock.

7.2 Groundwater Conditions

Water level observations during drilling of boreholes in the GI indicate ground water table is observed at depth between 2.5 to 6 m from ground level.

In order to provide information on the seasonal variation, during construction phase, monitoring shall be carried out in standpipe/piezometer installed at the shaft and station locations. It is recommended to maintain water level monitoring installations during the site construction activities.

7.3 Settlement Predictions

As per the available ground investigation results, the running tunnel will generally be embedded in hard compact rock with anticipated minimum rock cover of about 2m above the tunnel crown. Minor surface settlements are anticipated in such conditions however regular monitoring is suggested while tunnelling near the river and other critical locations. All this has to be considered while calculating the volume loss and settlement prediction.

8. Design Parameters

Design parameters for this package are based on the information available from lab test and literature as described in the followings sections. The methodology followed to arrive at the geotechnical parameters is as follows:

- The field/laboratory test results are analyzed to study the general characteristics of surface and sub surface layers. This is discussed in Sections 6.1 and 6.2.
- The range of geotechnical parameters is taken corresponding to the values obtained from the laboratory and Field test results. This is discussed in Section 6.2.
- Rock shear strength parameters were interpreted using Roc Lab software program based on generalized Hoek and Brown criteria.

For detailed calculation of design parameters Appendix 1 ,2 and 3 can be referred. Codes do not specify any guideline for the derivation of design parameters, while it emphasizes on engineering judgement. Strength properties for rock being encountered along the whole alignment are summarized in tables given below:

Ramp to Shivaji nagar Station

Type of Stratum	Ground Level RL (m)	Corrected SPT N value/RQD	Bulk Density	Design Parameters			E(Deformation modulus) MPa
			γ_b	c'	Φ'	u'	
			kN/m ³	MPa	deg		
Soil/sandy clay/gravels	0-6	-					
Fractured amygdaloidal basalt	6-8	25.6	24	0.85	56	0.3	447
Compact Basalt	8-30	82	25.2	1.13	67	0.3	11998

Shivaji nagar Station and Shaft

Type of Stratum	Ground Level RL (m)	Corrected SPT N value/RQD	Bulk Density	Design Parameters			E(Deformation modulus) Mpa
			γ_b	c'	Φ'	u'	
			kN/m ³	MPa	deg		
Soil/sandy clay/gravels	0-4	-					
Fractured amygdaloidal basalt	4-7	18	25	0.18	53	0.26	703
Compact Basalt	7-30	74	26	0.98	64	0.26	12104.7

Bored Tunnel between Shivaji nagar & Civil court

Type of Stratum	Ground Level RL (m)	Corrected SPT N value/ RQD	Bulk Density	Design Parameters			E (Deformation modulus) Mpa
			γ_b	c'	Φ'	u'	
			kN/m ³	MPa	deg		
Soil/sandy clay/gravels/weathered rock	0-5	-					
Fractured amygdaloidal basalt	5-10	20	26	0.109	53	0.3	450
Compact Basalt	10-30	74	26	0.75	66	0.3	10515

Civil Court Station and shaft

Type of Stratum	Ground Level RL (m)	Corrected SPT N value/RQD	Bulk Density	Design Parameters			E(Deformation modulus) Mpa
			γ_b	c'	Φ'	u'	
			kN/m ³	MPa	deg		
Soil/sandy clay/gravels/weathered rock	0-3						
Fractured amygdaloidal basalt	3-12	33	24	0.298	53	0.3	1187
Compact Basalt	12-30	82	25	0.95	62	0.3	11285

Bored Tunnel between Civil Court to Budhwar pet station

Type of Stratum	Ground Level RL (m)	Corrected SPT N value/RQD	Bulk Density	Design Parameters			E(Deformation modulus) Mpa
			γ _b	c'	Φ'	υ'	
			kN/m ³	MPa	deg		
Soil/sandy clay/gravels/weathered rock	0-6						
Fractured amygdaloidal basalt	6-12	31	25	0.114	58	0.3	729
Compact Basalt	12-30	78	26	0.72	66	0.3	9726

Budhwarpet station to Mandai Station

Type of Stratum	Ground Level RL (m)	Corrected SPT N value/RQD	Bulk Density	Design Parameters			E(Deformation modulus) Mpa
			γ_b	c'	Φ'	u'	
			kN/m³	MPa	deg		
Soil/sandy clay/gravels/weathered rock	0-8						
Fractured amygdaloidal basalt	8-10.5	65	25	0.133	57	0.3	807
Compact Basalt	10.5-30	88	26	0.172	60	0.3	1487

Bored Tunnel between Mandai to Swargate

Type of Stratum	Ground Level RL (m)	Corrected SPT N value/RQD	Bulk Density	Design Parameters			E(Deformation modulus) Mpa
			γ_b	c'	Φ'	u'	
			kN/m ³	MPa	deg		
Soil/sandy clay/gravels/weathered rock	0-5						
Fractured amygdaloidal basalt	5-8	28	24	0.149	60	0.3	996
Compact Basalt	12-30	78	25	0.72	66	0.3	10515

Swargate Metro Station and shaft

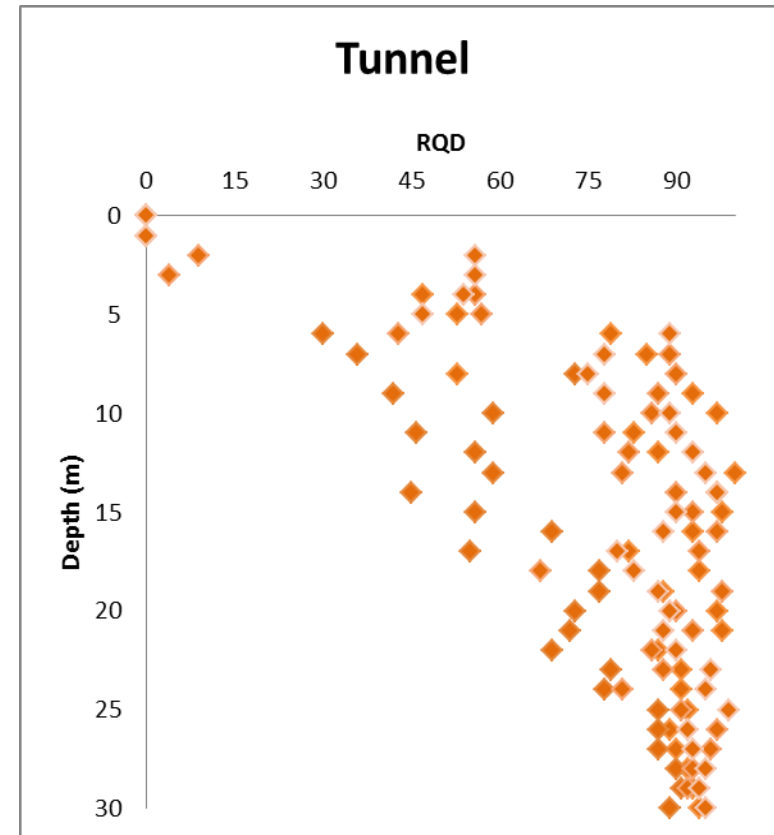
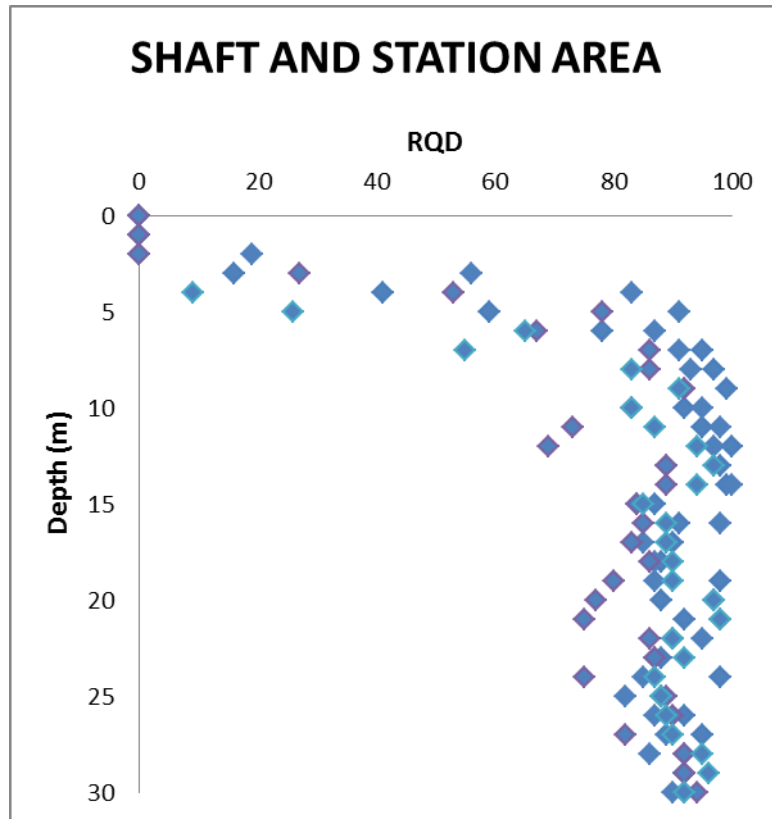
Type of Stratum	Ground Level RL (m)	Corrected SPT N value/RQD	Bulk Density	Design Parameters			E(Deformation modulus) Mpa
			γ_b	c'	Φ'	u'	
			kN/m ³	MPa	deg		
Soil/sandy clay/gravels/weathered rock	0-12						
Fractured amygdaloidal basalt	12-16	30	24	0.217	55	0.3	968
Compact Basalt	16-30	74	25	0.83	64	0.3	11419

1 Appendix – A

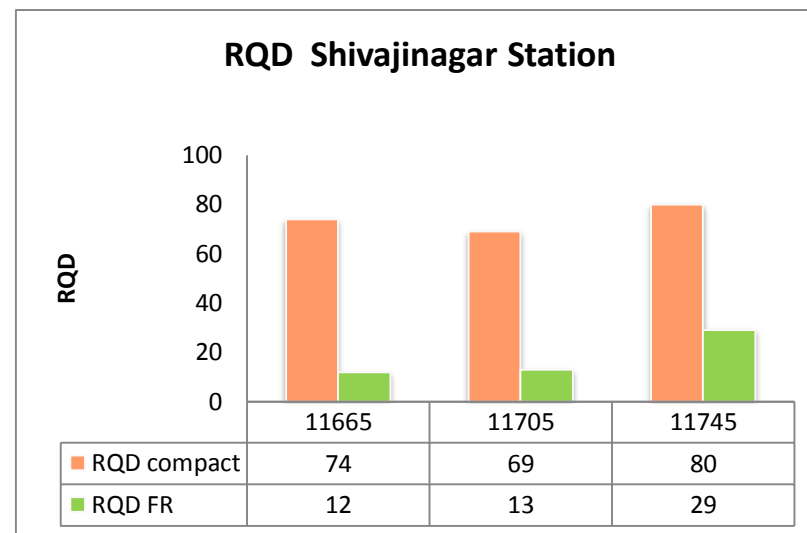
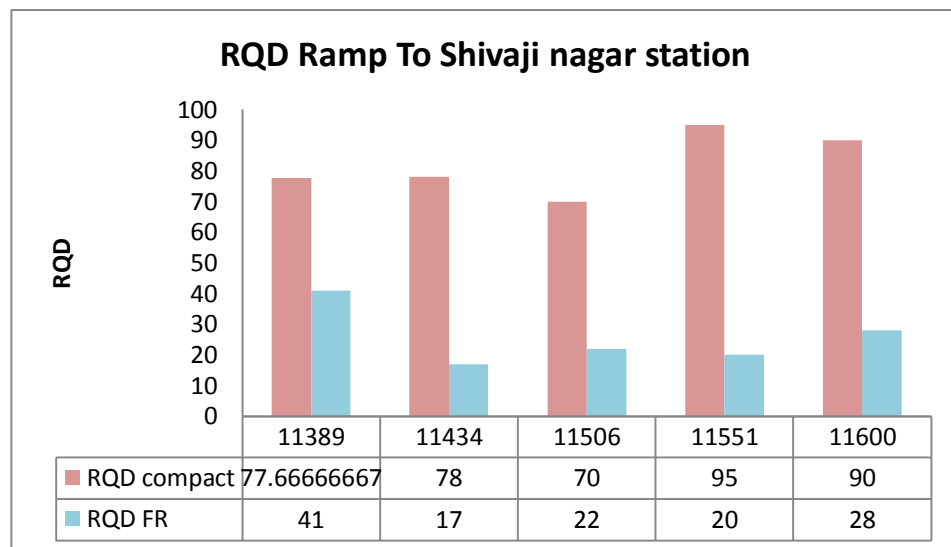
1.1 Plots for RQD v/s Depth

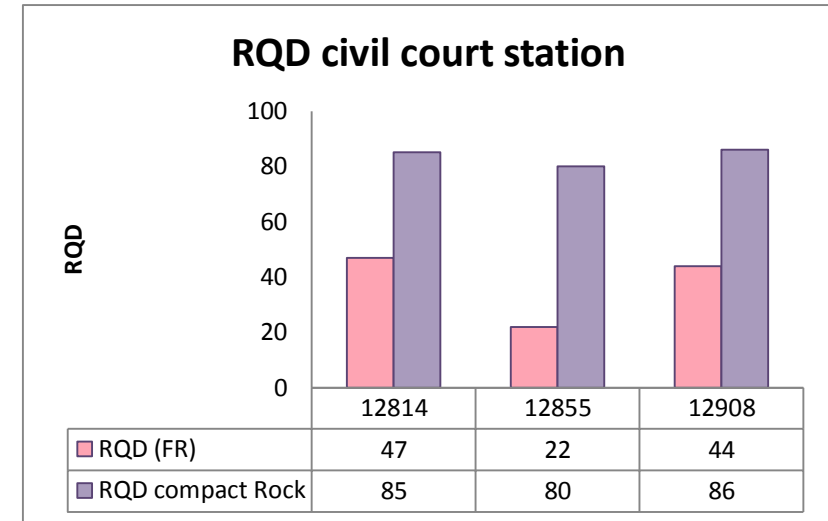
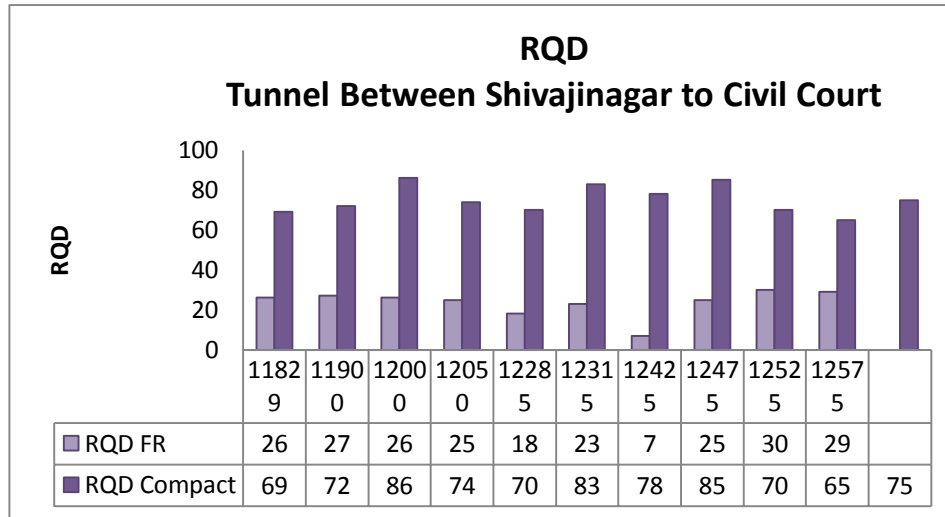
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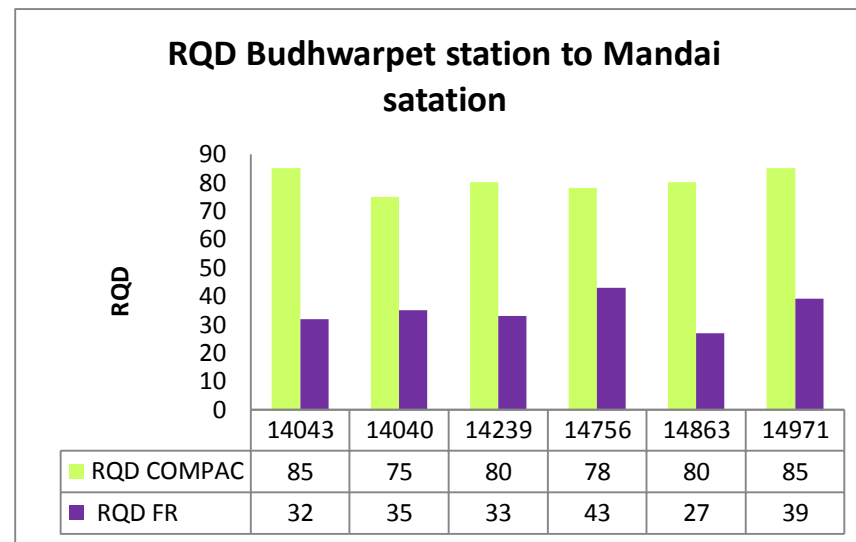
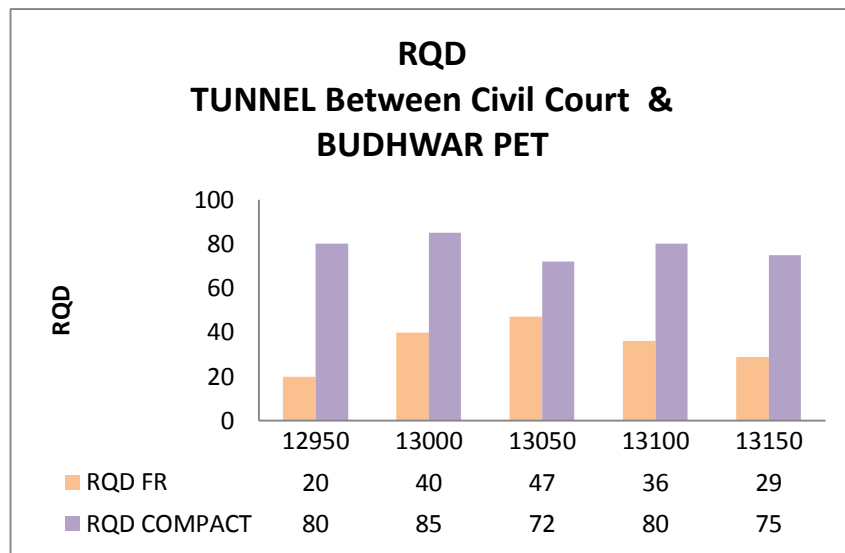
Variation of RQD with Depth

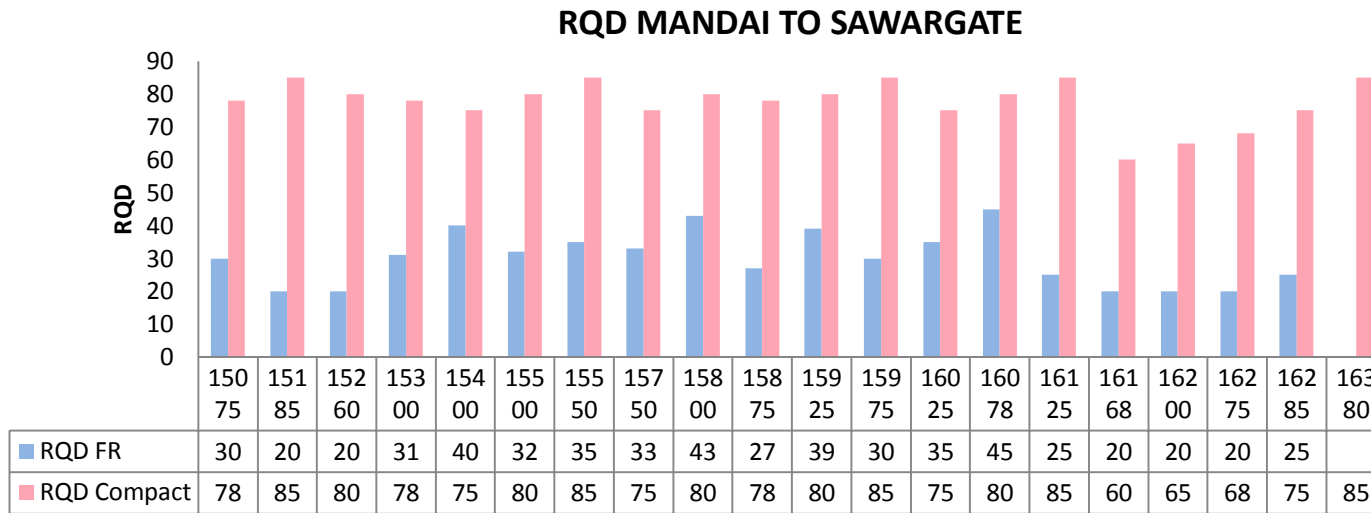


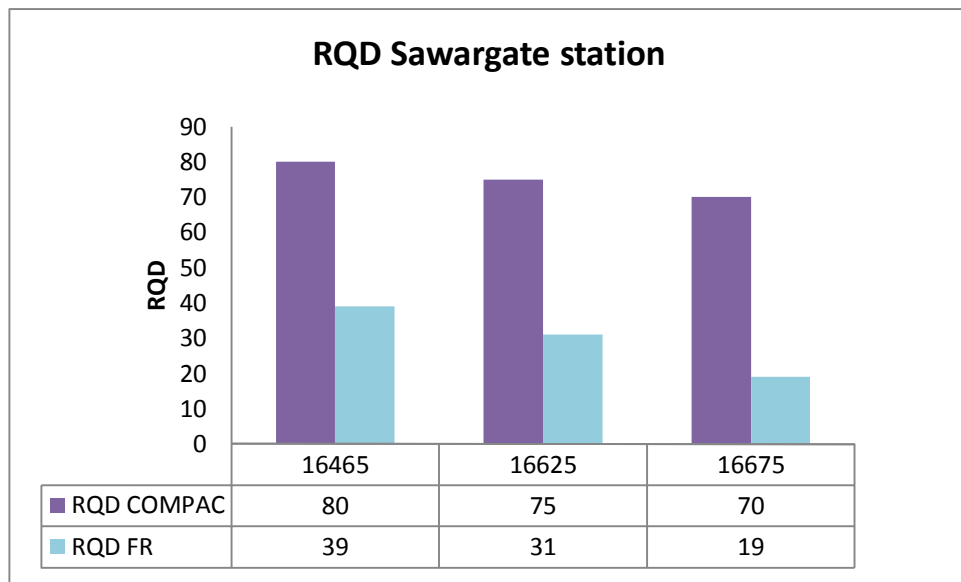
1. Variation of RQD in different Stretch



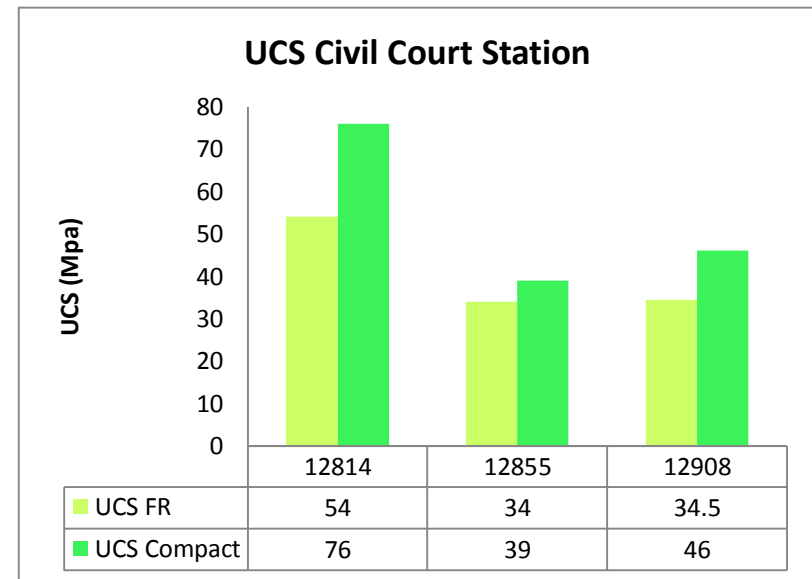
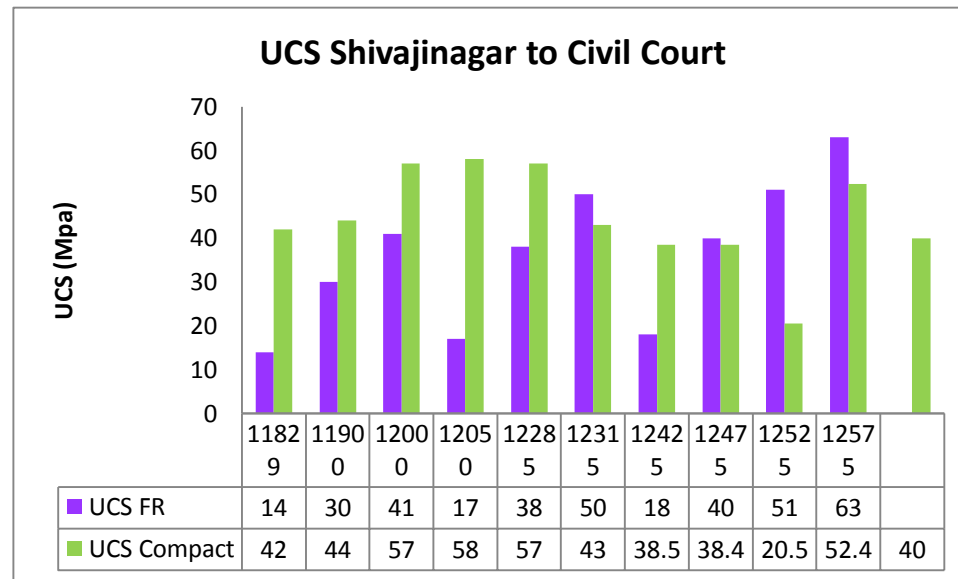
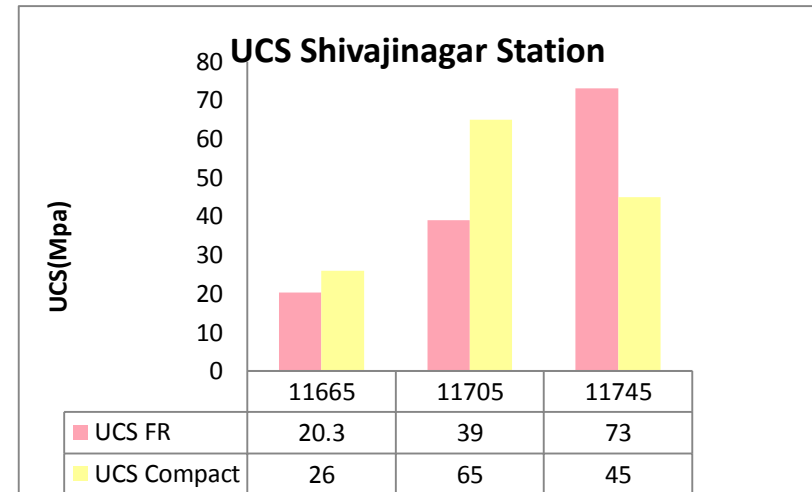
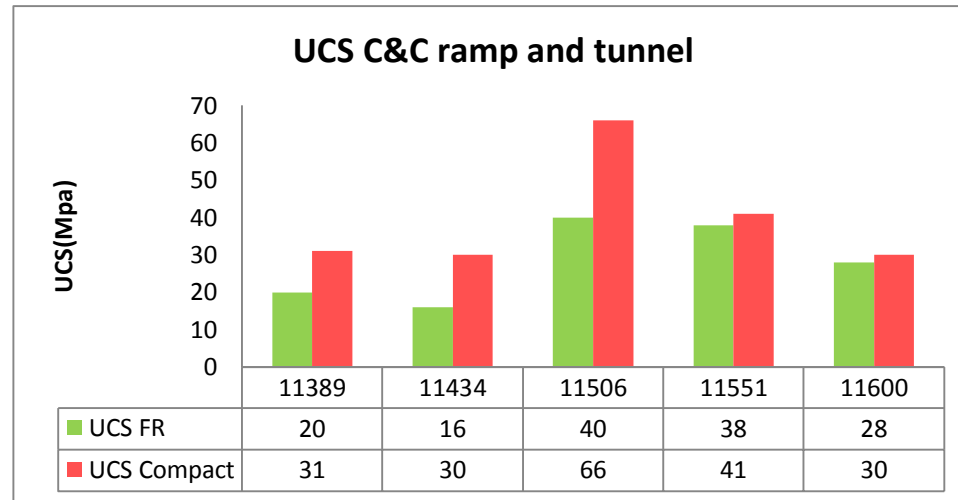




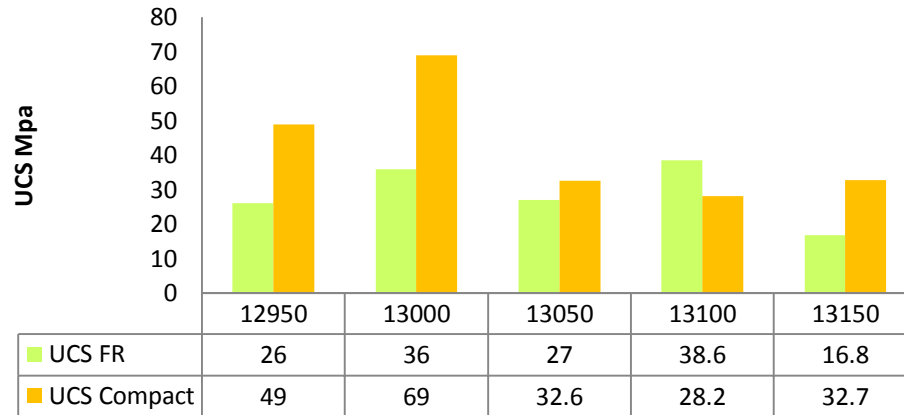




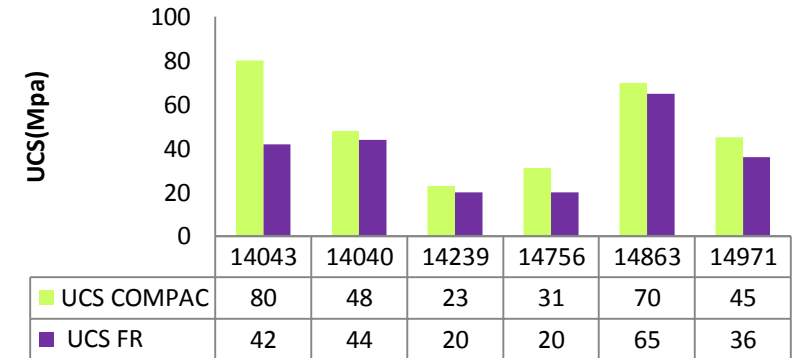
1.3 Variation of UCS along the alignment

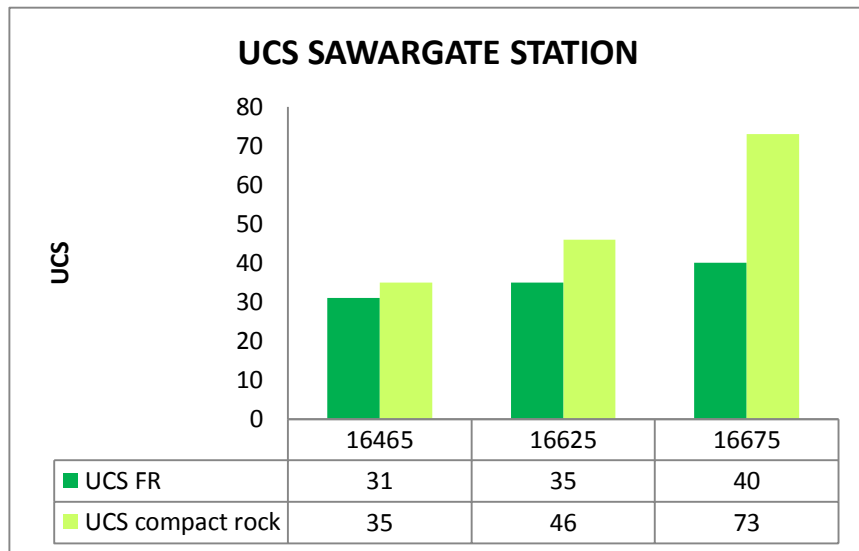
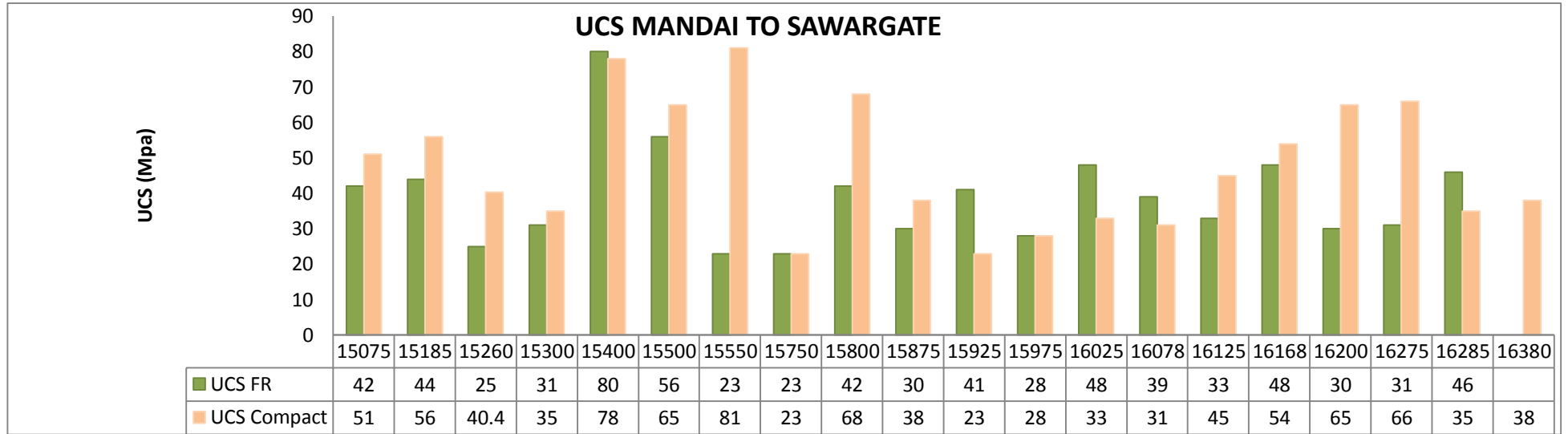


UCS Tunnel Between Civil Court& Budhwar pet



UCS Budhwarpet station to Mandai satation





2 Appendix – B

Roc lab Results

Tunnel before SN station(Compact Rock)		Tunnel before SN station(Fractured Rock)	
Hoek Brown Classification		Hoek Brown Classification	
sigci	40 MPa	sigci	28 MPa
GSI	78	GSI	20
mi	25	mi	25
D	0	D	0
Ei	14000	Ei	9800
Hoek Brown Criterion		Hoek Brown Criterion	
mb	11.3949	mb	1.43582
s	0.0867743	s	0.000138
a	0.500707	a	0.543721
Failure Envelope Range		Failure Envelope Range	
Application	Tunnels	Application	Tunnels
sig3max	0.223657 MPa	sig3max	0.194693 MPa
Unit Weight	0.025 MN/m3	Unit Weight	0.024 MN/m3
Tunnel Depth	15 m	Tunnel Depth	15 m
Mohr-Coulomb Fit		Mohr-Coulomb Fit	
c	1.1395 MPa	c	0.085849 MPa
phi	67.1487 degrees	phi	56.0016 degrees
Rock Mass Parameters		Rock Mass Parameters	
sigt	-0.304609 MPa	sigt	-0.00269 MPa
sigc	11.7626 MPa	sigc	0.222936 MPa
sigcm	19.8728 MPa	sigcm	3.73364 MPa
Erm	11998.6 MPa	Erm	447.582 MPa

SHIVAJINAGAR STATION (fractured rock)			SHIVAJINAGAR STATION (Compact rock)		
Hoek Brown Classification			Hoek Brown Classification		
sigci		44 MPa	sigci		45 MPa
GSI		20	GSI		72
mi		25	mi		25
D		0	D		0
Ei		15400	Ei		15750
Hoek Brown Criterion			Hoek Brown Criterion		
mb		1.43582	mb		9.19699
s		0.000138	s		0.044551
a		0.543721	a		0.50116
Failure Envelope Range			Failure Envelope Range		
Application	Slopes		Application	Slopes	
sig3max		0.465644 MPa	sig3max		0.518496 MPa
Unit Weight		0.026 MN/m ³	Unit Weight		0.026 MN/m ³
Slope Height		20 m	Slope Height		20 m
Mohr-Coulomb Fit			Mohr-Coulomb Fit		
c		0.181197 MPa	c		0.980598 MPa
phi		53.1779 degrees	phi		64.7565 degrees
Rock Mass Parameters			Rock Mass Parameters		
sigt		-0.00423 MPa	sigt		-0.21799 MPa
sigc		0.350329 MPa	sigc		9.46404 MPa
sigcm		5.86715 MPa	sigcm		19.374 MPa
Erm		703.342 MPa	Erm		12104.7 MPa

TUNNEL BETWEEN SN & CC		FR ROCK	TUNNEL BETWEEN SN & CC		COMPA
Hoek Brown Classification			Hoek Brown Classification		
sigci		28 MPa	sigci		41 MPa
GSI		20	GSI		70
mi		25	mi		25
D		0	D		0
Ei		9800	Ei		14350
Hoek Brown Criterion			Hoek Brown Criterion		
mb		1.43582	mb		8.56297
s		0.0001379	s		0.035674
a		0.543721	a		0.501355
Failure Envelope Range			Failure Envelope Range		
Application	Tunnels		Application	Tunnels	
sig3max		0.275086 MPa	sig3max		0.32937 MPa
Unit Weight		0.026 MN/m3	Unit Weight		0.026 MN/m3
Tunnel Depth		20 m	Tunnel Depth		22 m
Mohr-Coulomb Fit			Mohr-Coulomb Fit		
c		0.109394 MPa	c		0.756527 MPa
phi		53.6889 degrees	phi		66.0122 degrees
Rock Mass Parameters			Rock Mass Parameters		
sigt		-0.002689 MPa	sigt		-0.170809 MPa
sigc		0.222936 MPa	sigc		7.709 MPa
sigcm		3.73364 MPa	sigcm		16.8746 MPa
Erm		447.582 MPa	Erm		10515.9 MPa

Civil Court station Fractured Rock

Hoek Brown Classification

sigci	32 MPa
GSI	34
mi	25
D	0
Ei	11200

Hoek Brown Criterion

mb	2.36726
s	0.000653392
a	0.517064

Failure Envelope Range

Applicatio Slopes

sig3max	0.676757 MPa
Unit Weig	0.026 MN/m ³
Slope Heiç	30 m

Mohr-Coulomb Fit

c	0.298759 MPa
phi	53.3506 degrees

Rock Mass Parameters

sigt	-0.00883238 MPa
sigc	0.721757 MPa
sigcm	6.1967 MPa
Erm	1187.07 MPa

Civil Court Station Compact Basalt

Hoek Brown Classification

sigci	44 MPa
GSI	70
mi	25
D	0
Ei	15400

Hoek Brown Criterion

mb	8.56297
s	0.035674
a	0.501355

Failure Envelope Range

Applicatio Slopes

sig3max	0.745332 MPa
Unit Weig	0.026 MN/m ³
Slope Heiç	30 m

Mohr-Coulomb Fit

c	0.956085 MPa
phi	62.8086 degrees

Rock Mass Parameters

sigt	-0.18331 MPa
sigc	8.27307 MPa
sigcm	18.1093 MPa
Erm	11285.3 MPa

Civil Court To BP FR

Hoek Brown Classification

sigci	24 MPa
GSI	31
mi	25
D	0
Ei	8400

Hoek Brown Criterion

mb	2.12674
s	0.0004682
a	0.520889

Failure Envelope Range

Application	Tunnels
sig3max	0.204118 MPa
Unit Weight	0.025 MN/m ³
Tunnel Depth	15 m

Mohr-Coulomb Fit

c	0.114115 MPa
phi	58.6625 degrees

Rock Mass Parameters

sigt	-0.005283 MPa
sigc	0.442449 MPa
sigcm	4.33078 MPa
Erm	729.41 MPa

Civil Court To BP Compact

Hoek Brown Classification

sigci	37 MPa
GSI	71
mi	25
D	0
Ei	12950

Hoek Brown Criterion

mb	8.87432
s	0.0398664
a	0.501254

Failure Envelope Range

Application	Tunnels
sig3max	0.299697 MPa
Unit Weight	0.026 MN/m ³
Tunnel Depth	20 m

Mohr-Coulomb Fit

c	0.721657 MPa
phi	66.037 degrees

Rock Mass Parameters

sigt	-0.166216 MPa
sigc	7.35784 MPa
sigcm	15.5728 MPa
Erm	9726.21 MPa

Budhwarpet Station To Mandai Station		Budhwarpet Station To Mandai Station		FR
Hoek Brown Classification	Compact Rock	Hoek Brown Classification		
sigci	35 MPa	sigci	19 MPa	
GSI	36	GSI	36	
mi	25	mi	25	
D	0	D	0	
Ei	12250	Ei	6650	
Hoek Brown Criterion		Hoek Brown Criterion		
mb	2.54253	mb	2.54253	
s	0.000816	s	0.000815988	
a	0.514908	a	0.514908	
Failure Envelope Range		Failure Envelope Range		
Application	Tunnels	Application	Tunnels	
sig3max	0.258925 MPa	sig3max	0.249606 MPa	
Unit Weight	0.026 MN/m3	Unit Weight	0.026 MN/m3	
Tunnel Depth	18 m	Tunnel Depth	18 m	
Mohr-Coulomb Fit		Mohr-Coulomb Fit		
c	0.17284 MPa	c	0.134438 MPa	
phi	60.9331 degrees	phi	57.2731 degrees	
Rock Mass Parameters		Rock Mass Parameters		
sigt	-0.01123 MPa	sigt	-0.00609776 MPa	
sigc	0.89923 MPa	sigc	0.488153 MPa	
sigcm	7.09154 MPa	sigcm	3.84969 MPa	
Erm	1487.09 MPa	Erm	807.278 MPa	

Mandai to sawargate FR		Mandai to sawargate compact rock	
Hoek Brown Classification		Hoek Brown Classification	
sigci	35 MPa	sigci	41 MPa
GSI	30	GSI	70
mi	25	mi	25
D	0	D	0
Ei	12250	Ei	14350
Hoek Brown Criterion		Hoek Brown Criterion	
mb	2.05212	mb	8.56297
s	0.000418942	s	0.035674
a	0.522344	a	0.501355
Failure Envelope Range		Failure Envelope Range	
Application	Tunnels	Application	Tunnels
sig3max	0.262939 MPa	sig3max	0.221473 MPa
Unit Weight	0.024 MN/m3	Unit Weight	0.025 MN/m3
Tunnel Depth	20 m	Tunnel Depth	15 m
Mohr-Coulomb Fit		Mohr-Coulomb Fit	
c	0.149772 MPa	c	0.720222 MPa
phi	59.1466 degrees	phi	67.3279 degrees
Rock Mass Parameters		Rock Mass Parameters	
sigt	-0.00714526 MPa	sigt	-0.17081 MPa
sigc	0.602104 MPa	sigc	7.709 MPa
sigcm	6.16365 MPa	sigcm	16.8746 MPa
Erm	996.943 MPa	Erm	10515.9 MPa

Sawargate Station FR			Sawargate station Compact		
Hoek Brown Classification			Hoek Brown Classification		
sigci		34 MPa	sigci		47 MPa
GSI		30	GSI		68
mi		25	mi		25
D		0	D		0
Ei		11900	Ei		16450
Hoek Brown Criterion			Hoek Brown Criterion		
mb		2.05212	mb		7.97266
s		0.000419	s		0.028566
a		0.522344	a		0.501579
Failure Envelope Range			Failure Envelope Range		
Application	Slopes		Application	Slopes	
sig3max		0.466496 MPa	sig3max		0.516376 MPa
Unit Weight		0.026 MN/m ³	Unit Weight		0.026 MN/m ³
Slope Height		20 m	Slope Height		20 m
Mohr-Coulomb Fit			Mohr-Coulomb Fit		
c		0.217222 MPa	c		0.832045 MPa
phi		55.1504 degrees	phi		64.5924 degrees
Rock Mass Parameters			Rock Mass Parameters		
sigt		-0.00694 MPa	sigt		-0.1684 MPa
sigc		0.584901 MPa	sigc		7.89916 MPa
sigcm		5.98755 MPa	sigcm		18.5118 MPa
Erm		968.459 MPa	Erm		11419.7 MPa

Maha Metro



Tender Documents

**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

PART IV – REFERENCE DOCUMENT

Section XIV – OSH&E MANUAL

Volume 2 – Safety and Health

June 2018

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SCHEDULES

1. STATEMENT OF INTENT

It is the intention of the Maha Metro Rail Corporation to build the Pune Metro North-South Corridor in a way that will further raise the standards of health and safety on construction sites to a level that will be recognised as the best in India and comparable to the highest standards achieved worldwide.

This can only be achieved if there is a commitment from all parties involved in the construction and management of the Project, from the most senior level of managers within the MMRCL and the Contractors, to the workers on the sites.

This document shall have the full support of all of the MMRCL Project Team and any officer failing to give support to it shall be subject to internal discipline.

The Maha - Metro shall actively support the efforts and initiatives that are instigated by the Contractors and sub-contractors in their efforts for achieving high standards of health and safety on the Project.

The ingredients that are needed to make and achieve a high standard of health and safety, are well known to most of us, it is however the level of commitment that is demonstrated that shall determine whether or not we succeed.

This manual represents the minimum standards that the Maha Metro will accept on matters of Safety and Health. The Corporation will use its best endeavours to ensure that all of the Contractors employed on the Project achieve these Standards

Managing Director/MMRCL

2. REFERENCES AND DISTRIBUTION OF THIS MANUAL

2.1 References

- 2.1.1 The procedures in this manual should be read in conjunction with;
- The Maharashtra Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007;
 - The Factories Act, 1948;
 - Other Laws of India, Regulations, Rules and Codes of Practice on Safety Health and the Environment that may be applicable;
 - The Conditions of Contract in respect of Health and Safety, that apply to the specific Contract under which the Contractor is employed;
 - The important Indian Standards and British Standards as applicable to the work of this contract;

2.2 Distribution of this Manual

- 2.2.1 Copies of this Health and Safety Manual are distributed to all Tenderers for Contracts where this has been shown as a referenced document for the Conditions of Contract, Safety Health and Environment. It will also be issued to all appropriate staff of MMRCL and all other persons who have need of it.

3. DEFINITION OF TERMS

3.1 Introduction

- 3.1.1 The following terms used in this manual are defined as follows and shall be construed accordingly.
- Safety** means the freedom from unacceptable risks of personal harm, i.e. the avoidance of accidents and incidents.
 - Health** means the physical wellbeing of a person and the freedom from any illness caused due to working conditions.
 - Hazard** means a situation with the potential to cause harm including human injury, damage to property, plant or equipment, damage to the environment, or economic loss.
 - Risk** means the chance of something adverse happening and its severity. It is a combination of the probability, or frequency, of the occurrence of a defined hazard and the magnitude of the consequences of the occurrence.
 - Foreseeable** means that which is likely or possible.
 - Chief Safety Officer** means an officer nominated by MMRCL as Chief Safety Officer
 - Site Safety Plan** means the contract specific safety plan that the Contractor has produced from his Outline Safety Plan.
 - Outline Safety Plan** means the contract specific outline safety plan that the Contractor will prepare as part of his tender submission.
 - Reportable Accident / Incident** means an Accident or Incident that is reportable to the Engineer. It shall include all fatalities, major injury accidents, dangerous occurrences and all accidents, which result in incapacity for more than Forty Eight hours or more immediately following the accident.
 - Major Injury Accident** is defined as:
 - Any fracture, other than to the fingers or toes;

- 2) Any loss of a limb or part of a limb;
- 3) Dislocation of the shoulder, hip, knee or spine;
- 4) Loss of sight (whether temporary or permanent);
- 5) Penetrating injury to the eye; or
- 6) Any other injury that:
 - Leads to unconsciousness
 - Requires resuscitation;
 - Requires admittance to hospital for more than 24 hours;
 - or which causes more than 10 days absence from work.

(k) **Dangerous Occurrence** is defined as:

- 1) Collapse or failure of lifting appliances or hoist or conveyors or other similar;
- 2) Collapse or failure of a crane, derrick, winch, hoist or other appliance used in raising or lowering persons or goods or any part thereof (except the breakage of chain or rope slings), or the overturning of a crane;
- 3) Explosion or fire causing damage to the structure of any room or place in which persons are employed, or to any machine or plant, resulting in the complete suspension of ordinary work;
- 4) Electrical short circuit or failure of electrical machinery, plant or apparatus, attended by explosion or fire, causing structural damage involving its stoppage or disuse;
- 5) Explosion of a receiver or container used for the storage at a pressure greater than atmospheric pressure of any gas or gases (including air) or any liquid or solid resulting from the compression of gas;
- 6) Collapse in whole or part from any cause whatsoever of any roof, wall, floor, structure or foundation forming part of the construction site in which persons are employed;
- 7) Total or partial collapse of any overburden, face, tip or embankment on the construction site;
- 8) The overturning of, or collision with any object by any bulldozer, dumper, excavator, grader, lorry or shovel loader, or any mobile machine used for the handling of any substance on the construction site.

4. GENERAL

4.1 Introduction

- 4.1.1 It is the objective of the MMRCL to ensure that the Contract is completed on time, within budget, and to conforming standards of Health and Safety.
- 4.1.2 This manual has system wide application, and therefore not all of the sections will apply to all Contractors. Each Contractor shall develop his own contract specific Site Safety Plan, which will represent his approach to the management of safety on his work, sites under the Contract with MMRCL.
- 4.1.3 It is the intention of MMRCL to levy fines against Contractors who do not comply with the requirements of this Manual. The fines levied will be donated to the MMRCL Welfare Fund to assist those who have suffered as a result of this Project. The level of fines to be levied will set out in the Conditions of Contract.

4.2 Purpose of the Manual

- 4.2.1 This manual has been produced in order to outline the minimum health and safety, standards that shall be required by MMRCL during construction of the Pune Metro Project. Furthermore the manual has been developed to give guidance and assistance to the respective Contractors in the development and production of their Site Safety Plans, to satisfy the required health and safety standards established by the Contract Conditions and the Employer's Requirements. This manual represents the minimum standards required and each Contractor is encouraged to expand and improve upon it.
- 4.2.2 This manual is not intended to replace existing standards that are currently in force in India. However, it is intended to support the standards and to highlight to Contractors the areas of concern that shall be addressed in their respective Site Safety Plans in order to establish good health and safety practices.
- 4.2.3 This document is intended to supplement the Section on Safety Measures as is contained in the Employers Requirement.
- 4.2.4 The obligations and requirements for Health and Safety set out within this document are entirely without prejudice and do not derogate from the Contractor's obligations with respect to the Contract and his statutory obligations with respect to Health and Safety.

4.3 Scope of the Manual

- 4.3.1 The Contractor is fully responsible for the safety of the Works, his personnel, sub-contractors' personnel, the public and all persons directly or indirectly associated with the Works or on or in the vicinity of the Site.
- 4.3.2 This manual provides relevant information and procedures to assist the Contractor to ensure that his employees and sub-contractors work within a safety-conscious and safety-regulated environment. Compliance with the procedures set out in this manual shall not relieve the Contractor of any of his Statutory Duties or his responsibilities under the Contract.

4.4 Policy Objectives

- 4.4.1 Every Contract should aim at zero fatal accidents.
- 4.4.2 Every Contract should aim at zero dangerous occurrences (see section 3.1.1 (i) for the definition of 'dangerous occurrence').
- 4.4.3 Every Contract should aim at an Accident Frequency Rate (AFR) of less than 0.5 per 100,000 hours worked on the Contract.

4.5 Implementation of Policy Objectives

- 4.5.1 The following general approach has been adopted by MMRCL with a view to achieving the policy objectives set out above
 - (a) Secure a commitment to safe and healthy working practices by all parties involved in the construction process, including consultants, Contractors, sub-contractors, workers' unions, and utility providers.
 - (b) Develop contract provisions that require Contractors to prepare, implement and monitor safety plans, and ensure that sub-contractors are also obliged to comply with the same. (Copies of the provisions relating to Health and Safety are contained in the Conditions of Contract).
 - (c) Arrange accident prevention, safety management training for all site staff supervising Contracts.

- (d) Establish Site Safety Management Committees to monitor the implementation of safety plans and keep a record of the Meetings of the Committees.
- (e) Build up a database of accidents and dangerous occurrences, as defined in Section 9 of this manual, for the purpose of monitoring trends, analysing data, and formulating measures for accident prevention.
- (f) Publish this Manual to assist in the administration of construction safety matters of the Employer's contracts.
- (g) Oversee the safety performance of the Contractors and sub-contractors to ensure that their duties and responsibilities on health and safety under the Contract, this Manual, and other relevant Employer and Government requirements are fully discharged.
- (h) To publish and issue any further instruction / appendices needed for any specific requirement of the Contract

4.6 Responsibility for the Manual

- 4.6.1 The Directors/Any other nominated officials of MMRCL are responsible for ensuring that the contents of this Manual continue to meet the requirements of the MMRCL and that they are implemented rigorously.

5. GENERAL DUTIES OF CONTRACTORS AND OTHERS

5.1 Introduction

- 5.1.1 Securing safe, healthy places of work requires the full co-operation of Contractors and sub-contractors and the persons employed by them. It is imperative that there is no ambiguity with regard to the responsibilities of any individuals in connection with duties relating to health and safety.
- 5.1.2 The responsibilities shall be clearly detailed in the Site Safety Plan from the level of the most Senior Manager downwards; these duties shall be explained to the individuals concerned in order to ensure that they clearly and concisely understand them.
- 5.1.3 Responsibilities for safety, health and the environment shall be allocated amongst others to the following personnel of the Contractors and sub-contractors:
 - (a) CEO / Managing Director:
 - (b) Project Manager:
 - (c) Site Agent/Manager:
 - (d) Engineers:
 - (e) Safety Officer:
 - (f) Supervisors:
 - (g) General Workers
- 5.1.4 The Contractor shall report to the Employer the total number of workmen engaged by all including any subcontractor within 2 hours of starting of any shift in any day. This reporting shall be the primary duty of the Chief SHE Manager of the Contractor and reporting shall be through tele-fax / email. The onus of checking the receipt of the same by the Employer lies with the Contractor. If the information is not received or received more than 2 hrs after starting of the shift, penalty shall be levied as per relevant clause.
- 5.1.5 The contractor shall ensure that workmen who have undergone the underground construction training programme are deputed for tunnelling operations and records are maintained both of their reporting and exit from the tunnel.

5.2 General Duties of Persons Employed

- 5.2.1 Every person employed by Contractors and sub-contractors on construction sites are obliged to comply with the general duties imposed on them under the Contract. Every person employed should, not only avoid careless or reckless behaviour, but should also take positive steps to understand workplace hazards. They must follow all necessary safety and environment rules and procedures, and ensure that their acts or omissions at work do not put the health and safety of self or others at risk.

5.3 Contractors and Sub-contractors Responsibilities

- 5.3.1 Contractors and sub-contractors are responsible for complying with all statutory and contractual requirements on construction safety, health and environment including the general duties imposed on them under the Laws and Regulations of the Government of India, Government of Maharashtra.
- 5.3.2 The Employer/Engineer shall only deal with health and safety matters through the Contractor and shall hold the Contractor responsible for all his and his sub-contractors, actions. All sub-contractors shall be responsible to the Contractor.
- 5.3.3 All Contractors and sub-contractors shall ensure that an adequate level of competent supervision is maintained at the workplace at all times with all supervisory staff having the relevant knowledge, training, and experience to enable them to supervise the work in a proper manner.
- 5.3.4 Contractors shall ensure that all sub-contractors are able to demonstrate a successful track record with regard to the management of health and safety. The type of information that shall be requested from the sub-contractors during the tendering/selection process in order to determine their suitability shall include amongst other things the following information relating to their activities over the last five years
- (a) Fatal accidents
 - (b) Major lost time due to accidents
 - (c) Accidents involving members of the public
 - (d) Dangerous Occurrences
- 5.3.5 Contractors and sub-contractors are responsible for submitting written statements on their policies relating to construction safety within fourteen days of a requirement to do so by Employer/Engineer.
- 5.3.6 Contractors and sub-contractors are responsible for providing comprehensive safety and environment plans for the review by Employer/Engineer, and for subsequent implementation of the measures detailed in the safety and environment plans.
- 5.3.7 Contractors and sub-contractors are responsible for the provision of suitably trained and qualified safety staff to carry out regular safety inspections, safety promotion, and safety audits and for retention of records of all such activities for inspection by Employer/Engineer.
- 5.3.8 Contractors and sub-contractors are responsible for providing safety and environment training to all workers and supervisors on site, and for retention of records of such activities for inspection by the Employer/Engineer.
- 5.3.9 Contractors and sub-contractors are responsible for organising site safety committees which shall meet at least monthly.
- 5.3.10 Any wilful delay in verbal and written reporting to the Employer shall be penalised as per relevant clause.
- 5.3.11 Contractors and sub-contractors are responsible for reporting dangerous occurrences and accidents to the Engineer by the quickest practicable means.

5.4 Discipline

- 5.4.1 Any major breaches of the Site Safety Plan, relevant Statutory Provisions and Safety Codes, or any other blatant disregard for the health and safety by any person directly or indirectly associated with the works may result in the MMRCL exercising their authority in requiring the removal from the Site of the Contractor's Site Manager and/or other personnel.
- 5.4.2 The Contractors shall develop a system of disciplinary measures and procedures, which shall be implemented immediately that the site activities commence. These measures and procedures should include amongst other things:
 - (a) The issue of Warning Notices.
 - (b) The removal from site of personnel who disregard safety instructions.
- 5.4.3 Any person who is removed from the site for breach of safety measures shall not be allowed to be re-employed on any other MMRCL worksite.

6. CONTRACTOR SHE POLICY AND PLAN

- 6.1 The Contractor as per Section 39 of the BOCW Act shall formulate a SHE policy and get it approved by DG/CIIBC and display it at conspicuous places at work sites in Hindi and local languages understood by the majority of construction workers.
- 6.2 Within 4 weeks of the notification of acceptance of the tender, the Contractor shall submit a detailed and comprehensive Contract specific SHE Plan. The SHE Plan shall include detailed policies, procedures and regulations which, when implemented, will ensure compliance of the contract provisions. The SHE Plan shall include the following but not be restricted to:
 - (i) A statement of the Contractor's policy, organisation and arrangements for SHE
 - (ii) The name(s) and experience of person(s) within the Contractor's proposed management who shall be responsible for co-ordinating and monitoring the Contractor's SHE performance;
 - (iii) The number of SHE staff who shall be employed on the Works, their responsibilities, authority and line of communication with the proposed Contractor's agent;
 - (iv) A statement of the Contractor's policy and procedures for identifying and estimating hazards, and the measures for addressing the same;
 - (v) A list of SHE hazards anticipated for this Contract and sufficient information to demonstrate the Contractor's proposals for achieving effective and efficient health and safety procedures;
 - (vi) A description of the SHE training courses and emergency drills which shall be provided by the Contractor, with an outline of the syllabus to be followed;
 - (vii) Details of the safety equipment which shall be provided by the Contractor, including personal protective equipment;
 - (viii) A statement of the Contractor's policy and procedures for ensuring that Contractor's Equipment used on the Project Site are maintained in a safe condition and are operated in a safe manner;
 - (ix) A statement of the Contractor's policy and procedures for ensuring that sub-contractors comply with the Contractor's safety plan;
 - (x) A statement of the Contractor's disciplinary procedures with respect to SHE related matters, and

- (xi) A statement of the Contractor's procedure for reporting and investigating accidents, dangerous occurrences or occupational illnesses
- 6.3 The Contractor shall, from time to time and as necessary are required by the Employer to produce supplements to the SHE Plan such that it is at all times a detailed, comprehensive and contemporaneous statement by the Contractor of his site safety, industrial health and environment obligations, responsibilities, policies and procedures relating to work on Site. Any and all submissions of supplements to the SHE Plan shall be made to the Employer in accordance with the agreed procedures.
- 6.4 If at any time the SHE plan is, in the Employer's opinion, insufficient or requires revision or modification to ensure the security of the Works and the safety of all workmen upon and visitors to the Site, the Employer may instruct the Contractor to revise the SHE plan and the Contractor shall within 7 days submit the revised plan to the Employer for review.
- 6.5 Any omissions, inconsistencies and errors in the SHE Plan or the Employer's acceptance or rejection of the SHE Plan and/or supplements thereto shall be without prejudice to the Contractor's obligations with respect to site safety, industrial health and environment and shall not excuse any failure by the contractor to adopt proper and recognised safety practices throughout the execution of the Work.
- 6.6 The Contractor shall adhere to the SHE Plan and shall ensure, as far as practically possible, that all sub-contractors of all tiers require that contracting parties each have a copy of the Site SHE Plan and comply with its provisions.
- 6.7 The details of contents to be covered in the site SHE plan are given in [Appendix No. 3](#).

7. SAFETY TRAINING AND SAFETY PROMOTION

7.1 Safety Training

- 7.1.1 Safety Training is an important factor in managing safety on construction sites. All Contractors shall provide as a minimum the following types of training:
- 7.1.2 **Induction Training** shall be given to all persons prior to permitting them to go to the worksite. The workers Identification Card should not be issued until this training has been given. This training should include at least the following:
 - (a) General safety awareness
 - (b) First aid
 - (c) Emergency procedures
 - (d) Use of personal protective equipment
 - (e) Specific site hazards
- 7.1.3 **Refresher Training** shall be conducted at least every three months to ensure that all workers on site are kept up to date with safety requirements on site.
- 7.1.4 **Specific Training** shall be provided to persons with safety related tasks, such as Crane Operators, Banksman, Slings and Plant Operators etc.
- 7.1.5 **Toolbox Talks** shall be conducted so that every worker on site receives at least two toolbox talks every week. These talks should be designed to highlight relevant safety and industrial health issues to the workforce on a regular basis in order to raise their level of awareness. These should be prepared so that they can be presented by the Site Supervisors. Examples of Toolbox Talks are given in Schedule 2 of this Manual.

- 7.1.6 All training that is carried out shall be formally recorded on dated and signed attendance records, with copies of the records being kept on the sites for inspection by the Engineer. Details of the respective training course programmes shall be produced, on demand or as per intervals prescribed, which include the following information:
- (a) Course Title.
 - (b) Course Duration
 - (c) Course Content.
 - (d) Target Audience.
 - (e) Actual Audience with record of attendance. (Use form SAF 031)
- 7.1.7 The Contractor shall keep detailed records of all training undertaken, and shall keep such records available for inspection by the Engineer.

7.2 Safety Promotion

- 7.2.1 The Contractors at each of their sites in the interests of promoting safety awareness amongst the workforce shall devise and implement practical Safety Promotion schemes. The objective of these schemes should be to recognise and reward individuals who continually endeavour to work in a safe manner.
- 7.2.2 Suggestions for such promotions may include such items as the issue of the following as rewards to individuals for good safety performance:
- (a) Key Rings.
 - (b) T-Shirts
 - (c) Holdall Bags
- 7.2.3 Other safety award and safety incentive schemes should be considered
- 7.2.4 Regular Safety and Industrial Health Poster Campaigns / Billboards / Banners / Glow signs should be devised, with posters displaying safety and industrial health related issues being displayed around the worksites as part of the effort to raise Safety Awareness amongst the workforce. Posters should be in Hindi, English and local language. Posters / Billboards / Banners / Glow signs should be changed at least once a month to maintain their impact.

7.3 ID CARD AND FIRST DAY AT WORK, SHE ORIENTATION TRAINING

- 7.3.1 The Contractor shall ensure that all personnel working at the site receive an induction SHE training explaining the nature of the work, the hazards that may be encountered during the site work and the particular hazards attached to their own function within the operation. The training shall cover the contents as given in the General Instruction [MAHA-METRO/SHE/GI/004](#).
- 7.3.2 All personnel shall be issued a photo identity card of size 85mm x 55mm duly signed by the authorized representative of the Contractor before they are engaged for any work as per the format given in the General Instruction [MAHA-METRO/SHE/GI/005](#)
- 7.3.3 Contractor shall also issue a personnel SHE handbook in a language known to the workers, which provides information on SHE and emergency procedures that all personnel working on contract are required to know and the need to follow. Contractor shall ensure that this is distributed and its content introduced to all personnel working at the site.

8. SAFETY INSPECTIONS AND FOLLOW UP ACTION

8.1 Inspections by Contractor's Safety Supervisory Staff

- 8.1.1 The Contractor's Project Manager and supervisory staff are required to carry out weekly site safety inspections and prepare reports of such inspections. Copies of the completed inspection reports shall be kept on site and available for inspection by the Engineer.
- 8.1.2 The frequency of the inspections shall be determined by site activities and general conditions. However the inspections should be conducted at a minimum of once a week. Where high-risk activities are being carried out inspections should be carried at least once daily.
- 8.1.3 The inspection reports should be discussed with the relevant Site Managers. These shall also be discussed with the sub-contractors and other levels of site management in the Site Safety Meetings as detailed in Section-9 of this Manual.
- 8.1.4 For each Contract the Contractor shall prepare a comprehensive safety inspection checklist, as a requirement of the Safety Plan. This check-list can then be used for:
 - (a) Inspections by the Contractor's Safety Officers;
 - (b) Monitoring of the Contractors' safety inspections by the Site Safety Management Committee.
- 8.1.5 The Engineer Staff may carry out site safety inspections, which shall be attended by the Contractors' Site Manager and Safety Manager.
- 8.1.6 In relation to Works Contracts, the insurers providing insurance cover for Contractor's All Risks and Third Party liability may visit the sites with a view to checking whether the Contractors have taken adequate safety precautions against damage to the works.
- 8.1.7 All inspection records and reports will be properly kept and filed for audit purpose. Inspection reports of Planned General Inspection and Routine Inspection will be used for discussion during Safety Committee Meetings.

8.2 Follow up actions

- 8.2.1 Remedial action to rectify any deficiency identified or unsafe practices discovered during the safety inspections should be implemented immediately. Until the remedial action is taken the task may be discontinued.
- 8.2.2 In cases where the Engineer believe that the Contractor's or sub-contractors' workmen are using unsafe working methods; the Contractor's Representative should be informed by them as soon as possible. If the unsafe activity continues, it shall be reported to the Employer's Chief Safety Officer.
- 8.2.3 If the Contractor's working method is deemed so unsafe as to represent a risk to life, the Engineer may require specific actions by the Contractor, such as proposals on preventive/remedial measures, or suspension of relevant portions of the works, and introduction of measures deemed necessary. All such instructions shall be confirmed in writing and shall include a proviso that the issue of the instruction shall not relieve the Contractor of his responsibilities under the Contract or Statutory obligations. The Engineer may also invoke a fine on the Contractor in accordance with Section 4.1.3.

9. CONTACTOR'S SITE SAFETY COMMITTEES

9.1 General

- 9.1.1 All employees should be able to participate in the making and monitoring of arrangements for safety and health at their place of work. The establishment of site safety committees in which employees and Contractor and sub-contractor management are represented can increase the involvement and commitment of employees. The Contractor shall set up such site safety committees to promote and

monitor safety and health on their worksites. A copy of the agenda shall be forwarded to the Engineer seven days prior to the meeting date, in order that they can decide if it is necessary for them to attend.

9.2 Composition and Functions of Contractor's Safety Committees

9.2.1 The Contractor should form a safety committee for each contract, however should the situation require more than one committee, or the Engineer so requires, additional committees shall be created.

9.2.2 The Contractor's SHE management should send the following reports to the Employer periodically:

- (i) Daily Reporting of total number of workmen
- (ii) Monthly SHE Report (as given in [Clause 9.3](#))
- (iii) SHE Committee Meeting Minutes (as given in [Clause 9.2.5](#))
- (iv) SHE Inspection Reports
- (v) SHE Audit Reports
 - a. Monthly Audit Rating Score (MARS) report
 - b. External SHE Audit
 - c. Electrical Safety Audit
- (vi) Air and Noise Quality monitoring report

9.2.3 The Terms of Reference for the committee should be as follows;

- (a) To monitor the adequacy of the Contractor's Site Safety Plan and ensure its implementation;
- (b) To monitor safety inspection reports;
- (c) To study accident and incident reports;
- (d) To study accident statistics and trends so as to identify unsafe practices and conditions;
- (e) To review the emergency and rescue procedures;
- (f) To review site safety training;
- (g) To promote safety and industrial health on site;
- (h) To discuss the Contractor's monthly safety report;
- (i) To take follow up actions on minutes of meeting.
- (j) To establish company safety policies and practices
- (k) To review the Contractor's monthly SHE report.
- (l) Committee team members should perform a site inspection before every committee meetings and to monitor SHE inspection reports.
- (m) To look into the health hazards associated with handling different types of explosives, chemicals and other construction materials and to suggest remedial measures including personal protective equipment.

9.2.4 The Membership of the committee should be as follows;

Chairman:	The Contractor's most Senior Manager for the Contract.
Secretary:	The Contractor's Safety Officer
Members:	Contractor's and Sub-contractors management representatives and safety staff.
Employers Representative	MAHA – METRO SHE in charge and representative

In attendance as and when they wish,

A minimum period of 21 days shall be maintained between any two SHE monthly committee meetings. The secretary shall circulate the agenda of the meeting at least seven working days in advance of the schedule of the meeting to all members.

- 9.2.5 Minutes of the Site Safety Committee shall be prepared as per the format provided at SF-002 and sent to all members within two working days of the meeting preferably by mail fax followed by hard copies. Copies of the minutes should be displayed on notice boards so that employees are kept informed of the Site Safety Committee's activities and decisions.
- 9.2.6 The chairman shall inform the members of any outstanding issues in the meeting and in case of repeated offence/ non-compliance by some members or other co/sub contractors and propose suitable disciplinary action including provisions of monetary penalty as per the relevant contract clauses, the Employer shall ensure that the same is implemented.

9.3 Monthly SHE Report

The Contractor shall prepare a monthly SHE report consisting of the following and submit 3 copies within 7th of next month to the Employer as specified in the Project SHE Manual.

- (i) Monthly man-hour details as specified in the Project SHE manual
- (ii) Monthly accident / incident details as specified in the Project SHE manual
- (iii) SHE committee details
- (iv) Details of SHE training conducted in the month
- (v) SHE Inspection
- (vi) SHE internal audit details like electrical audit etc.
- (vii) SHE Communication activities undertaken in the month indicating the number of posters displayed and balance availability in stock.
- (viii) Air quality
- (ix) Toolbox talks details
- (x) PPE details: Quantity purchased, issued to the workmen and stock available.
- (xi) Details on IP 44 panel boards, lighting poles, welding and cutting equipments, Ladders, Hoists, tools & tackles.
- (xii) Monthly Lux meter study results
- (xiii) Housekeeping
- (xiv) Barricade maintenance details
- (xv) No of critical excavations
- (xvi) Health & Welfare activities
- (xvii) Safety walk conducted by Contractors' Project Manager in the month
- (xviii) SHE Activities Planned for next month

10. REPORTING OF ACCIDENTS AND DANGEROUS OCCURRENCES

10.1 Contractors Responsibility

- 10.1.1 All accidents and dangerous occurrences shall be recorded, regardless of whether or not personnel injury occurs.
- 10.1.2 The Employer and the Engineer shall be notified by the quickest possible means, for example by telephone of the following classifications of accidents and incidents and by subsequent written notification within twenty four hours on the Contractors

Accident and Incident Reporting Form (for example of form see Schedule 1):

- (a) Fatal Accident
- (b) Major Injury Accident (see definition in 3.1.1)
- (c) Dangerous Occurrence (see definition in 3.1.1)
- (d) Any Incident Involving A Member Of The Public

10.1.3 The Site Safety Officer shall conduct in depth investigations into all fatal accidents, major injury accidents, incidents involving a member of the public, dangerous occurrences, and selected over three-day lost time injury accidents. Copies of these investigations shall be forwarded to the Engineer within seven days of the incident.

10.1.4 The Contractor shall report immediately, orally and in writing, all fatal accidents, and other occurrences requiring reporting, to the police, at the police station in whose jurisdiction the accident occurred.

10.2 Reportable Accidents

10.2.1 An accident shall also become reportable to the Engineer if it causes incapacity for more than three days excluding the day of the accident. The Contractor must submit a report on form SAF 001 to the Engineer within seven days of the incident.

10.2.2 The following information is required in reporting an accident to the Engineer.

- (a) Particulars of the Contractor or Sub-contractor employing the injured person;
- (b) Particulars of the deceased or injured person: name, address, occupation, sex, and age;
- (c) The date, cause or circumstances of the accident; and
- (d) The nature of the injury, stating whether death or incapacity was caused by the injury.

10.3 Dangerous Occurrences

10.3.1 The Engineer requires that all dangerous occurrences on site must be reported in writing to him within 24 hours, irrespective of whether there are casualties or not. The following information has to be provided:

- (a) The time of the occurrence;
- (b) Damage to any building, machinery or plant; and
- (c) The circumstances in which the accident occurred.

A copy of the standard 'Dangerous Occurrence Report form' SAF 001 (as attached to this Manual) may be used.

10.3.2 If no one is injured, the above notification is sufficient. In the case of death or serious injury, the accident reporting procedure outlined in Section 9.1.2 must also be followed.

10.4 Reporting of Fires by Contractor

10.4.1 The Contractor shall report to the Engineer all fires which occur on site including any fires that have been extinguished by the Contractor himself, and the Engineer may send staff to investigate such fires. The following information should be provided:

- (a) time of fire;
- (b) location of fire;
- (c) means of extinguishing the fire;
- (d) injury to any person/damage to any property; and
- (e) the probable cause of fire.
- (f) This action is in addition to reporting the incident to the Chief Fire Officer, and Police in accordance with local regulations.

10.5 Reporting to the Engineer

- 10.5.1 The Contractor shall duly complete standard forms on dangerous occurrences and accidents as required by the Engineer to enable the Engineer to prepare a database on accident statistics. The Contractor shall deliver to the Engineer a copy of any statutory reports he submits to the Relevant Authorities.
- 10.5.2 The Contractor shall send a monthly report to the Engineer of all accidents and dangerous occurrences whether they are of a serious nature or not.

11. ACCIDENT INVESTIGATION

11.1 General

- 11.1.1 Investigations should be conducted in an open and positive atmosphere that encourages the witnesses to talk freely. The primary objective is to ascertain the facts with a view to prevent future and possibly more serious occurrences. Accidents are rarely just the fault of the worker. If the worker has not been trained, instructed or properly supervised then the fault may well lie with management.
- 11.1.2 Accidents and Dangerous Occurrences which result in death, serious injury or serious damage must be investigated by the Contractor immediately to find out the cause of the accident/occurrence so that measures can be formulated to prevent any recurrence. (Refer to the advice contained in 10.2.1 below.)
- 11.1.3 Near misses and minor accidents should also be recorded and investigated by the Contractor as soon as possible as they are signals that there are inadequacies in the safety management system.

11.2 Recommended actions in incident investigation

- 11.2.1 It is important after any Accident or Dangerous Occurrence that information relating to the incident is gathered in an organised way. The following steps are recommended;
- Take photographs and make sketches
 - Examine involved equipment, workpiece or material and the environmental conditions
 - Interview the injured, eye-witnesses and other involved parties
 - Consult expert opinion where necessary
 - Identify the specific Contractor or Sub-contractor involved.
- 11.2.2 Having gathered information, it is then necessary to make an Analysis of Incident
- Establish the chain of events leading to the accident or incident
 - Find out at what stage the accident took place
 - Consider all possible causes and the interaction of different factors that led up to the accident, and identify the most probable cause
- Note: The cause of an accident should never be classified as carelessness. The specific act or omission that caused the accident must be identified.
- 11.2.3 The next stage is to proceed with the Follow-up Action
- Report on the findings and conclusions
 - Formulate preventive measures to avoid recurrence
 - Publicise the findings and the remedial actions taken

12. ACCIDENT STATISTICS

12.1 Introduction

Accident data, if properly collected and analysed, indicates trends, and can show

where and how problems arise. Comprehensive accident information enables accident prevention efforts to be targeted at problem areas.

12.2 Collection of Accident Statistics

- 12.2.1 The procedures that apply for the reporting and collation of data in respect of accident statistics are set out below.
- 12.2.2 The Contractors' safety officers are required to send duly completed Report Forms (Refer to Schedule 1 – SAF 002 and SAF 003), to the Engineer within five days after the end of each month. The Construction Accident Statistics Monthly Report Form must be submitted even if there are no injuries or dangerous occurrences within the current month.
- 12.2.3 'Man-hours' is defined as the man-hours worked by all persons employed on site. (including site supervisory staff, management staff and clerical staff).
- 12.2.4 'Man-days' is defined as the man-days worked by all persons employed on site. (including site supervisory staff, management staff and clerical staff).

12.3 Calculation of man-days lost - Construction Accident Statistics

When calculating the man-days lost for the Construction Accident Statistics Summary Sheet, the following applies:

The number of man-days lost refers to the total number of man-days lost during the reported month due to:

- (a) Non-fatal reportable accidents which happened within the reported month
- (b) Non-fatal reportable accidents which occurred in previous months.

The day on which the reportable accident occurred should be excluded in calculating man-days lost but public holidays within the injured period should be counted.

12.4 Calculation of Accident Frequency Rate (AFR)

The Accident Frequency Rate (AFR) per 100,000 man-hours worked shall be calculated using the following formula

$$\left\{ \frac{\text{No. of reportable accidents}}{\text{Man-hours worked}} \right\} \times 100,000$$

A reportable accident is a Fatality, a Major Injury Accident as defined in 9.4, and reportable accidents as defined in 9.2.

13. HAZARD IDENTIFICATION AND RISK ASSESSMENT

13.1 General

- 13.1.1 The purpose of Hazard Identification and Risk Assessment is to identify all the significant hazards, which may occur during the construction phase, and to rank them according to their severity. Having ranked the risks by severity the Contractor shall then introduce measures to mitigate the effects of that risk.
- 13.1.2 Prior to the commencement of any potential High-Risk operations the Contractor shall conduct a detailed hazard analysis and risk assessment of the task and shall record his findings on appropriate worksheets. Examples of worksheets SAF 020 may be found in Schedule 2.
- 13.1.3 The worksheets should then show what measures the Contractor is going to take to

reduce the level of risk to acceptable levels.

13.2 Method Statements

13.2.1 As a result of the Hazard Identification and Risk Assessment detailed method statements shall need to be produced for medium and high risk activities including amongst others the following:

- (a) Craneage of items in excess of 1 tonne
- (b) Erection of steel structures.
- (c) Excavations deeper than 2m.
- (d) Erection and loading of formwork
- (e) Demolition.
- (f) Tunnelling operations.
- (g) Inflammable materials – the use and storage
- (h) Use and storage of explosives

A component part of the detailed method statement shall be the inclusion of the completed Hazard and Risk Worksheet as discussed in Section 12.1 above.

13.2.2 Method Statements will usually be attached to Design Submissions but should be cross-referenced to the Contractor's Site Safety Plan.

13.2.3 A method statement should contain sufficient information to enable the task to be undertaken safely and should contain as a minimum the following information

- (a) Introduction – A brief outline of the Task
- (b) Details of the Risks involved
- (c) A step by step description of how the task is to be undertaken detailing
 - what needs to be done;
 - the order in which the task will be carried out;
 - what plant or equipment is required;
 - who the task will be done by;
 - who will supervise the task;
 - where will the task take place;
 - when will the task take place;
 - the precautions which must be taken before the task is undertaken;
 - what to do if things go wrong;

13.3 Permits to Work

13.3.1 The Contractor shall develop a permit-to-work system, which is a formal written system used to control certain types of work that are potentially hazardous. A permit-to-work is a document, which specifies the work to be done, and the precautions to be taken. Permits-to-work form an essential part of safe systems of work for many construction activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

13.3.2 A permit is needed when construction work can only be carried out if normal safeguards are dropped or when new hazards are introduced by the work. Examples of high risk activities include but are not limited to:

- (a) Work close to 25kV overhead Catenery/Contact System.
- (b) Entry into Confined Spaces (SAF 010)
- (c) Work in Close Proximity to Overhead Power lines and Telecommunication Cables.
- (d) Hot Work (SAF 012)
- (e) To Dig - where underground services may be located

- (f) Work with moving construction locomotives.
- (g) Working on Electrical Apparatus (SAF 011)
- (h) Work with Radioactive isotopes.

13.3.3 The permit-to-work system should be fully documented, laying down:

- (a) How the system works;
- (b) The jobs it is to be used for;
- (c) The responsibilities and training of those involved; and
- (d) How to check its operation;

13.3.4 The permit-to-work form must help communication between everyone involved. It should be designed by the Contractor issuing the permit, taking into account individual site conditions and requirements. Separate permit forms may be required for different tasks, such as hot work and entry into confined spaces, so that sufficient emphasis can be given to the particular hazards present and precautions required.

13.3.5 The permit to work form should contain:

- (a) clear identification of who may authorise particular jobs (and any limits to their authority);
- (b) clear identification of who is responsible for specifying the necessary precautions (e.g. isolation, emergency arrangements, etc);
- (c) a detailed description of the task clearly identifying the work to be done and the associated hazards;
- (d) plans and diagrams be used if appropriate to assist in the description of the work to be done, its location and limitations;
- (e) Identification of the hazards and the precautions to be taken;
- (f) clear rules about how the job should be controlled or abandoned in the case of an emergency;
- (g) the time limitations should be stated;
- (h) job specific toolbox talk conducted by the supervisor

13.3.6 A Permit To Work authorisation Form shall be completed with the maximum duration period not exceeding twenty four hours (for example of a Permit To Work authorisation form see Schedule 1)

13.3.7 A copy of each Permit To Work shall be displayed, during its validity, in a conspicuous location in close proximity to the actual works location to which it applies.

13.3.8 A pre-permit activation job specific toolbox talk shall be conducted by the supervisor including amongst others the following.

- (a) All identified hazards are explained;
- (b) Risk mitigation process clarified;
- (c) Method of work explained stressing points (a) and (b) above;
- (d) Emergency response procedure is clarified and persons assigned tasks in the event of an emergency;
- (e) Personal Protective Equipment (PPE) requirements including PPE serviceability checks and training if required;

All workers and supervision shall attend the toolbox talk and sign the toolbox attendance register. Any person's coming late to the work site shall be given the toolbox talk and sign the attendance register. A copy of the toolbox talk and attendance register shall be displayed as per section 12.3.7 of this manual.

14. EMERGENCY PREPAREDNESS PLANS

14.1 Emergency Situations

14.1.1 Every Contractor shall formulate an Emergency Preparedness Plan for each of his sites. These plans will address foreseeable emergencies that may arise during the construction activities. Examples of activities for which plans should be prepared include amongst other things:

- (a) An Accident Which Results In Death or Major Injury. (Major Injury as defined in Section 3.1.1)
- (b) A Serious Fire That Threatens Life.
- (c) A Flood, Earthquake, Storm and other natural calamities That Threatens Life.
- (d) Leakage of Any Dangerous Materials or Chemicals.
- (e) Leakage / Short Circuit of any Electrical supply.
- (f) Major Engineering Failures such as:
 - collapse of tunnels or structures
 - Collapse of lifting appliances and transport equipments
 - major utility collapse
 - unintended explosions
 - subsidence causing damage to structures or services

14.1.2 An Emergency Preparedness plan should include details of the following;

- (a) The name, location and phone number of the Emergency Co-ordinator;
- (b) Designated Personnel with locations and phone numbers;
- (c) Details of the Emergency Response Team with locations and phone numbers;
- (d) Functions of the Emergency response Team;
- (e) The means of Escape;
- (f) Communication with the Emergency Services;
 - Police
 - Fire Services
 - Ambulance and Hospital Services
- (g) First-Aid Facilities;
- (h) Site plans;
- (i) Suppliers of emergency equipment such as sump pumps, lighting, craneage, etc.

14.1.3 Copies of the emergency procedures and the Contractor's rescue organisation (reviewed without objection by the Engineer) should be displayed at each place of work and notice boards. This information should be reviewed and updated as often as is required, but at least once annually. Drills should be arranged to test the efficiency in mobilising the necessary personnel and equipment. These Drills should be carried out at least every three months.

14.1.4 Regular joint exercises between the Contractor's rescue teams and the Fire and Emergency Services should also be carried out for the major contracts.

15. SAFETY SIGNAGE

15.1 Safety Signs

15.1.1 All safety signage that is displayed in and around the sites shall be in both local language and English, examples of signs that shall be required shall include amongst others the following:

- (a) Wear Safety Helmets
- (b) Permit to Work areas
- (c) Wear Safety Footwear
- (d) Wear Hearing Protection

- (e) Wear Eye Protection
- (f) Danger Electricity
- (g) Danger Crane Overhead
- (h) Stop Look and Listen
- (i) No Smoking
- (j) First Aid
- (k) No Entry signs
- (l) Fire precautions
- (m) Emergency Exit from underground works

15.1.2 All safety signs shall comply with the internationally recognised Safety Colours as indicated below:

- Blue : Mandatory
- Yellow : Danger
- Red : Prohibition
- Green : Safe Condition

15.1.3 The Contractor shall also observe important days as listed in General Instruction [MAHA-METRO/SHE/GI/005](#) and printing and displaying safety signage and posters as listed in General Instruction [MAHA-METRO/SHE/GI/006](#)

15.2 References

Indian Standards

- | | |
|---------------|--|
| IS 9457:1980 | : Standard for colours of Safety Signs |
| IS 12349 1988 | : Fire Protection - Safety Signs |

16. INDUSTRIAL HEALTH AND WELFARE

16.1 Introduction

16.1.1 Hazards to Health on a construction site can arise from the use of a number of materials, substances and processes if they are not properly controlled. Some of the more serious risks are caused by the inhalation of dusts, fibres, toxic fumes, by the misuse of chemicals, lasers and radioactive isotopes. Excessive vibration and excessive noise can also cause ill health. Many man-days are lost as a result of dermatitis, tenosynovitis, bronchitis and rheumatism.

16.1.2 The Contractor shall be responsible for maintaining healthy working conditions for all his, and his sub-contractors, workers. In particular he shall pay attention to the effects of noise, dust, air pollution and the use of chemicals. If it is not possible to remove the cause of harm then suitable and sufficient Personal Protective Equipment (PPE) should be provided to those workers who could be affected.

16.1.3 If the use of PPE is the only means of providing protection the Contractor shall ensure that all the workers affected are properly trained in the use of the PPE and that adequate supervision is provided to ensure its proper use.

16.2 Hazardous Substances

16.2.1 The Contractor shall obtain Material Safety Data Sheets (MSDS) for all substances that are deemed to be hazardous to be used on site. An inventory shall be kept of all such materials with the relevant MSDS and shall be available for inspection by the Engineer who may require further MSDS's to be obtained.

- 16.2.2 The Contractor shall conduct an assessment of the substance in relation to its intended usage on site. Particular attention must be given to the actual location of usage as a substance, which is safe for use in the open air, may be extremely hazardous in a confined space. The results of all assessments shall be recorded and method statements produced. (For an example of a Hazardous Substance Assessment Form see Schedule 1).
- 16.2.3 The objective of the assessment is to establish what precautions and control measures shall be implemented in order that a safe system of work can be established for the use of the substance on site.

16.3 Noise

- 16.3.1 Industrial deafness is caused by over exposure to high levels of noise from plant, machinery or construction processes. Once a part of a person's hearing has been lost it can never be recovered. Deafness can also lead to further accidents on site with workers being unable to hear warnings and other instructions.
- 16.3.2 For continuous exposure, i.e. for eight hours in any one-day, the sound level should not exceed 90dB (A). For non-continuous exposure a calculated equivalent continuous sound level (Leq) should not exceed 90dB (A). Workers should not be exposed to sound levels exceeding 90dB (A) unless they are wearing suitable hearing protectors, which effectively reduce the sound level at the user's ear to, or below, 90dB (A).
- 16.3.3 If Peak noise levels exceed 120dB (A) then the wearing of suitable hearing protectors shall be Mandatory.
- 16.3.4 The Contractor shall carry out noise assessments to establish what noise levels his workers are being exposed to. If excessive noise levels above 90dB (A) are found then the Contractor shall introduce a noise control programme to protect his workers.
- 16.3.5 Consideration should always be given first to reducing the noise level at source. Examples of noise reduction methods include;
- (a) More efficient silencers on compressors and maintenance of exhaust systems;
 - (b) Fitting acoustic lining to machinery panels;
 - (c) Use of Acoustic screens and sheds to protect other workers;
 - (d) Using noise reduced tools;
 - (e) Sighting of noisy plant away from the workplace
- 16.3.6 Where it is not possible to reduce the noise level to which the worker is exposed the Contractor shall provide the workers with suitable and sufficient hearing protection to protect them. The Contractor shall ensure that all the workers affected are properly trained in the use of the Hearing Protection and that adequate supervision is provided to ensure its proper use.

16.4 Ventilation in Shafts and Tunnels

- 16.4.1 The Contractor shall assign a Competent Person to perform all air monitoring required to determine proper ventilation and quantitative measurement of potentially hazardous gases. The atmosphere in all underground areas shall be tested quantitatively by the Contractor for toxic gases, dust, vapour, mist, and fumes as often as necessary to ensure that prescribed limits given at 15.4.3 below are met. Quantitative tests for methane shall also be performed in order to determine whether an operation is potentially hazardous. For every test carried out the Contractor shall maintain a record of the air quality, the location, date, time, substances and amount monitored. These records shall be made available to the Engineer on demand.

16.4.2 The ventilation system shall be adequate to maintain circulation of air in all parts of tunnels and shafts and following conditions shall be taken care of:

16.4.3 Air shall be considered unfit for workmen to breathe if it contains any of the following :

- (a) Less than 19.5% oxygen by volume.
- (b) More than 0.005% carbon dioxide by volume.
- (c) More than 0.01% carbon monoxide by volume.
- (d) More than 0.001% hydrogen sulphide by volume.
- (e) More than 0.005% oxides of nitrogen.
- (f) More than 0.5% of methane at any place in the tunnel.
- (g) More than 0.0002% of aldehyde.
- (h) Any other poisonous gas in harmful amounts.

In addition to the requirements given above, 2 m³ of fresh air per minute shall be furnished for each brake horsepower of diesel engine used in the tunnel.

16.4.4 The Contractor will ensure the supply of fresh air to all underground work areas in sufficient amount to prevent any harmful accumulation of dust, vapour or gases. The Contractor shall provide at least 6m³ of fresh air per minute per employee underground.

16.4.5 No inflammable materials or oil and grease shall be stored inside or near the tunnels or shafts and all combustible rubbish from the tunnel or shaft shall be promptly removed. A regular analysis of the gases inside the tunnel should be done with advance of the tunnel.

16.4.6 Tools made of light alloys (such as Al and Mg) are not to be used inside the tunnel. They may cause sparks.

16.4.7 Regular checking of gas (referred at 15.4.3) at the faces shall be done before each shift. This should be carried out using a multi gas detector.

16.4.8 Motive power other than electric, shall not be used without prior authorisation from the Engineer. No petrol engines shall be used underground. Diesel locomotives shall only be used with the prior consent of the Engineer. Diesel engines shall not be used underground unless equipped with a filter that will remove all carbon monoxide and oxides of nitrogen. Such filters shall be tested by the Contractor's chief mechanic and more frequently by the plant operator.

16.4.9 The Contractor shall take every effort to illuminate the work site as per the Employer's requirement illustrated in General Instruction **MAHA-METRO/SHE/GI/008**.

16.4.10 The Contractor shall conduct a monthly illumination monitoring by lux meter for all the locations and the report shall be sent to the Employer within 7th of the next month and the same shall be reviewed during the monthly SHE committee meeting.

16.5 Toilets

16.5.1 The Contractors shall ensure that an adequate number of toilets are made available at the work sites with the ratio being no less than one toilet for every 50 workers or part thereof. The toilets shall be located so that persons do not have to walk more than five hundred metres to use them.

16.5.2 The toilets shall have adequate water supply and be kept in a clean and tidy condition

at all times.

16.6 Drinking Water

- 16.6.1 The Contractors shall ensure that effective arrangements are made to provide and maintain at suitable points a sufficient supply of wholesome drinking water.
- 16.6.2 All such points shall be legibly marked “Drinking Water” in local language and English and no such point shall be situated within six metres of any washing place, urinal or latrine.
- 16.6.3 As per Section 32 of BOCWA the Contractor shall make in every worksite, effective arrangements to provide sufficient supply of wholesome drinking water with minimum quantity of 5 litres per workman per day. Quality of the drinking water shall conform to the requirements of national standards on Public Health.
- 16.6.4 While locating these drinking water facilities due care shall be taken so that these are easily accessible within a distance of 200m from the place of work for all workers at all location of work sites.

16.7 Lifting and Carrying of Excessive Weights

All Contractors shall ensure that no worker lifts by hand or carries overhead or over his back or shoulders any material, article, tool or appliances exceeding in weight the maximum limits set out below unless aided by another worker or a mechanical device.

Adult – man	55kg
Adult – female	30kg

16.8 Canteen

- a) In every workplace wherein not less than 250 workers are ordinarily employed, the Contractor shall provide an adequate canteen conforming to Section 37 of BOCWA, Rule 244 of BOCWR and as stipulated in Rule 247 of BOCWR the changes for food stuff shall be based on ‘no profit no loss’ basis. The price list of all items shall be conspicuously displayed in such canteen.
- b) Serving of tea and snacks at the workplace
- As per Rule 246 of BOCWR, at a building or other construction work where a workplace is situated at a distance of more than 200 m from the canteen provided under Rule 244(1) of BOCWR, the Contractor employing building works shall make suitable arrangement for serving tea and light refreshment to such building works at such place.
- Proper Housekeeping should be maintained at such locations where tea and snacks are served.

16.9 References

Indian Regulation

The Maharashtra Building And Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter X - General Safety Provisions

Indian Standards

- IS 4756 : 1978 Safety Code for Tunnelling works
- IS 1179 : 1967 Specification for equipment for eye and face protection during welding
- IS 2925 : 1984 Specification for Industrial Safety Helmets

British Standards

- BS EN 352: Hearing protectors. Safety requirements and testing
- 352-1 & 2: 1993: Ear muffs & Ear Plug respectively
- 352-3: 1997: Earmuffs attached to an industrial safety helmet.

17. WORKING AT HEIGHT

17.1 General

- 17.1.1 Working at height is the largest single cause of serious accidents in the construction industry and therefore the Contractor shall carry out risk assessments for all work where workers or materials can fall more than two metres.
- 17.1.2 Where work is being carried out above areas where there is public access such as roads footpaths etc. particular care must be taken to ensure that no materials can fall from the working area.
- 17.1.3 Edge protection shall be provided at all leading edges or openings where workers or materials can fall more than two metres. Edge protection shall meet the minimum standard of;
 - a) A main guardrail at least 1 metre above the edge
 - b) A toe board at least 200 mm high; and
 - c) An intermediate guard rail or other barrier so that there is no gap more than 470 mm.

17.2 Use of Scaffolds

- 17.2.1 All scaffolds should be erected and dismantled by workmen who are thoroughly experienced in the erection and dismantling of scaffolding.
- 17.2.2 All scaffolds should be inspected by a competent person at least every three days after erection and the results of inspections recorded and the records shall be kept available for checking by the Engineer.
- 17.2.3 Tags shall be fitted to all scaffolds to show whether they are safe for use or not. All Safe for Use tags shall be signed by a senior site engineer from the Contractor.
- 17.2.4 All scaffolds shall be constructed of sound materials free from patent defect.
- 17.2.5 The following measures shall be taken;
 - (a) the scaffold shall be constructed for the correct use (Light or Heavy Duty)
 - (b) securely fixed to existing structures or adequately buttressed;
 - (c) the use of barrels, boxes, loose tiles or other unsuitable material shall not be used as supports for working platforms;
 - (d) all working platforms shall be fully boarded;
 - (e) all working platforms shall have guard rails at one metre height and shall also have an intermediate rail at half height;
 - (f) all working platforms shall be provided with toe boards;
 - (g) all working platforms shall be kept free of unnecessary obstruction or rubbish
 - (h) secure ladder access shall be provided;

17.3 Use of Ladders

- 17.3.1 All ladders shall be of sound construction and shall be free from patent defect.

- 17.3.2 Ladders should be checked weekly and defective ladders shall be promptly and properly repaired or replaced.
- 17.3.3 Ladders shall not be used as working platforms but may be used for work of short duration of up to thirty minutes.
- 17.3.4 Metal ladders shall not be used near or adjacent to overhead power lines unless they have been certified dead under a permit to work system.
- 17.3.5 Ladders shall;
- (a) be secured at the top or footed at the bottom to prevent slippage;
 - (b) not be used if any rung is missing;
 - (c) not be used for any other purpose than to provide access;
 - (d) be set at an angle of seventy five degrees unless designed for vertical access;
 - (e) all vertical ladders shall be fitted with hoops to prevent falls;

17.4 Safety Harnesses / Fall Arresters

Where it is not possible to provide a safe working platform then the use of safety harnesses may be considered. If safety harnesses are used they should be of the full body type and secure anchorage points shall be provided and used. Workers must be instructed in the proper use of harnesses.

A risk assessment shall be carried out and it shall be determined that the work activity can so far as in reasonably practicable be performed safely while using safeguard and without affecting its effectiveness.

17.5 References

Indian Regulation

The Maharashtra Building And Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XIX - Ladders and Step Ladders and XXIII about Scaffolds

Indian Standards;

IS 3696 (Part 1) : 1987	Safety Code for Scaffolds and Ladders, Part 1, Scaffolds
IS 3696 (Part 2) : 1991	Safety Code for Scaffolds and Ladders, Part 2, Ladders
IS 13416 (Part 1):1992	Recommendations for preventive measures against hazards in the workplace, Part 1, Falling material hazards protection
IS 13416 (Part 2):1992	Recommendations for preventive measures against hazards in the workplace, Part 2, Fall protection

British Standards

BS EN 354:1993	: Personal protective equipment against falls from a height. Lanyards
BS EN 355:1993	: Personal protective equipment against falls from a height. Energy absorbers
BS EN 358:1993	: Personal equipment for work positioning and prevention of falls from a height. Work positioning systems
BS EN 360:1993	: Personal protective equipment against falls from a height. Retractable type fall arresters
BS EN 361:1993	: Personal protective equipment against falls from a height. Full body harnesses
BS EN 362:1993	: Personal protective equipment against falls from a height. Connectors

BS EN 363:1993	: Personal protective equipment against falls from a height. Fall arrest systems
BS EN 364:1993	: Personal protective equipment against falls from a height. Test methods
BS EN 365:1993	: Personal protective equipment against falls from a height. General requirements for instructions for use and for marking
BS EN 795:1997	: Protection against falls from a height. Anchor devices. Requirement and testing

18. EXCAVATIONS

18.1 General

- 18.1.1 Excavation is one of the important phases of any construction activity. Due to insufficient attention to the safety aspects it frequently becomes the cause of many accidents. Contractors are therefore required to plan and execute all excavations in a safe manner.
- 18.1.2 The Contractor shall ensure that all excavations are supervised by workers with thorough knowledge and experience of excavation work.
- 18.1.3 The integrity of the excavation and the support system shall be inspected prior to the commencement of any works on a daily basis with the results of the inspections being formally recorded. All such records shall be kept available for inspection by the Engineer.
- 18.1.4 Where there is the possibility of any ingress of water then pumping sumps shall be established with pumps being readily available for use and additional ladders placed for use in the event of an emergency evacuation.

18.2 Planning

The correct planning of excavations is essential for safety and before digging any excavations Contractors should plan against the following;

- Collapse of the sides;
- Materials falling onto people working in the excavation;
- People and vehicles falling into the excavation;
- People being struck by plant;
- Undermining nearby structures;
- Contact with underground services;
- Fumes; and
- Make sure the necessary equipment needed such as trench sheets, props, etc, are available on site before work starts.

18.3 General Precautions

The following precautions should be observed;

- Prevent the sides and the ends from collapsing by battering them to a safe angle or supporting them with timber, sheeting or proprietary support systems.
- Do not go into unsupported excavations.
- Never work ahead of the support.
- Remember that even work in shallow trenches can be dangerous. You may need to provide support if the work involves bending or kneeling in the trench.
- Prevention of materials falling into excavations
- Do not store spoil or other materials within one metre of the sides of excavations. The spoil may fall into the excavation and the extra loading will

- make the sides more prone to collapse.
- (g) Make sure the edges of the excavation are protected against falling materials. Provide toe boards where necessary.
- (h) Wear a hard hat when working in excavations.
- (i) Take steps to prevent people falling into excavations. If the excavation is 2 m or more deep, provide substantial barriers, e.g. guard rails and toe boards.
- (j) Keep vehicles away from excavations wherever possible. Use brightly painted baulks or barriers where necessary.
- (k) Where vehicles have to tip materials into excavations, use stop blocks to prevent them from over-running. Remember that the sides of the excavation may need extra support.

18.4 Undermining nearby structures

The following precautions should be taken to prevent the undermining of nearby structures;

- (a) Make sure excavations do not affect the footings of scaffolds or the foundations of nearby structures. Walls may have very shallow foundations, which can be undermined by even small trenches.
- (b) Decide if the structure needs temporary support before digging starts. Surveys of the foundations and the advice of a structural engineer may be needed.

18.5 Avoiding underground services

The following precautions should be taken to avoid underground services;

- (a) Look around for obvious signs of underground services, e.g. valve covers or patching of the road surface.
- (b) Use locators to trace any services. Mark the ground accordingly.
- (c) Make sure that the person supervising excavation work has service plans and knows how to use them. Everyone carrying out the work should know about safe digging practices and emergency procedures.
- (d) Operate a "Permit to Dig" system.

18.6 References

Indian Regulation

The Maharashtra Building And Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XVII - Excavation and Tunnelling Works

Indian Standards

IS 3764: 1992	Excavation Work – Code of Safety
IS 13430: 1992	Safety during additional construction to existing buildings – Code of Practice.
IS 2314: 1986	Steel Sheet Piling sections
IS 5121: 1969	Safety Code for Piling and Other Deep Foundations

19. LIFTING OPERATIONS

19.1 Lifting Appliances:

- 19.1.1 The Contractor shall ensure that all lifting appliances, including synchronised mobile jacks, pit jacks, mobile cranes, tower cranes, gantry cranes, launching beams and lorry mounted cranes, prior to being allowed to work on site shall have available for

inspection by the Engineer a current Certificate of Inspection issued by a Competent Person approved by MMRCL.

- 19.1.2 All lifting appliances with a lifting capacity of more than one tonne shall, where practicable, be fitted with Automatic Safe Load Indicators and Audible Warning Devices which shall be kept in an operable condition at all times the lifting appliance is in use. Checks should be made to ensure that the Automatic Safe Load Indicator is properly calibrated and is functioning properly.
- 19.1.3 All lifting appliances shall be maintained in accordance with the manufacturer's instructions and shall be subject to a regular preventative maintenance programme.
- 19.1.4 All lifting appliances shall be inspected every three months by a third party competent person approved by MMRCL. Certificates of Inspection shall be available with the lifting appliance and a copy shall also be sent to the Engineer.
- 19.1.5 The operators of lifting appliances shall conduct daily inspections of their respective lifting appliances with the results of the inspections being recorded and kept available for inspection by the Engineer.
- 19.1.6 The Contractor shall ensure that only thoroughly trained and experienced persons aged twenty-one years and over are allowed to operate lifting appliances.

19.2 Lifting Gear:

- 19.2.1 Lifting Gear includes chain slings, rope slings, or similar gear and a ring, link, hook, plate clamp, shackle, swivel or eye bolt.
- 19.2.2 The Contractor shall ensure that all lifting gear shall be in good condition and shall be tested and certified every six months, with the Safe Working Load being stamped or clearly displayed upon it. Records of test shall be kept available for inspection by the Engineer.
- 19.2.3 All lifting gear shall be visually inspected before any use and if any defects are found then it shall be removed from site or dismantled / disabled in order to ensure that it is not used in a defective state.
- 19.2.4 All lifting gear shall be properly stored and not left lying on the ground where it could be damaged or used in an unsafe manner.

19.3 Lifting Operations:

The Contractor shall ensure that during the course of any lifting operations the following minimum requirements shall be followed:

- (a) All lifting operations shall be under the control of a competent "Lifting Supervisor" appointed by the Contractor.
- (b) Only thoroughly trained and experienced crane drivers shall be allowed to operate cranes.
- (c) Only thoroughly trained and experienced slingers and riggers shall be allowed to sling loads and give directions to crane operators.
- (d) A standard code of hand signals shall be adopted for controlling the movements of the crane and both the driver and the signaller shall be thoroughly familiar with the signals.
- (e) The driver of the crane shall respond to signals from only the appointed signaller but shall obey the stop signal at any time no matter who gives it.
- (f) Before commencing any lifting operations the ground conditions on which the crane is to stand shall be investigated in order to ensure that the load bearing capabilities are adequate.
- (g) The weight of the load must be known to the crane driver and the

- slinger/rigger before lifting commences.
- (h) No loads are to be slewed over public areas without stopping pedestrians and vehicles first.
- (i) No unauthorised persons are allowed into the lifting zone.
- (j) No person is allowed to ride the hook of the crane or the loads being lifted.
- (k) Any areas where a minimum clearance of six hundred millimetres from the rear of the slewing kentledge of the crane cannot be achieved and where persons could be trapped against obstacles then a fence shall be erected to prevent access.
- (l) All crane hooks shall be fitted with an operable safety catch.
- (m) Wherever practicable all loads shall have tag-lines attached in order to ensure that the load can be controlled at all times.
- (n) Provision shall be made to ensure that the lifting slings or chains can be safely removed from the loads once they have been landed.
- (o) All lifted loads and stacked materials shall be left in a secure and stable condition at all times.
- (p) Whenever working close to isolated overhead power-lines the lifting appliances shall be grounded to earth as a secondary precaution against accidental energisation.
- (q) No close working to any live overhead power-lines is permitted without the operation of a strict Permit to Work system being in place.

19.4 References

Indian Regulation

The Maharashtra Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XI - (Lifting Appliances and Gear)

Indian Standards

IS 807: 1976	Code of Practice for the design, manufacture and testing of cranes
IS 7293: 1974	Safety Code for working with Construction Machinery;
IS 13583: 1993	Code of Practice for training of Crane Drivers Part 1 General

British Standards

BS 7121:	Code of practice for safe use of cranes
BS 7262:1990	Specification for automatic safe load indicators

20. WORK IN CONFINED SPACES

20.1 General

20.1.1 The term 'confined space' has three defining features as, any space;

- (a) in which a person can bodily enter;
- (b) which has limited entry / egress; and
- (c) which is not meant for occupancy.

Generally it is a place which is substantially (though not always entirely) enclosed with a reasonably foreseeable risk of serious injury from hazardous substances or conditions within the space or nearby.

20.1.2 Some confined spaces are fairly easy to identify, for example, closed tanks and sewers. Others are less obvious but may be equally dangerous, for example closed and unventilated or inadequately ventilated rooms and silos, ducts, culverts, tunnels, boreholes, bored piles, manholes, shafts, excavations, sumps, inspection pits, cofferdams, and building voids.

20.2 The hazards

The most likely hazards are as follows:

- (a) Flammable Substances and Oxygen Enrichment;
- (b) Toxic Gas, Fume or Vapour
- (c) Oxygen deficiency
- (d) The Ingress or Presence of Liquids
- (e) Presence of Excessive Heat,
- (f) Excessive Humidity

20.3 Entry Procedures

20.3.1 Contractors will ensure that no work will be undertaken in Confined Spaces unless a Permit to Work, see Section 13.3, has been prepared and issued.

20.3.2 Only persons who have been thoroughly trained, experienced and are physically fit shall be allowed to work in Confined Spaces.

20.3.3 Persons with any of the following medical conditions shall not be allowed to work in confined spaces:

- (a) a history of fits, blackouts or fainting attacks,
- (b) a history of heart disease or disorder,
- (c) high blood pressure,
- (d) asthma bronchitis, or shortness of breath on exertion,
- (e) deafness
- (f) meniers disease or disease involving giddiness or loss of balance,
- (g) claustrophobia or nervous or mental disorder,
- (h) back pain or joint trouble that would limit mobility in confined spaces,
- (i) deformity or disease of the lower limbs limiting movement.
- (j) Chronic skin disease,
- (k) Serious defects in eye sight or lack of sense of smell

20.3.4 No smoking shall be allowed in or within 2 metres of the opening to any confined space and suitable warning signs shall be positioned.

20.3.5 Before any confined space work commences the following equipment shall be available for use:

- (a) Multi Gas Monitor; or other suitable gas monitoring equipment.
- (b) Sufficient sets of Self Contained Breathing Apparatus to enable rescue to be carried out;
- (c) Full Body Type Harness for each worker;
- (d) Tripod and Lifeline Hoist Rope; for work in situations where a vertical exit from the confined space is required.
- (e) Flame-proof lighting. (Hand lamps not more than 24 volts.);
- (f) Resuscitation Equipment;
- (g) Ventilation Equipment.

The persons involved in the confined space working operations shall need to be thoroughly trained and certified as being competent in the use of the above detailed item of equipment.

20.4 References

Sections 7A and 36 of the Factories Act 1948

Indian Standards

IS 11972: 1987 Code of Practice for safety precautions to be taken when

entering a sewerage system

21. SITE ELECTRICITY

21.1 General

- 21.1.1 The Contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Engineer for review not later than 4 weeks before the appointment and who shall be solely responsible for ensuring the safety of all temporary electrical equipment on Site. The Contractor shall not install or operate any temporary Site electrical systems until this representative is appointed and has commenced duties.
- 21.1.2 The name and contact telephone number of the representative having been reviewed without objection by the Engineer shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.
- 21.1.3 The Contractor shall submit schematic diagrams and the details of the equipment for all temporary electrical installations, and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for review.
- 21.1.4 All electrical installation work on Site shall be carried out in accordance with the requirements laid down in the Specification. All work shall be supervised or executed by qualified and suitably categorised electricians.
- 21.1.5 The Contractor shall ensure plugs, sockets – outlets and couplers available in the construction site as “splash proof” type. All Temporary Electrical Site installations and distribution systems shall as a minimum meet IP44 standards and be in accordance with:-
- (a) Indian Electrical Regulations;
 - (b) The Power Companies’ Supply Rules;
 - (c) BS 7671 Requirements for electrical installation, the IEE Wiring Regulations (16th Edition);
 - (d) BS 7375 Distribution of Electricity on Construction and Building Sites;
 - (e) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites; and
 - (f) BS 6164 Safety in Tunnelling in the Construction Industry.

21.2 Design Considerations

- 21.2.1 Distribution equipment utilised within the temporary electrical distribution system shall incorporate the following features:-
- (a) Flexibility in application for repeated use;
 - (b) Suitability for transport and storage;
 - (c) Robust construction to resist moisture and damage; and
 - (d) Safety in use.
- 21.2.2 All cabling shall be run at high level whenever possible and firmly secured to ensure it does not present a hazard or obstruction to people and equipment.
- 21.2.3 The installation on Site shall allow convenient access to authorised and competent operatives to work on the apparatus contained within.

21.3 Distribution of supply

- 21.3.1 The Site mains voltage shall be as the Electricity Utility supplies, 415V 3-phase 4-wire system.
- (a) Single-phase voltage shall be as the Electricity Utility supplies, 240V supply.
 - (b) Reduced voltages shall conform to BS 7375.

21.3.2 The following voltages shall be adhered to for typical applications throughout the distribution systems:

- (a) fixed plant - 415V 3 phase;
- (b) movable plant fed by trailing cable - 415V 3 phase;
- (c) installations in Site buildings - 240V 1 phase;
- (d) fixed flood lighting - 240V 1 phase;
- (e) portable and hand held tools - 110V 1 phase;
- (f) Site lighting (other than flood lighting) - 110V 1 phase; and
- (g) portable hand-lamps (general use) - 110V 1 phase.

21.3.3 When the low voltage supply is energised via the Employer's transformer, any power utilised from that source shall be either 415V 3 phase or / 240V. 1 phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.

21.3.4 Protection shall be provided for all main and sub-circuits against excess current, residual current and earth faults. The protective devices shall be capable of interrupting (without damage to any equipment or the mains or sub-circuits) any short circuit current that may occur.

21.3.5 Earthing and bonding shall be provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises and to ensure that faults are rapidly cleared by installed circuit protection.

21.3.6 Only plugs and fittings of the weatherproof type shall be used and they should be colour coded in accordance with the Internationally recognised standards for example as detailed as follows:

- (a) 110 volts : Yellow
- (b) 240 volts : Blue
- (c) 415 volts : Red

21.4 Cables

21.4.1 Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required. For supply cables up to 3.3kV the cable armouring shall be used as the earth return in conditions where the cable is continuously extended and not subject to continuous movement after installation.

21.4.2 For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to one of the following specifications appropriate to the duties imposed on it:

- (a) BS 6708 flexible cables for use at mines and quarries;
- (b) BS 6007 rubber insulated cables for electric power and lighting; and
- (c) BS 6500 insulated flexible cords and cables.

21.5 Maintenance

21.5.1 Strict maintenance and weekly checks of control apparatus and wiring distribution systems shall be carried out by an electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems. The Contractor shall submit for review by the Engineer details of his maintenance schedule and maintenance works record.

21.5.2 All portable electrical appliances shall be permanently numbered (scarf tag labels or similar) and a record kept of the date of issue, date of the last inspection carried out and the recommended inspection period.

21.6 References

- (a) Indian Electrical Regulations;
- (b) BS EN 60529 Degrees of protection provided by enclosures (IP Code)
- (c) The Power Companies' Supply Rules;
- (d) BS 7671 Requirements for electrical installation the IEE Wiring Regulations (16th Edition);
- (e) BS 7375 Distribution of Electricity on Construction and Building Sites;
- (f) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites; and
- (g) BS 6164 Safety in Tunnelling in the Construction Industry.

22. WELDING AND CUTTING

22.1 General

- 22.1.1 Contractors shall ensure that all welding, cutting and gouging is carried out so that the risks are kept at a minimum. There will be some circumstances when Permits to Work will need to be issued, such as
- (a) working in tunnels;
 - (b) welding over areas where others are working;
 - (c) working in areas with increased fire risks or hazardous environments;
- 22.1.2 All equipment must be in good condition, properly installed and routinely inspected by a competent person, and records must be kept available for inspection by the Engineer.
- 22.1.3 Flexible hoses, cables and connections must be free from damage or risk of damage in service. Cables and hoses shall have adequate carrying capacity.
- 22.1.4 Welders shall wear the correct personal protective equipment which includes the following;
- (a) Face and eye protection with correct grade of shield;
 - (b) Gauntlet gloves;
 - (c) Safety footwear
 - (d) Welders apron or fire retardant overalls;
 - (e) The atmosphere in the vicinity of work must be known to be safe to breathe and free from flammable gases.
- 22.1.5 Adequate ventilation and fume extraction must be provided and used as required by the risk assessment and especially in enclosed areas and pits.
- 22.1.6 Surfaces to be heated by the process must be cleaned of contaminants that may be degraded by heat or give off noxious fumes (e.g. paints, plastics, zinc coating).
- 22.1.7 Naked flames or high temperature surfaces must not be allowed in the vicinity of volatile solvents.
- 22.1.8 All moveable flammable materials must be removed from the vicinity of work and fireproof covers placed over all flammable materials that cannot be removed.
- 22.1.9 During all welding the work piece and any access equipment must be safely secured.

22.2 Oxy-fuel Gas Processes

- 22.2.1 Handle cylinders carefully, keep outside enclosed areas and secure in an upright position. Keep oxygen cylinders away from fuel gas cylinders where possible.
- 22.2.2 Flash back arresters shall be fitted to both the fuel gas and oxygen cylinders;
- 22.2.3 Non return valves shall be fitted to the torch or cutting torch;
- 22.2.4 Ensure screwed fittings and hoses are correct and keep screwed and sealed surfaces free of contaminants, such as oil and grease.
- 22.2.5 Close cylinder valves when flame is extinguished.

- 21.2.6 Ensure any vessel, drum or tank that has contained flammable or toxic substances has been properly cleaned and inspected before subjecting it to hot work.
- 21.2.7 Checks for gas leaks should be carried out using soapy water.
- 21.2.8 Remove all torches from enclosed areas when not in use.
- 21.2.9 Suitable fire extinguisher to be available at all places where hot work is being carried out.
- 21.2.10 Use firewatchers if there is a possibility of ignition unobserved by the operator (e.g. on the other side of bulkheads).

22.3 Arc Cutting, Gouging and Welding Processes

- 22.3.1 Connect the welding current return cable to the work piece close to the arc point or to a well electrically conductive support structure in good contact with the work piece. Also, connect the work piece or the support structure to a separate earth terminal.
- 22.3.2 Take precautions against the risk of increased fume hazards when welding with chrome containing fluxed consumables or high current metal inert gas (MIG) or tungsten inert gas (TIG) processes.
- 22.3.3 Avoid being in contact with water or wet floors when welding. Use duckboards or rubber protection.
- 22.3.4 Provide screens to limit exposure of others to glare from arcs.
- 22.3.5 Use the correct eye and face protection with the correct filter glass.
- 22.3.6 Use a low voltage open circuit relay device if welding with alternating current in constricted or damp places.

22.4 References

Indian Standards.

IS 818: 1961	Code of Practice for safety and health requirements in electric, gas welding and cutting operations.
IS 1179: 1967	Specification for equipment for eye and face protection during welding
IS 5983: 1980	Specification for protective filters for welding, cutting and similar operations.
IS 13416 (Part 5) :1994	Preventative measures against hazards at workplaces – Recommendations Part 5 Fire Protection

British Standards

BS EN 166:1996	Personal eye-protection. Specifications
BS EN 169:1992	Specification for filters for personal eye protection equipment used in welding and similar operations
BS EN 175:1997	Personal protection. Equipment for eye and face protection during welding and allied processes

23. COMPRESSED GASES

23.1 Storage

- 23.1.1 The Contractor shall ensure that all compressed gases, such as oxygen and fuel gases, are stored in a safe manner in keeping with the following requirements.
- 23.1.2 When not in use compressed gas cylinders should preferably be stored in the open air in a well ventilated area at ground level on a firm level surface at least 3m away

from any cellars, drains, excavations or other hollows where vapour may collect. There should be good access to the area, which should be kept clean and clear of combustible material, including wood, packing materials and vegetation. If any protection is provided to prevent cylinders being exposed to the weather, it should be of non-combustible material and should not inhibit ventilation. The area should not be close to any source of heat.

- 23.1.3 If storage in the open air is not reasonably practicable, compressed cylinders must be stored in adequately ventilated storerooms. The storeroom must be constructed of non-combustible material
- 23.1.4 Liquefied Petroleum Gas (LPG) cylinders should be stored separately from oxygen cylinders, other flammable liquids, oxidising materials such as sodium chlorate, and toxic or corrosive substances. Such materials should be kept at least 3 metres away from LPG cylinders.
- 23.1.5 It is important that the valves of so-called 'empty' cylinders are kept closed as well as those of full cylinders and that plugs, shrouds and caps are kept in place on all cylinders. This is necessary not only to prevent the escape of any residual compressed gas into the atmosphere but also to ensure that air is not sucked into the cylinder to form an explosive mixture inside it. All cylinders should be stored with their valves uppermost. Storage of LPG cylinders on their sides is particularly hazardous as in the event of a leaking or inadequately closed valve there is the possibility of leakage of liquid and a consequential release into the atmosphere of far greater quantities of flammable vapour.
- 23.1.6 The storage area should be enclosed by a fence approximately 2 metres in height. The fence should be made of non-combustible material and should not inhibit natural ventilation, particularly at low level - a wire mesh fence is particularly suitable for this purpose. The fence should have at least two means of exit, which should not be adjacent to each other. The gates should open outwards and not be self-locking. Both exits should be unlocked when persons are within the storage compound. At all times when the site is unattended the storage area should be secured.
- 23.1.7 On sites where only small quantities of compressed gas are stored (i.e. less than 300 kg) and it is practicable neither to provide an open air storage compound as described in para 21.1.6 nor a properly constructed storage building cylinders may be kept in a lockable wire cage in a safe place in the open air. Only one exit will be necessary providing there is no risk of a person being trapped in the enclosure. The cage should be clearly marked "Highly Flammable" and notices prohibiting smoking and naked lights should be displayed.
- 23.1.8 Suitable portable first aid fire extinguishers shall be positioned in close proximity to the storage area for use in an emergency.

23.2 Handling Compressed Gas cylinders

- 23.2.1 Cylinders should be handled with care and wherever practicable moved on specially designed trolleys. The valve on a cylinder should not be used for lifting or to lever the cylinder into position. Damage to the valve can result in highly dangerous situations following the escape of gas. For the same reason throwing or dropping cylinders should be prohibited as in such circumstances damage to the valve is even more likely.
- 23.2.2 Before connecting any cylinder or container of compressed gas to equipment it is essential that all fires, flames or other sources of ignition in the vicinity, including cigarettes and pilot lights, are extinguished. Where practicable cylinders should be changed in the open air. The cylinder should be examined and any damaged or

faulty cylinder should NOT be used. No attempt should be made to rectify any fault or damage. The cylinder should be put in a safe place away from other cylinders or combustible materials until returned to the supplier.

- 23.2.3 If a cylinder is found to be leaking and the leak cannot be stopped, the cylinder should be carefully removed to a well-ventilated open space free from sources of ignition. It should be left with the leak, usually at the valve, uppermost, marked faulty and notices displayed prohibiting smoking or other naked lights. General access should be prevented by barriers or otherwise. The supplier of the cylinder should be informed immediately. Under no circumstances should users attempt to dismantle or repair defective cylinders.

23.3 Regulators

Regulators should be suitable for the gas and pressure in use. Checks for leaks at the regulator nuts should be made only by using soapy water. In the event of a defect or of any damage to a regulator, no attempt should be made to repair it. Such repairs should only be carried out by specialists.

23.4 Hoses

Flexible tubing should only be used for final connections to appliances. Flexible hoses should comply with BS 3212, BS 5120 or other nationally recognised standard. They should be additionally protected or of steel braid reinforced construction wherever they might be subject to damage by abrasion and so sited that they are not exposed to excessive heat. The length of hoses should be kept as short as practicable.

23.5 Training and Instruction

Many accidents involving compressed gas are due to ignorance of simple basic precautions. It is essential that all persons using compressed gas are suitably instructed about the hazards and the precautions to be taken in its use

23.6 References

Indian Standards

- IS 2190: 1992 Code of Practice for the selection installation and maintenance of portable first aid fire extinguishers.

24. MACHINERY

24.1 Machinery Fencing

- 25.3.23 The Contractor shall ensure that all gears, revolving shafts, flywheels, couplings and other dangerous parts of machinery shall be effectively guarded unless they are so constructed, installed or placed as to be safe as if they were guarded.

- 25.3.24 Fencing of dangerous parts of machinery shall not be removed while the machinery is in use or in motion. If the fencing is required to be removed for maintenance purposes it shall be replaced before the machine is taken into use.

24.2 Maintenance

- 24.2.1 The Contractor shall ensure that all machinery used on site is in safe condition and is properly maintained and repaired by duly authorised, thoroughly trained and

experienced persons.

24.2.2 No repair to machinery shall be carried out whilst it is in motion unless it is unavoidable.

24.2.3 Maintenance records shall be kept available for inspection by the Engineer.

24.3 Air Receivers

24.3.1 All Air receivers shall be fitted with a pressure relief valve and shall have the safe working pressure clearly marked upon them.

24.3.2 Every air receiver shall be subject to an annual test, which shall be carried out by a duly authorised person. The results of all tests shall be recorded and the records shall be kept available for inspection by the Engineer.

24.3.3 The connection couplers on compressed airlines shall be securely fixed together and have safety chains or be wired at the joints in order to ensure that the joints do not come apart when charged with compressed air.

24.4 Woodworking Machines

24.4.1 All woodworking machines shall be fitted with the following guards and devices;

- (a) Top Guard;
- (b) Riving Knife;
- (c) Guards to protect all drive belts etc.;
- (d) An emergency stop switch easily accessible by the operator;
- (e) A push stick;

24.4.2 Woodworking machines shall be operated only by thoroughly trained and experienced operators.

24.5 Abrasive Wheels

24.5.1 All Abrasive wheel machines shall be fitted with appropriate guards which shall be kept in place at all times the machine is in use.

24.5.2 All abrasive wheel machines shall have the spindle speed clearly marked upon them in revolutions per minute.

24.5.3 Only thoroughly trained and experienced persons are allowed to change the wheels on the machines. Wheels must be inspected and ring tested before mounting to ensure that wheels are free from cracks or defects.

24.5.4 Safety Goggles or Face shields must be worn when grinding or cutting with abrasive wheels.

24.6 References

Indian Standards

IS 7293 : 1974 Safety Code for Working with Construction Machinery

25. HEAVY PLANT OPERATIONS

25.1 General

25.1.1 The Contractor shall ensure that only safe and well-maintained plant and equipment shall be allowed to operate on any of the sites.

25.1.2 All operators of heavy plant such as, earth movers, piling rigs, etc. shall be medically

fit, over eighteen years of age and be thoroughly trained and experienced to operate the equipment.

- 25.1.3 No unauthorised person shall be permitted to ride on plant.
- 25.1.4 The operators shall conduct daily inspections of their respective items of plant with the results of these inspections being recorded and the records kept available for inspection by the Engineer.
- 25.1.5 All mobile heavy plant shall be equipped with at least one 5kg Dry Powder Fire Extinguisher, carried at a suitable position so as to ensure its easy availability.
- 25.1.6 Whenever heavy plant is operating in congested areas, thoroughly trained and experienced banksmen shall be deployed to control the plant and personnel movement and interface.
- 25.1.7 Any waste engine oil and filters following any on site servicing and maintenance shall be removed from the sites and disposed of in an environmentally conscious manner at authorised disposal locations.
- 25.1.8 All drums of fuel oil shall be stored on drip trays or the fuel shall be kept in banded bulk storage fuel tanks, with quantities stored being kept to a minimum.
- 25.1.9 The storage areas shall have dry powder fire extinguishers positioned in close proximity to their location for use in an emergency.

25.2 References

Indian Standards

IS 7293 : 1974	Safety Code for Working with Construction Machinery
IS 2190 : 1992	Code of Practice for the selection, installation and maintenance of portable first aid fire extinguishers.

26. TUNNELLING OPERATIONS

26.1 Procedures

The Contractor shall develop safety procedures and methods of working to be adopted during the course of tunnelling operations. These procedures shall include but not be limited to;

- (a) Shafts and Tunnels Entry Procedure(Including visitors.)
- (b) Blasting operations.
- (c) Atmosphere Monitoring (Oxygen Levels, Explosive Gases, Carbon Monoxide, Hydrogen Sulphide, Oxides of Nitrogen, temperature , humidity, dust etc.) See also Section 15.4 of this Manual.
- (d) Portal Gantry Crane Operating Procedures.
- (e) Emergency Preparedness Plan for the Shaft and Tunnels. (Including liaison with the Emergency Services.)
- (f) Work Train Operating Procedure.
- (g) Tunnel Boring Machine Cutter Head Chamber Entry procedure.

A detailed method statement as outlined in Section 12.2 METHOD STATEMENTS must be produced by the Contractor, and approved by the Engineer before the commencement of any tunnelling operations.

26.2 Sanitation and Drinking Water

- 26.2.1 Unless the worksite is within 500 metres of the portal of the tunnel, sanitation facilities shall be provided. Suitable toilets shall be provided on the scale of one unit for every 50 men on the shift. Toilets shall be effectively and regularly cleaned and

disinfectants provided.

26.2.2 At least 5 litres of clean drinking water shall be provided per person employed on the shift. The water shall be sited near the portal and also inside tunnels over 500 metres in length. The water shall be contained in a clean container with a tight fitting lid.

26.2.3 Washing and cleaning facilities shall be provided for all workers near the portal.

26.3 Lighting

26.3.1 The Contractor shall provide adequate lighting at the face and at any other point where work is in progress. A minimum of 50 lux shall be provided at the face, walkways and similar work areas. When mucking is done by tipping wagons running on trolley tracks a minimum of 30 lux shall be maintained. In all other areas the level of lighting shall not be less than 10 lux.

26.3.2 Emergency lighting shall be installed at the working faces and at 100m intervals along the tunnel to help escape workmen in case of accidents.

26.4 Ventilation

The Contractor shall make provision for adequate ventilation of all shafts and tunnels. The ventilation shall be sufficient to ensure proper dispersal of any dust or fume. (see also Section 15.4)

26.5 Protection Against Fire

26.5.1 As far as practicable, combustible materials shall not be used in the construction of any room or recess containing electrical apparatus.

26.5.2 No flammable material shall be stored in any part of the tunnel unless it is contained in suitable flameproof containers.

26.5.3 An adequate supply of suitable first aid fire fighting equipment shall be kept at convenient locations throughout the tunnel. This equipment shall be tested at least once a month and records kept available for inspection by the Engineer.

26.6 Warning Signals

26.6.1 The Contractor shall install a suitable system of warning signals for the movement of plant and materials within shafts and tunnels.

26.6.2 The system shall be checked daily immediately prior to the commencement of tunnelling work under the supervision of a responsible person.

26.6.3 The Contractor shall make detailed emergency warning signals for cases of fire, tunnel collapse etc.

26.7 References

Indian Regulation

The Maharashtra Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XVII - Excavation and Tunnelling Works

Indian Standards

IS 4756: 1978

Safety Code for Tunnelling Work.

IS 2190: 1992

Code of Practice for the selection, installation and maintenance of portable first aid fire extinguishers.

British Standard

BS 6164: 2001 Code of Practice for safety in tunnelling in the construction industry

27. BLASTING OPERATIONS

27.1 Authorisation for Blasting

27.1.1 The Contractor shall ensure that all blasting operations will only be permitted following consultations with the relevant authorities and subsequent issuing of the permission to blast permits. The Engineer must also give his consent in writing before any blasting operations take place.

27.1.2 All blasting shall be conducted under the direct supervision of a Licensed Shotfirer.

27.2 Risk Assessment and Method Statements

The Contractor shall produce a detailed hazard and risk assessment and an in depth method statement for amongst others the following elements:

- (a) Type of explosives to be used.
- (b) Anticipated effects of vibration on nearby structures.
- (c) Blasting patterns.
- (d) Delivery of the explosives.
- (e) Transportation and storage of explosives on site.
- (f) Drilling and charging of holes.
- (g) Warning sirens.
- (h) Measurement of Vibration
- (i) Provision of sentries.
- (j) Use of blast screens.
- (k) ALL CLEAR.
- (l) Ventilation following blasting.
- (m) Atmosphere monitoring.
- (n) Procedure for miss-fires.

27.3 References

Indian Regulation

The Maharashtra Building And Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XXVI - Explosives.

Indian Standards

IS 4081: 1986 Safety Code for Blasting and related Drilling Operations

British Standards

BS 5607 : 1988 Code of Practice for the safe use of explosives in the construction industry.

28. DEMOLITION

28.1 General

28.1.1 The Contractor shall ensure that all demolition works shall be carried out in a controlled manner under the management of experienced and competent supervision.

28.1.2 Prior to any demolition commencing, a survey shall be conducted to identify if there are any hazardous materials present, for example the presence of materials such as asbestos and lead.

- 28.1.3 If any hazardous materials are found, then consideration shall be given as to whether they shall need to be removed by a Specialist Agency or Sub-contractor prior to the main demolition works commencing.
- 28.1.4 Before the demolition commences all relevant notifications will need to be given to the local authorities and media.
- 28.1.5 Measures for protection to the public shall be required to be put into place in order to give protection from any possible falling debris and dust generation.
- 28.1.6 All power supplies and services shall be disconnected before any demolition work commences.

28.2 References

Indian Regulation

The Maharashtra Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XVI - Demolition

Indian Standards

IS 4130: 1991	Demolition of Buildings – Code of Safety
IS 13416 (Part 3):1994	Recommendations for preventive measures against hazards in the workplace, Part 3, Disposal of Debris

29. FALSEWORK / FORMWORK

29.1 General

- 29.1.1 The Contractor shall ensure that all falsework / formwork has been properly designed and is suitable for the purpose.
- 29.1.2 All designed falsework / formwork shall be erected in strict accordance to the design.
- 29.1.3 Prior to the loading and subsequent striking of falsework / formwork, permission shall be obtained from the Contractor's Designer and Engineer who shall both inspect and sign off on the structure in person.
- 29.1.4 Adequate provision shall be made on the working platforms for the concrete placement operations, these shall include locations for vibrators and the unobstructed movement of personnel controlling the rubber hose during the concrete pumping operations or the concrete skip during any skipping operations.
- 29.1.5 The Contractor should use the following checklist to check that falsework / formwork is being used safely;
- Have the design and the supports for shuttering and falsework / formwork been checked?
 - Is it being erected safely from steps or proper platforms?
 - Are the props plumb and properly set out?
 - Are the bases and ground conditions adequate for the loads?
 - Are the correct pins used in the props?
 - Are the timbers in good condition?
 - Is it inspected by a competent person against the agreed design before permission is given to pour concrete?

29.2 References

Indian Regulation

The Maharashtra Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XXI - Structural frame

and Form Work

30. PILING AND DIAPHRAGM WALLS

30.1 General

- 30.1.1 The Contractor shall prepare safe systems of work and method statements for all work concerned with piling and diaphragm walls. He shall take the following points into consideration.
- 30.1.2 Any excavated piles or panels shall not be left unattended, unless they are adequately fenced around to prevent accidental entry into the immediate vicinity of the pile or panel.
- 30.1.3 Because of the use of heavy plant and equipment in generally congested work areas then trained banksmen shall be deployed to control the movement of the plant and personnel interface.
- 30.1.4 All lifting operations shall be conducted in accordance with the requirements as detailed in Section 18 Lifting Operations.
- 30.1.5 Calcium Oxide shall not be used for stabilising the excavated spoil as it is an acute irritant, unless an agreed method statement has been produced.
- 30.1.6 A method statement shall be produced by the Contractor, which details the process for grab retrieval in the event of a grab becoming detached during the course of a pile or panel excavation.
- 30.1.7 A method statement shall be produced by the Contractor, which details the process for stop end recovery.
- 30.1.8 Wheel washing facilities shall be available on the sites for washing down the spoil removal trucks and the concrete delivery vehicles.
- 30.1.9 Bentonite and polymer storage tanks shall be bunded around to retain any unintentional and uncontrolled spillage.
- 30.1.10 The Contractor shall submit to the Engineer, for approval, proposals for the treatment of Bentonite slurry and its subsequent disposal.
- 30.1.11 No Bentonite spillage shall be allowed on any roads.
- 30.1.12 Regular site cleaning shall be carried out at all work-sites.
- 30.1.13 The Contractor as part of his Emergency Plans shall develop procedures for the collapse of piles and diaphragm walls.

30.2 References

Indian Regulation

The Maharashtra Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XXVII - Piling

Indian Standards

IS 5121: 1969	Safety Code for Piling and other Deep Foundations
IS 8989: 1978	Safety Code for the Erection of Concrete Framed Structures

31. WORK PERMIT SYSTEM

- 6.1 The Contractor shall develop a Work Permit system, which is a formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done, and the precautions to be taken. Work Permits form an essential part of safe systems of work for many construction

activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

6.2 A permit is needed when construction work can only be carried out if normal safeguards are dropped or when new hazards are introduced by the work. Examples of high-risk activities include but are not limited to:

- (i) Entry into confined spaces
- (ii) Work in close proximity to overhead power lines and telecommunication cables.
- (iii) Hot work
- (iv) To dig where underground services may be located
- (v) Work with heavy moving machinery
- (vi) Working on electrical equipment
- (vii) Work with radioactive isotopes
- (viii) Heavy lifting operations and lifting operations closer to live power line

6.3 The permit-to-work system should be fully documented, laying down:

- (i) How the system works;
- (ii) The jobs it is to be used for;
- (iii) The responsibilities and training of those involved; and
- (iv) How to check its operation;

6.4 A Work Permit authorisation form shall be completed with the maximum duration period not exceeding 12 hours.

6.5 A copy of each Permit-to-Work shall be displayed, during its validity, in a conspicuous location in close proximity to the actual works location to which it applies.

32. WORK ADJACENT TO LIVE RAILWAYS

General

Whenever work is to be conducted in close proximity to the live railways then the following measures shall need to be addressed:

- (a) The rules provided for in the Railway's manual shall be followed.
- (b) No persons are allowed to encroach onto the railway unless specific authority has been given by the owner.
- (c) Adequate protection in accordance with the railway owner's requirements shall be followed. (Provision of Block Inspectors, Flagmen and Lookouts.)
- (d) All persons shall wear high visibility clothing at all times.
- (e) Any induction training requirements of the railway owner shall be strictly observed

33. WORK ADJACENT TO LIVE ROADWAYS

33.1 General

Whenever working adjacent to any live roadways then the following aspects shall be considered.

- (a) Close liaison with the Police and Municipal Authorities.
- (b) Production of an agreed traffic management scheme in accordance with the local traffic laws. (Barriers, signs, lights and road markings) this shall include adequate provision for pedestrians.

- (c) The provision and wearing of high visibility clothing by all personnel engaged in the activities.
- (d) Traffic Marshals shall be appointed and deployed to ensure that all road movement is carried out safely.

34. PERSONAL PROTECTIVE EQUIPMENT

34.1 General

34.1.1 The Contractor shall at all times keep and maintain an adequate supply of suitable personnel protective equipment which shall be readily available for use at all times on the sites, and would include amongst others the following items:

- (a) Safety Helmets.
- (b) Hearing Protection.
- (c) Respiratory Protection.
- (d) Eye Protection.
- (e) Protective Gloves.
- (f) Safety Footwear.
- (g) High Visibility Clothing to BS EN 471 Class 3 standard

34.1.2 All sites shall be designated as HARD HAT and SAFETY BOOTS SITES and as such an adequate supply of safety helmets and safety boots shall be kept available for use by all staff, workers and authorised visitors to the sites.

34.1.3 The Contractor shall remove from the site any worker who consistently refuses to wear the appropriate personal protective equipment.

34.1.4 The Contractor shall not pay any cash amount in lieu of PPE to the workers/sub-contractors and expect them to buy and use during work.

34.1.5 The Contractor shall at all time maintain a minimum of 10% spare PPEs and safety appliances and properly record and show to the Employer during the inspections. Failing to do so shall invite appropriate penalty as per the provisions of the contract.

34.2 References

The PPEs and safety appliances provided by the Contractor shall be of the standard as prescribed by Bureau of Indian Standards (BIS). If materials conforming to BIS standards are not available, the Contractor as approved by the Employer shall procure PPE and safety appliances.

Indian Standards

IS 2925 : 1984	Specification for Industrial Safety Helmets.
IS 1179 : 1967	Specification for equipment for eye and face protection during welding.
IS 6994 (Part 1)	Standard for Industrial Gloves

British Standards

BS EN 166:1996	Personal eye-protection. Specifications
BS EN 169:1992	Specification for filters for personal eye protection equipment used in welding and similar operations
BS EN 175:1997	Personal protection. Equipment for eye and face protection during welding and allied processes
BS EN 352:	Hearing protectors. Safety requirements and testing

	352-1: 1993: Ear muffs
	352-2: 1993: Ear plugs
	352-3: 1997: Earmuffs attached to an industrial safety helmet
BS EN 345-1:1993	Safety footwear for professional use
BS EN 471:2003	High visibility clothing

35. FIRST AID

35.1 First Aid Bases

35.1.1 The Contractor shall establish a First Aid Base, in accordance with the Employer's Requirements, at each of his principal work areas. If during the life of the contract the Contractor's principal work area moves from one location to another, the Contractor shall be required to move his First Aid Base.

35.1.2 If the Contractor operates more than one principal work area he will be required to have a First Aid Base at each of his principal work areas.

35.1.3 The First Aid Base shall consist of as a minimum;

- (a) A treatment room fitted with two treatment couches,
- (b) A hand wash basin with running water;
- (c) Lockable cupboards to contain sufficient medical supplies;
- (d) Bed.
- (e) Six Chairs with footrests
- (f) Desk and chair.
- (g) Six Stretchers (Which can be lifted and lowered by a crane.)
- (h) Pillows and blankets.
- (i) Refuse containers.
- (j) Medical dressings. (Bandages, plasters, antiseptic wipes.)
- (k) Eye irrigation sterile solution.
- (l) Paper towels.
- (m) Disposable gloves.

35.1.4 The first-aid unit shall be provided with air conditioning and shall be kept in a clean and tidy state at all times.

35.2 Medical Examination

35.2.1. A qualified Doctor, Nurse and assistant Nurse shall be in attendance at the first aid base during all times when work is being undertaken on the site.

35.2.2. The Contractor shall arrange a medical examination of all his employees including his sub-contractor employees employed as drivers, operators of lifting appliances and transport equipment before employing, after illness or injury, if it appears that the illness or injury might have affected his fitness and, thereafter, once in every two years up to the age of 40 and once in a year, thereafter.

1. The Contractor shall maintain the confidential records of medical examination or the physician authorized by the Employer.
2. No building or other construction worker is charged for the medical examination and the cost of such examination is borne by Contractor employing such building worker.
3. The medical examination shall include:
 - a. Full medical and occupational history
 - b. Clinical examination with particular reference to:
 - (i) General Physique;

- (ii) Vision: Total visual performance using standard orthorator like Titmus Vision Tester should be estimated and suitability for placement ascertained in accordance with the prescribed job standards.
- (iii) Hearing: Persons with normal must be able to hear a forced whisper at twenty-four feet. Persons using hearing aids must be able to hear a warning shout under noisy working conditions.
- (iv) Breathing: Peak flow rate using standard peak flow meter and the average peak flow rate determined out of these readings of the test performed. The results recorded at pre-placement medical examination could be used as a standard for the same individual at the same altitude for reference during subsequent examination.
- (v) Upper Limbs: Adequate arm function and grip
- (vi) Spine: Adequately flexible for the job concerned.
- (vii) Lower Limbs: Adequate leg and foot concerned.
- (viii) General: Mental alertness and stability with good eye, hand and foot coordination.
- c. Any other tests which the examining doctor considers necessary

35.3 Ambulance

A fully equipped ambulance and driver shall be provided at the first aid base during all working hours. The ambulance shall be equipped with emergency life support equipment suitable for application in construction site accidents.

35.4 First Aid Boxes

- 35.4.1 Portable first aid boxes will be maintained fully equipped at each local site offices and work locations where 20 or more persons work at a time. Every first-aid shall be distinctly marked “First-Aid” and is equipped with article specified in schedule – III BOCWR.
- 35.4.2 In each site office and location one employee, suitably trained in first aid, should be available at all working hours for the purpose of attending to emergencies.

35.5 Alcohol and drugs

- a) The Contractor shall ensure at all times that no employee is working under the influence of alcohol / drugs which are punishable under Government regulations.
- b) Smoking at public worksites by any employee is also prohibited as per Government regulations

35.6 HIV/ AIDS prevention and control

- 35.6.1 The Contractor shall adopt the Employer’s Policy on “HIV / AIDS Prevention and Control for Workmen Engaged by Contractors” and the copy of the policy is given in [Appendix No. 4.](#)
- 35.6.2 The Employer will engage a professional agency for implementing the guidelines laid down in the policy and communicate to the Contractor.

- 35.6.3 The Contractor shall extend necessary support to the appointed agency by deputing the workmen to attend the awareness creation programmes.
- 35.6.4 The Contractor shall also extend necessary organizational support to the appointed agency for the effective implementation of the Employers' workplace policy on HIV/AIDS for workmen of the Contractors.
- 35.6.5 As laid down in the policy the Contractor shall identify peer educators (1 for every 100 workers) and refer them for professional training to the Employers' appointed agency for the purpose.
- 35.6.6 The peer educators on completion of the training shall serve as the focal point for any information, education and awareness campaign among the workmen throughout the contract period.
- 35.6.7 The peer educators will be paid a monthly honorarium as fixed by the Employer for rendering his services in addition to his regular duty.
- 35.6.8 The total number of peer educators (1 for 100 workers) shall always be maintained by the Contractor.
- 35.6.9 In case if these peer educators leave the Contractor by creating vacancy, then the Contractor at his own expense train the new replacement peer educator from the Employers' appointed agency for the purpose.
- 35.6.10 It is suggested to the Contractor that due care should be taken to select the peer educators from among the group of workmen so that they remain with the Contractor throughout the contract period.

35.7 References

Indian Regulation

The Maharashtra Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules 2007 : Chapter XXVIII - Medical facilities

36. FIRE PRECAUTIONS

36.1 General

- 36.1.1 The Contractor shall be responsible for supplying and maintaining adequate fire precaution facilities on all his sites. The following minimum standards should be adhered to.
- 36.1.2 The Contractor shall ensure that specially trained personnel are available to deal with fires due to electrical causes, gas explosions etc.
- 36.1.3 A good standard of housekeeping shall be maintained at all times on the sites.
- 36.1.4 No accumulations of rubbish shall be allowed to gather.
- 36.1.5 Combustible scrap and other construction debris should be disposed off site on a regular basis. If scrap is to be burnt on site, the burning site should be specified and located at a distance no less than 12 metres from any construction work or any other combustible material.
- 36.1.6 Signage shall be erected at prominent positions showing the correct use of portable first aid fire extinguishers.
- 36.1.7 Emergency plans and Fire Evacuation plans shall be prepared and issued. Mock drills should be held on a regular basis to ensure the effectiveness of the arrangements.

36.2 Fire Fighting Equipment

- 36.2.1 At various locations around the site clearly visible fire points shall be established for use in an emergency and each fire point should have available as a minimum the following type of equipment:
- (a) Dry Powder Extinguisher.
 - (b) Water Type Extinguisher.
 - (c) Bucket of Sand.
- 36.2.2 Recharging of fire extinguishers and their proper maintenance should be ensured and as a minimum should meet Indian National Standards.
- 36.2.3 Water supply for fire fighting purposes should be provided at the construction site. This may be in the form of static water tank of adequate capacity or a hydrant line with adequate water pressure at outlet points.
- 36.2.4 Sufficient number of fire hoses with branch pipes should be provided at site so that the fire can be controlled until the arrival of the Fire Brigade.
- 36.2.5 The Contractor shall need to give consideration to the provision of adequate fire fighting arrangements within the underground and tunnelling operations including the provision of Fire Service compatible hose connections and emergency lighting.
- 36.2.6 The Telephone Number of the local fire brigade should be prominently displayed near each telephone on site.
- 36.2.7 Supervisors and workmen at the site should be trained in the use of fire fighting equipment provided at the site.

36.3 Storage of Flammable Liquids

- 36.3.1 All flammable liquids shall be kept in a secure fire resistant store protected from electrical sparks welding sparks open flames and smoking.
- 36.3.2 Only such amounts of flammable liquids should be issued as are required for immediate use. Cans for carrying flammable liquids should be leak proof and having proper stopper and clearly marked "FLAMMABLE LIQUID".
- 36.3.3 Rags soaked in paints, kerosene and other flammable liquids should be disposed of daily under supervision. Large quantities of such rags should not be allowed to accumulate.
- 36.3.4 All Diesel fuel storage tanks shall be bunded around in order to control any spillage or leakage that may occur.
- 36.3.5 "NO SMOKING" signs shall be prominently displayed at all areas where flammable materials are stored.

36.4 References

Indian Standards

IS 13416 (Part 5) : 1994	Preventative measures against hazards at workplaces – Recommendations Part 5 Fire Protection
IS 1646: 1997	Code of Practice for fire safety of buildings (general) : Electrical Installations
IS 2190: 1979	Code of practice for selection installation and maintenance of portable first aid fire extinguishers
IS 12349: 1988	Fire Protection – Safety Signs

Also, Part IV of National Building Code of India: 1983

37. SITE PERIMETER HOARDING

37.1 General

- 37.1.1 The Contractor is required to keep the site as safe and secure as possible at all times, this includes the erection of site perimeter Hoarding which shall also deter trespassers both adult and children alike.
- 37.1.2 The Contractor shall provide a solid two metre high securely erected fence be installed around the perimeter of the site, with agreed and guarded access and egress points for both personnel and vehicles.
- 37.1.3 The Site Perimeter Fencing shall be constructed in accordance with the Employer's Requirement and as approved by the Engineer.
- 37.1.4 At each entrance to the site the Contractor shall erect a large billboard warning all persons who enter the site that they are required to wear the appropriate Personal Protective Clothing and that no unauthorised access is allowed.
- 37.1.5 Wherever the fence runs adjacent to the highway with no buffer-zones then the fence shall have traffic warning lights duly affixed to it.
- 37.1.6 Wherever the fence borders on pedestrian footpaths lighting shall be provided to illuminate the pedestrian routes. The positioning of the fence-line shall not reduce the width of the pedestrian footpath to less than 900 mm in order to be able to accommodate disabled persons in wheelchairs.
- 37.1.7 Site perimeter fencing shall be washed at least once a month and repainted at least annually.
- 37.1.8 The site fencing shall need to be inspected on a regular basis in order to ensure that the integrity of the fencing is maintained at all times as far as is practicable.

37.2 References

Indian Standards

- | | |
|-----------------|---|
| IS 13430 : 1992 | Safety During Additional Construction and Alteration to Existing Buildings - Code of Practice |
| IS 9457:1980 | Standard for colours of safety signs |

38. TRAFFIC MANAGEMENT

38.1 General

- 38.1.1 The Contractor shall ensure that all traffic management schemes shall be in accordance with the agreed schemes following consultation with the Local Traffic Police and the Metropolitan and other Authorities in charge of the area.
- 38.1.2 Adequate and clear warning signs shall be displayed at appropriate distances before the commencement of the site workings. In addition prior warning shall be given concerning the location of the approaching site entry and exit points.
- 38.1.3 All traffic signs, barriers, cones and lighting shall be kept maintained and clean at all times.
- 38.1.4 Site vehicles exiting the site shall observe caution at all times; if the vehicles are exiting directly onto the live carriageway then they shall be directed by an identifiable Traffic Controller.
- 38.1.5 Regular inspections of the traffic management schemes shall be conducted by the Contractors in both the daytime and night time hours with the results of these inspections being recorded. These records shall be kept available for inspection by the Engineer.
- 38.1.6 A warning sign as given in General Instruction **MAHA-METRO/SHE/GI/009** shall be installed at all secondary road which merges with the primary road where the

construction work is in progress at sufficient distance before it merges with the primary road so as to alert the road users regarding the 'Metro Work in Progress'.

38.2 Vehicle Control

Traffic Controllers shall be available for directing vehicles that are exiting the sites directly onto the live carriageways. Any vehicles entering the sites that are required to execute reversing manoeuvres shall do so under the strict control of a trained and designated banksman. (Banksman defined as {reversing assistant} is the skilled person who directs the operation of a crane.)

38.3 Spoil Removal

- 38.3.1 Only well maintained and licensed vehicles shall be allowed to be used for the removal of excavated spoil from the sites.
- 38.3.2 All drivers shall be medically fit and in possession of a valid and current driving licence.
- 38.3.3 No vehicles, which are overloaded, shall be allowed to leave the site.
- 38.3.4 Any vehicles leaving the sites carrying loads which are liable to produce airborne contaminants shall prior to leaving the site securely sheet the load over in order to effectively contain any dispersement during transportation on the public highway.
- 38.3.5 Vehicles exiting the site directly onto the live carriageway shall do so under the control of the clearly identified Traffic Controller.
- 38.3.6 Any vehicles that are required to reverse whilst on the site shall do so under the control of a trained banksman.
- 38.3.7 Any vehicles prior to leaving the site shall have their wheels washed and any loose material removed.
- 38.3.8 Any spoil that is removed from the work-sites shall be disposed of only at authorised dumping sites.

38.4 Tow away vehicle

The Contractor shall make arrangements keeping tow away van / manpower to tow away any breakdown vehicle in the traffic flow without losing any time at his cost.

38.5 Cleaning of roads

The Contractor shall ensure the cleanliness of roads and footpaths by deploying proper manpower for the same. The Contractor shall have to ensure proper brooming, cleaning washing of roads and footpaths on all the time throughout the entire stretch till the currency of the contract including disposal of sweepage.

38.6 References

Indian standards

IS 4130: 1991

IS 13416 (Part 3):1994

Demolition of Buildings – Code of Safety

Recommendations for preventive measures against hazards in the workplace, Part 3, Disposal of Debris

39. VISITORS TO SITE

39.1 General

All visitors to site shall report to the Contractors site offices where they shall be issued with appropriate Personal Protective Equipment if they are to go out onto the site work areas. Any visitors going out to the site work areas shall be accompanied at all times by a member of the site personnel.

LIST OF ANNEXURES

Annexure 1 :	Safety, Welfare and occupational health requirement as per BOCW act 1996 and rules 1998 and Maharashtra BOCW rules 2003
Annexure 2 :	Site SHE Plan
Annexure 3 :	Workplace Policy on HIV/AIDS Prevention & Control for Workmen engaged by Contractor's

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<p>ANNEXURE - 1</p>	

Safety, Welfare and Occupational Health requirements as per BOCW Act 1996 and Rules 1998 and Maharashtra BOCW Rules 2003

(This list has been prepared in chronological order with primary importance to Section of Act and secondary importance to Rules)

- S - Refers relevant Sections in BOCWA
- R - Refers relevant Rules in BOCWR
- C - Refers relevant Chapter No. in BOCWR
- P - Refers to relevant rules in BOCWWCR 1998
- G - Refers to relevant rules in Maharashtra BOCWR 2003

SN	Items	Relevant Sections / Rules in BOCWA and BOCWR and MBOCWR 2003
1.	Registration of establishment	R – 23 to 27
2.	Display of registration certification at workplace	R – 26 (5)
3.	Hours of work	S – 28 R – 234 to 237
4.	Register of overtime	S – 28; S – 29 R – 241(1) Form XXII
5.	Weekly rest and payment at rest	R – 235
6.	Night shift	R – 236
7.	Maintenance of workers registers and records	S – 30 R – 238
8.	Notice of commencement and completion	S – 46 R – 239
9.	Register of persons employed as building workers	R – 240
10.	Muster roll and wages register	R – 241(1) (a); Form XVI and XVII

SN	Items	Relevant Sections / Rules in BOCWA and BOCWR and MBOCWR 2003
11.	Payment of wages	R – 248
12.	Display of notice of wages regarding	R – 249
13.	Register of damage or loss	R – 241(1)(a); Form XIX, XX, XXI
14.	Issue of wages book	R – 241(2)(a); Form XXIII
15.	Service certificate for each workers	R – 241(2)(b); Form XXIV
16.	Display an abstract of BOCWA and BOCWR	R – 241(5)
17.	Deduction of welfare cess by the government agencies	P – 4(3)
18.	Annual return	R – 242; Form XXV
19.	Drinking water	S – 32
20.	Latrines and Urinals	S – 33 R – 243
21.	Accommodation	S – 34
22.	Creches	S – 35
23.	First-aid boxes	S – 36 R – 231 and Schedule III
24.	Canteens	S – 37 R – 244
25.	Food stuff and other items served in the canteens	R – 245
26.	Supply of tea and snacks in work place	R – 246
27.	Food charges on no loss no profit basis	R – 247
28.	GBOCWR 2003 welfare Board Rules	
29.	Safety committee	S – 38 R – 208
30.	Safety officer	S – 38 R – 209 and Schedule VII
31.	Reporting of accidents and dangerous occurrences	S – 39 R – 210
32.	Procedure for inquiry in to the causes of accidents	R – 211
33.	Responsibility of employer	S - 44 R – 5
34.	Responsibility of Architects, Project engineer and Designers	R – 6
35.	Responsibility of workmen	R – 8

SN	Items	Relevant Sections / Rules in BOCWA and BOCWR and MBOCWR 2003
36.	Responsibility for payment of wages and compensation	S – 45
37.	Penalties and Procedures	S – 47; S – 55
38.	Excessive noise, vibration etc	R – 34
39.	Fire Protection	R – 35
40.	Emergency action plan	R – 36
41.	Fencing of motors	R – 37
42.	Lifting of carrying of excessive weight	R – 38
43.	Health, Safety and Environmental Policy	R – 39
44.	Dangerous and Harmful Environment	R – 40
45.	Overhead protection	R – 41
46.	Slipping, Tripping, Cutting, Drowning and Falling Hazards	R – 42
47.	Dust, Gases, Fumes, etc	R – 43
48.	Corrosive substance	R – 49
49.	Eye Protection	R – 45
50.	Head Protection and other protection apparel	R – 46; R – 54
51.	Electrical Hazards	R – 47
52.	Vehicular traffic	R – 48
53.	Stability of structure	R – 49
54.	Illumination	R – 50; R – 124
55.	Stacking of materials	R – 51
56.	Disposal of debris	R – 52
57.	Numbering and marking of floors	R – 53
58.	Lifting appliances and gears	C – VII; R – 55 to 81
59.	Runways and Ramps	C – VIII; R – 82 to 85
60.	Working on or adjacent to water	C – IX; R – 86 & 87
61.	Transport and earthmoving equipment's	C – X; R – 88 to 95
62.	Concrete work	C – XI; R – 96 to 107
63.	Demolition	C – XII; R – 108 to 118
64.	Excavation and Tunnelling works	C – XIII; R – 119 to 168
65.	Ventilation	R – 153
66.	Construction, repair and maintenance of step roof	C – XIV; R – 169 to 171
67.	Ladders and Step ladders	C – XV; R – 172 to 174
68.	Catch platform and hoardings, chutes, safety belts and nets	C – XVI; R – 175 to 180

SN	Items	Relevant Sections / Rules in BOCWA and BOCWR and MBOCWR 2003
69.	Structural frame and formworks	C – XVII; R – 181 to 185
70.	Stacking and unstacking	C – XVIII; R – 186 & 187
71.	Scaffold	C – XIX; R – 188 to 205
72.	Cofferdams and Caissons	C – XX; R – 206 to 211
73.	Explosives	C – XXI; R – 212 & 213
74.	Piling	C – XXII; R – 214 to 222
75.	Medical Examination for building and other construction worker, Crane operator and Transport vehicle drivers	R – 81; R – 223(a)(iii) and Schedule XII
76.	Medical examination for occupational health hazards	R – 223(a)(iv)
77.	Charging of workers for Medical Examination	R – 223(b)
78.	Occupational health centres and Medical officers	R – 225 and Schedule X & XI
79.	Ambulance van & room	R – 226 & 227 and Schedule IV & V
80.	Stretchers	R – 228
81.	Occupational health service for building workers	R – 229
82.	Medical examination for occupational health hazards	R – 223(a)(iv)
83.	Emergency care services and emergency treatment	R – 232
84.	Panel of experts and agencies	Central Rule 250
85.	Power of inspectors	Central rule 251 Maharashtra State Rules


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ANNEXURE - 2	

SITE SHE PLAN

Contract No	
Contractor Name	
Project Name	

1.	Project Highlights <ul style="list-style-type: none"> i) Title of the content ii) Contractor Number iii) Brief scope of work iv) Location map/ key plan v) Period of the project
2.	SHE Policy
3.	Site Organisation Chart Chart indicating reporting of SHE personnel
4.	Roles & Responsibility Individual responsibility of the: <ul style="list-style-type: none"> i) Project Manager ii) Construction Manager iii) Construction Supervisors iv) SHE Committee Members v) SHE In charge vi) Site Engineers vii) First Line Supervisors viii) Sub-contractors
5.	SHE Committee <ul style="list-style-type: none"> i) Details - Chairman, Members, Secretary and Employer's representative ii) Procedures for effective conduct of meeting
6.	SHE Training
7.	Subcontractor Evaluation, Selection and Control
8.	SHE Inspection
9.	SHE Audit

10.	Accident Investigation And Reporting Procedures
11.	Occupational Health Measures
12.	Labour Welfare Measures
13.	Risk assessment and mitigation procedures
14.	Safe Work Procedures <ul style="list-style-type: none"> i) Work at Height ii) Structural Steel Erection iii) Launching of segments iv) Floor, Wall Openings and Stairways v) Welding, Cutting and Bracing vi) Lifting appliances vii) Work Permit Systems viii) Electrical Equipments ix) Mechanical Equipments x) Excavation xi) Fire Prevention xii) Hazardous Chemicals and Solvents xiii) Ionising Radiation xiv) Lighting xv) Abrasive Blasting
15.	Work Permit System
16.	List of standard job specific PPEs to be used in the site
17.	Maintenance of Regime for construction Equipment and Machinery
18.	Traffic management
19.	Housekeeping
20.	Environmental Management
21.	Emergency Management
22.	Visitors and Security arrangement

 <p>नागपूर मेट्रो NAGPUR METRO</p>	<p>PUNE METRO RAIL CORPORATION LIMITED</p>
<p>ANNEXURE - 3</p>	

**WORKPLACE POLICY ON HIV/AIDS PREVENTION & CONTROL FOR
WORKMEN ENGAGED BY CONTRACTORS**

“Being mobile in and of itself is not a risk factor for HIV infection. It is the situations encountered and the behaviours possibly engaged in during mobility or migration that increase vulnerability and risk regarding HIV / AIDS.”

UNAIDS, Technical update on ‘Population, Mobility and AIDS’, February 2001, p.5

MAHA-METRO recognizes HIV / AIDS as a developmental challenge and realizes the need to *respond* to it by implementing regular HIV / AIDS prevention programmes and creating a non-discriminatory work environment for HIV infected workmen engaged by contractors. For the purpose of making conscientious, sensitive and compassionate decision in addressing the realities of HIV / AIDS, MAHA-METRO has established these guidelines based on ILO code of practice on HIV / AIDS.

- Creating awareness through professional agency using IEC (Information, Education and Communication) package specially designed for migrant workers.
- Institutional capacity building by training the project implementation team, Safety, Health & Environment (SHE) Managers, establishing linkages for efficient diagnosis and treatment of the affected workers, effective monitoring of implementation and documentation for further learning.
- Establishing peer educators by selecting them in consultation with Contractors and training them through professional agencies so that they become focal point for any information, education and awareness campaigns among the workmen throughout the contract period.
- Promotion of social marketing of condoms through State Aids Control Society


LIST OF SCHEDULES

The following Schedules are given to assist the Contractor's understanding of the Hierarchy of Safety adopted by MMRCL and to give additional advice in support of this Manual.

- | | |
|------------|---|
| Schedule 1 | General instructions |
| Schedule 2 | Examples of Toolbox Talks |
| Schedule 3 | Hierarchies of Safety and Industrial Health for MMRCL Contracts |
| Schedule 4 | Sample Safety Forms |

SCHEDULE 1

GENERAL INSTRUCTIONS

 <p>नागपुर मेट्रो NAGPUR METRO</p>	<p>PUNE METRO RAIL CORPORATION LIMITED</p>
<p>General Instruction: MAHA-METRO/SHE/GI/001</p>	

MINIMUM REQUIREMENTS OF SHE MONITORING AND AUDIO-VISUAL EQUIPMENTS


- For the purpose of minimum requirements of Audio-visual and Other equipment the contracts are categorized into the following groups:

Contract Value (Initial awarded value of contract)	Group
Upto 25 Cr	A
Upto 100 Cr	B
Upto 250 Cr	C
More than 250 Cr	D

- Every contractor falling into the above groups shall provide the following minimum required audio visual aids for conducting weekly review, monthly safety committee and other post review meeting of all fatal and major incidences effectively. These audio-visual equipment's are a must for conducting periodical in-house safety presentations in the training programmes.
- In addition to the above portable hand held digital sound level meter (SLM) and portable hand held digital lux meter are also to be provided.

SN	SHE monitoring and Audio-Visual Equipment details	SHE monitoring and Audio-Visual equipment required for			
		Group A Contract	Group B Contract	Group C Contract	Group D Contract
1.	Portable hand held Digital Sound Level Meter (SLM) Noise Monitoring deleted	1	1	1	1
2.	Portable hand held Digital Lux Meter	1	1	1	1
3.	Laptop Computer with standard configuration including multimedia facilities	1	1	1	1
4.	Colour Printer	1	1	1	1
5.	Computer projector with screen	-	1	1	1

SN	SHE monitoring and Audio-Visual Equipment details	SHE monitoring and Audio-Visual equipment required for			
		Group A Contract	Group B Contract	Group C Contract	Group D Contract
6.	Overhead projector	1			
7.	35mm Camera (For taking accident investigation photos in which case the images cannot be easily altered)	1	1	1	1
8.	Digital camera with flash of minimum 4 mega pixel and video facility	1	1	1	2
9.	Digital still camera with flash of minimum 4 mega pixel	1	2	4	6
10.	Portable loudspeaker (for tool-box talk and emergency purpose)	1	1	2	6
11.	Communication facility like mobile phone, walky-talky etc	For all supervisors and managers/engineers working in Safety, Health & Environment			
12.	Accident investigation Kit containing the following:	1	1	1	2
a)	Chalk piece for marking				
b)	Measuring tape for measuring Flexible tape – 2m length Metal Foot long scale and Metal tape – 30m				
c)	Equipment tags				
d)	Multipurpose Flash light				
e)	Barrier tape of 20m length				
f)	Accident investigation Forms and checklists				
g)	Enough Paper for witness recording and other noting				
h)	Emergency Phone Numbers list				

 <p>नागपुर मेट्रो NAGPUR METRO</p>	<p>PUNE METRO RAIL CORPORATION LIMITED</p>
<p>General Instruction: MAHA-METRO/SHE/GI/002</p>	


ID Card Format
(85 mm x 55mm)

Front side of ID card:

Pune Metro Rail Project	
Company Logo	Name & Address of Main / Sub / Labour contractor
Name: Designation: Blood Group: Valid up to:	Photo

Backside of ID card:

Employee Address: _____
1 This card is the property of "XX"(Main / Sub / Labour Contractor) and must be returned on demand and on transfer / cancellation of employment. 2 A charge will be levied for replacement of the card due to loss or theft
Main contractors' Address


 <p>महाराष्ट्र मेट्रो NAGPUR METRO</p>	PUNE METRO RAIL CORPORATION LIMITED
General Instruction: MAHA-METRO/SHE/GI/003	

SHE Training details for Managers and Supervisors

1. The Law and Safety Statutory requirement Appropriate regulations Duties of employer and employee	2. Policy and Administration Effect of incentive on accident prevention Human relations Consultation Safety Officer: duties, aims, objectives
3. Safety and the Supervisor Safety and efficient production go together Accidents affect morale and public relations	4. Principles of Accident Prevention Attitudes of management, supervision and operations Methods of achieving safe operations Accident and injury causes
5. Site Inspection The role of management Hazard Identification Procedure Records results Follow-up procedures Feedback	6. Human Behaviour Motivating agencies Individual behaviour Environmental effects Techniques of persuasion
7. Site housekeeping Site organization Relationship of site housekeeping to accident occurrence Site access Equipment storage Material stacking Materials handling	8. Health Medical examination Hazard to health on site Sanitation and welfare Protective clothing First Aid/CPR
9. Personal Protective Equipment Eye, face, hands, feet and legs Respiratory protective equipment Protection against ionizing radiation	10. Electricity Appreciation of electrical hazards Power tools Arc welding Low voltage system Lighting and power system on sites ELCB, RRCB, Grounding/Ground fault circuit interrupters (GFCIs)
11. Oxygen and Acetylene Equipment Cylinder storage and maintenance Condition and maintenance of valves, regulators, and gauges	12. Equipment Accidents related to moving parts of machinery Appreciation of principles of guarding


Condition and maintenance of hoses and fittings Pressures	Importance of regular maintenance
13. Transportation	14. Excavations
Transport to and from site Hazard connected with site transport Competent drivers Dumpers Tipping trucks Movement near excavations	Method of shoring Precautions while shoring Precautions at edge of excavations Removal of shoring Sheet steel piling
15. Working platforms, Ladders, and Scaffolding	16. Cranes and other Lifting Machines
Hazards connected with the use of ladders Maintenance and inspection Type of scaffold Overloading Work on roofs Fragile material Openings in walls and floors Use of safety belts and nets	Licensing, certification and training required for operation of cranes Slings methods Signalling Access to crane(s) Maintenance and examination Ground conditions Hazards and accident prevention methods connected with the use of different types of cranes/heavy equipment Crane Lift Plan for all lifts
17. Lifting Tackle	18. Fire Prevention and Control
Slings - single and multi-legged Safe working loads (SWLs) Safety hooks and eyebolts Cause of failure Maintenance and examination	Principle causes determining fire Understanding fire chemistry Fire fighting equipment Fire fighting training
19. Communications	20. Manual Handling
Effective methods of communication (particular interest to non-English speaking workers) Method and preparation of reports Safety committees Safety meeting	Body posture and procedure for lifting, pushing, pulling, dragging, sitting and walking Ergonomics Stretching exercises

[illegible]

 <p>नागपुर मेट्रो NAGPUR METRO</p>	PUNE METRO RAIL CORPORATION LIMITED
General Instruction: MAHA-METRO/SHE/GI/005	

DAYS TO BE OBSERVED FOR CREATING SHE AWARENESS

1 st Monday to Sunday of January	Road Safety Week (Subjected to confirmation from Ministry of Road Transport, Govt. of India every year.)
16 th February	Kyoto Protocol Day
March	Red Cross Month
4 th March	National Safety Day
7 th April	World Health Day
14 th April	Fire Safety Day
April 18 to 22	Earth Week
20 th April	Earth Day
20 th April	Noise Awareness Day
28 th April	ILO World Day for Safety and Health at Work
May 1 to 7	Emergency Preparedness Week
5 th June	World Environmental Day
12 th June	World Day against Child Labours
9 th July	Occupational Health Day
17 th October	World Trauma Day
1 st December	World AIDS Day

 <p>नागपुर मेट्रो NAGPUR METRO</p>	PUNE METRO RAIL CORPORATION LIMITED
General Instruction: MAHA-METRO/SHE/GI/006	

Minimum Requirements of SHE Communication Posters / Signages / Video

- For the purpose of Minimum requirements of SHE Communication Posters / Signages / Video the contracts are categorized into the following groups:

Contract Value (Initial awarded value of contract)	Group
Upto 25 Cr	A
Upto 100 Cr	B
Upto 250 Cr	C
More than 250 Cr	D

- Every contractor falling into the above groups shall prepare a SHE Communication Plan as a part of site specific SHE Plan and shall include the following minimum requirement of Posters / Signages / Video as applicable. In case readymade posters are available in any of the category from National Safety Council, Loss Prevention Association of India or any other safety related organisations they may procure the same and display it. In case the same is not available then the contractors' shall make necessary arrangements to get the posters designed and printed on their own.

All the above are to be detailed in the Site SHE Plan and get an approval from the Employer before displaying the posters.

Table 1: Minimum number of Posters

SN	SHE Poster Title	Min No. of concepts in each title	No. of Posters / Signage / Video			
			Group A Contract	Group B Contract	Group C Contract	Group D Contract
1.	Safety Culture	5	Each 10	Each 50	Each 75	Each 100
2.	Daily Safety Oath	1 English, 1 Hindi	Each 100	Each 200	Each 500	Each 1000
3.	Mandatory PPE Usage					
a)	Signages to display the messages like PPE ZONE, NO PPE ZONE, HARD HAT	2 types of sizes made up of metal sheet to be	Each 25	Each 50	Each 75	Each 200

SN	SHE Poster Title	Min No. of concepts in each title	No. of Posters / Signage / Video			
			Group A Contract	Group B Contract	Group C Contract	Group D Contract
	AREA etc.	mounted at different locations				
b)	Helmet	5	Each 25	Each 50	Each 75	Each 200
c)	Shoe	5	Each 25	Each 50	Each 75	Each 200
d)	Goggles & Ear Protection	5	Each 25	Each 50	Each 75	Each 200
e)	Full Body Harness	5	Each 25	Each 50	Each 75	Each 200
f)	Hi-Vi Jacket	5	Each 25	Each 50	Each 75	Each 200
4.	Emergency Management Plan	5	Each 25	Each 50	Each 75	Each 200
5.	Working at Heights	10	Each 25	Each 50	Each 75	Each 200
a)	Ladder, Stairway, Scaffold - Signages to display the messages like SAFE, UNSAFE, FIT FOR USE, AVOID USE etc.	5 types of sizes made up of metal sheet to be mounted at different locations	Each 25	Each 50	Each 75	Each 200
6.	Site Electricity	5	Each 25	Each 50	Each 75	Each 200
7.	Fire and Explosion	5	Each 25	Each 50	Each 75	Each 200
8.	Crane Safety	5	Each 25	Each 50	Each 75	Each 200
9.	Slings	5	Each 25	Each 50	Each 75	Each 200
10.	Rigging Procedures	5	Each 25	Each 50	Each 75	Each 200
11.	Excavation	5	Each 25	Each 50	Each 75	Each 200
12.	Occupational Health (Mosquito Control, HIV/AIDS awareness, Dust Control, Noise Control, No Smoking/Spitting, etc.)	10	Each 25	Each 50	Each 75	Each 200
13.	First – Aid	3	Each 25	Each 50	Each 75	Each 200
14.	Labour Welfare Measures (Payment of Minimum Wages, Avoidance of Child labour, Signing in the Muster Roll, In case of accidents-what to do? etc	5	Each 25	Each 50	Each 75	Each 200
15.	Importance of “Safety Handbook”	1	25	50	75	200
16.	Traffic Safety (Speed	5	Each 25	Each 50	Each 75	Each 200

SN	SHE Poster Title	Min No. of concepts in each title	No. of Posters / Signage / Video			
			Group A Contract	Group B Contract	Group C Contract	Group D Contract
	limit, safe crossing and working within barricaded area etc.)					
17.	Environmental Monitoring (Spillage of Muck, hazardous material, Improper drainage, water spray for dust containment etc.)	5	Each 25	Each 50	Each 75	Each 200
18.	Video in Hindi on PPE usage – 15 minutes duration	1	-	-	-	1


Note 1: Items mentioned under 17 is video. Items under 3 (a) and 5 (a) are metal signage boards and all other items are posters.

Table 2: Size of Posters / Signages

SN	Item	Size
1.	Posters – Standard	17"x22" –135 GSM 4 Colours Printing
2.	Posters – Special (Wherever required)	17"x22" card laminated FA Poster
3.	Posters - Mega size (Wherever required)	32"x40" Flex FA Poster
4.	First-Aid Booklet	6"x4"
5.	Safety Handbook	6"x4"
6.	Signages	Small : 12"x6" Big : 24"x12"
7.	Road Traffic Sign Boards	Strictly as per Indian Road Congress (IRC) specifications

Table 3: Safety Signage Colour (as per IS 9457)

SN	Type of signage	Colour
1	Mandatory	Blue
2	Danger	Yellow
3	Prohibit	Red
4	Safe conditions	Green

 <p>नागपुर मेट्रो NAGPUR METRO</p>	PUNE METRO RAIL CORPORATION LIMITED
General Instruction: MAHA-METRO/SHE/GI/007	

Experts / Agencies for SHE Services

SN	Organisation	Services
1.	<u>Bureau Veritas Industrial Services (India) Pvt. Ltd.,</u> B-21 & 22, First Floor, Sector-16, NOIDA-201 301 (U.P.) Phone: 0120 - 2515055 Fax: 0120 - 2515248 E-mail: enp.delhi@in.bureauveritas.com	<ul style="list-style-type: none"> • External SHE Audit • SHE Management / Technical Training
2.	<u>Central Labour Institute</u> <u>Post box no: 17851, NSMonkikarMarg</u> <u>Sion, Mumbai- 400 022</u> <u>Tel.: 022- 4092203</u> <u>Fax: 022 – 4071986</u> <u>E-mail: cli@dgfasli.nic.in</u>	<u>SHE Management / Technical Training</u>
3.	<u>Construction Industry Development Council</u> <u>801, 8th Floor,</u> <u>Hemkunt Chambers,</u> <u>89, Nehru Place,</u> <u>New Delhi – 110 019</u> <u>E-mail: cidc@vsnl.com</u>	<u>SHE Management / Technical Training</u>
4.	<u>Delhi Productivity Council</u> <u>1E/10, Swami Ramtirth Nagar</u> <u>New Delhi – 110 055</u> <u>Tel.: 23522835</u>	<u>SHE Management / Technical Training</u>
5.	<u>Det Norske Veritas AS,</u> <u>203, SavitriSadan 1,</u> <u>11 PreetVihar Community Centre,</u> <u>New Delhi-110 092</u>	<ul style="list-style-type: none"> • <u>External SHE Audit</u> • <u>SHE Management / Technical Training</u>

SN	Organisation	Services
	<p><u>Phone: 011-22531502/2253/1503,</u> <u>22427688/22531278</u></p> <p><u>Fax: 011-2253 0247</u></p> <p><u>Website: www.dnv.com</u></p>	
6.	<p><u>Dr AV Baliga Memorial trust</u> <u>Link House, Bagadur Shah Zafar Marg</u> <u>Press Area</u> <u>New Delhi – 110 002</u> <u>Phone: 011 – 23311119</u></p>	<u>HIV / AIDS awareness</u>
7.	<p><u>Dr.Cris Research Centre For Occupational Health & Safety</u> <u>306, Guru Arjuna Dev Bhawan,</u> <u>Ranjit Nagar Complex, New Delhi – 110 008</u> <u>Phone: 9810040406</u> <u>Fax: 011 – 25702929</u> <u>E-mail: team@drcri.com</u> <u>Website: www.drcri.com</u></p>	<ul style="list-style-type: none"> • <u>Ambulance Room & Van</u> • <u>Communication Materials</u> • <u>First-aid box</u> • <u>First-aid Training</u> • <u>HIV / AIDS awareness</u> • <u>ID Card</u> • <u>Medical Facilities</u> • <u>SHE Orientation Training</u>
8.	<p><u>DuPont Safety Resources,</u> <u>E.I. DuPont India Private Limited,</u> <u>Arihant Nitco Park 6th Floor,</u> <u>90, Dr. Radhakrishnan Salai,</u> <u>Mylapore, Chennai-600 004</u> <u>Phone: 044-2847 2800, 2847 3752</u> <u>Fax: 044-2847 3800</u> <u>Mobile: 9381201040</u> <u>Website: in.dupont.com</u></p>	<u>SHE Management Training</u>
9.	<p><u>EQMS INDIA PVT. LTD.</u> <u>304 & 305, 3rd Floor, Rishabh Towers,</u> <u>Plot No. 16, Community Centre,</u> <u>Karkardooma, Delhi - 110092.</u> <u>Phone: 011 - 22374729 / 22374775</u> <u>Fax: 011- 22374662</u> <u>E-mail: eqms@eqmsindia.org</u> <u>Website: www.eqmsindia.com</u></p>	<ul style="list-style-type: none"> • <u>ISO Certification</u> • <u>SHE Management / Technical Training</u>
10.	<p><u>Green Cross Consultants</u> <u>59, 7th Cross, 1st Floor,</u></p>	<u>SHE Management / Technical Training</u>

SN	Organisation	Services
	<u>Jai Bharath Nagar, Bangalore-560 033</u> <u>Phone: 080-2549 6782</u> <u>E-mail: etgrangan@yahoo.com</u>	
11.	<u>HSRTC, PENTASAFE,</u> <u>201, 2nd Floor, Town Centre,</u> <u>AndheriKurla Road, Marol,</u> <u>Andheri (East), Mumbai-400 059</u> <u>Phone: 022-2850 2210/20/50</u> <u>Fax: 022-2850 2260</u> <u>E-mail: training@penta-safe.com</u>	<u>SHE Practical Field Training for</u> <u>Height Safety</u>
12.	<u>Institute of Driving Training & Research,</u> <u>Wazirabad Road,</u> <u>Adjoining Loni Road flyover.</u> <u>New Delhi – 110 094</u> <u>Phone: 011 – 22813474, 22815833</u> <u>Fax: 011 - 22811131</u>	<u>SHE Technical Training for Vehicle</u> <u>Drivers.</u>
13.	<u>Institute for Research, Development & Training</u> <u>of Construction Trades & Management,</u> <u>An Educational Institute, Society and Trust,</u> <u>1st Floor, UVCE Alumni Association Building,</u> <u>K.R. Circle, Bangalore-560 001</u> <u>Phone: 080-22294291/22243257</u> <u>Fax: 080-22243257</u> <u>E-mail: ubrco@vsnl.com</u> <u>Website: www.instructindia.org</u>	<u>SHE Technical /Field Training</u>
14.	<u>International Engineering Company</u> <u>K – 10, South Extension,</u> <u>Part – 2, New Delhi – 110 049</u> <u>Phone: 011 – 26254761, 26258130</u> <u>Mobile: 9312260130</u> <u>E-mail: ashok@intenco.net</u>	<ul style="list-style-type: none"> • <u>Crane and Lifting appliances</u> <u>and Gears Certification</u> • <u>SHE Practical Field Training for</u> <u>Crane Safety</u>
15.	<u>L & T Eutectic</u> <u>32, SivajiMarg, New Delhi – 110 015</u> <u>Phone: 011 - 51419538, 51419539</u> <u>Fax: 011 - 51419600</u> <u>Website: www.lnteutecticwelding.com</u>	<u>SHE Practical Field Training for</u> <u>Welding Safety</u>

SN	Organisation	Services
16.	<u>Loss Prevention Association of India Ltd.</u> <u>Warden House,</u> <u>Sir P.M. Road,</u> <u>Mumbai – 400 001</u> <u>Website: www.lpaindia.org</u>	<u>SHE Management / Technical Training</u>
17.	<u>MFA Crucial Moments Healthcare Pvt. Ltd.,</u> <u>42, Okhla Industrial Estate, Phase – II</u> <u>New Delhi – 110 020</u> <u>Phone: 011 – 55624000</u> <u>Fax: 011 – 55624010</u> <u>E-mail: contact@crucialmoments.net</u>	<u>First-aid Training</u>
18.	<u>Modicare Foundation</u> <u>4 Community Centre, New Friends Colony,</u> <u>New Delhi – 110 065</u> <u>Phone: 011 – 5167235059</u> <u>Fax: 011 – 26915469</u> <u>E-mail: nivedita@modi.com</u> <u>nivedita@gmavil.com</u> <u>Website: www.modicarefoundation.org</u>	<u>HIV / AIDS awareness</u>
19.	<u>National Safety Council</u> <u>HQ and Institute Building</u> <u>98A, Sector 15, industrial Area</u> <u>C.B.D Belapur, Navi Mumbai – 400614</u> <u>Phone: 27579924</u>	<u>SHE Management / Technical Training</u>
20.	<u>NICMAR (National Institute of Construction Management and Research)</u> <u>910,9th Floor, Hemkunt Chambers,</u> <u>89, Nehru Place,</u> <u>New Delhi – 110 019</u> <u>Phone: 011 – 51618415, 51618417, 51618418</u> <u>Fax: 011 – 51618416</u>	<u>SHE Management / Technical Training</u>
21.	<u>Quality Growth Services Pvt. Ltd.</u> <u>H-13, Kirti Nagar,</u> <u>New Delhi – 110 015</u> <u>Fax: 011 – 25431737 / 25438598 / 25918332</u> <u>E-mail: qgs@qgspl.com</u>	<u>ISO Certification</u>

SN	Organisation	Services
	<u>Website: www.ggspl.com</u>	
22.	<u>Safety Engineers Association / Safety Educational Trust – India</u> <u>2/257, First Floor, Dr.Ambedkar Nagar,</u> <u>Manapakkam, Chennai – 600 116</u> <u>Phone: 044 – 22523461</u> <u>E-mail: safetrustindia@rediffmail.com</u>	<u>SHE Management / Technical Training</u>
23.	<u>SHE Management Consultancy & Support Services,</u> <u>145 A, Pocket-VI, (DDA Flats),</u> <u>KondliGharoli, MayurVihar-II,</u> <u>Delhi-110 096</u> <u>Fax: 011-2262 5015</u> <u>Mobile: 9811153873</u> <u>E-mail: r k p@vsnl.net</u>	<u>SHE Management / Technical Training</u>
24.	<u>St. Johns' Ambulance</u> <u>Red Cross Road</u> <u>New Delhi – 110 001</u>	<u>First-aid Training</u>
25.	<u>Vexil Business Process Services Pvt. Ltd.</u> <u>208, A/4, Savitri Nagar,</u> <u>New Delhi – 110 017</u> <u>Mobile: 9350232714, 98102832201,</u> <u>9350232716</u> <u>E-mail: info@vexilbps.com</u> <u>Website: www.vexilbps.com</u>	<ul style="list-style-type: none"> • <u>Emergency Preparedness Mock drill</u> • <u>SHE Management / Technical Training</u>
26.	<u>Welding Research Institute</u> <u>Bharat Heavy Electricals Ltd. (BHEL)</u> <u>Trichirappalli,</u> <u>Tamil Nadu – 620 014</u> <u>Phone: 0431 – 2577029, 2577283</u> <u>Fax: 0431 – 2520770</u> <u>E-mail: wri@bheltry.co.in</u>	<u>SHE Practical Field Training for Welding Safety</u>

PUNE METRO RAIL CORPORATION LIMITED

General Instruction: MAHA-METRO/SHE/GI/008

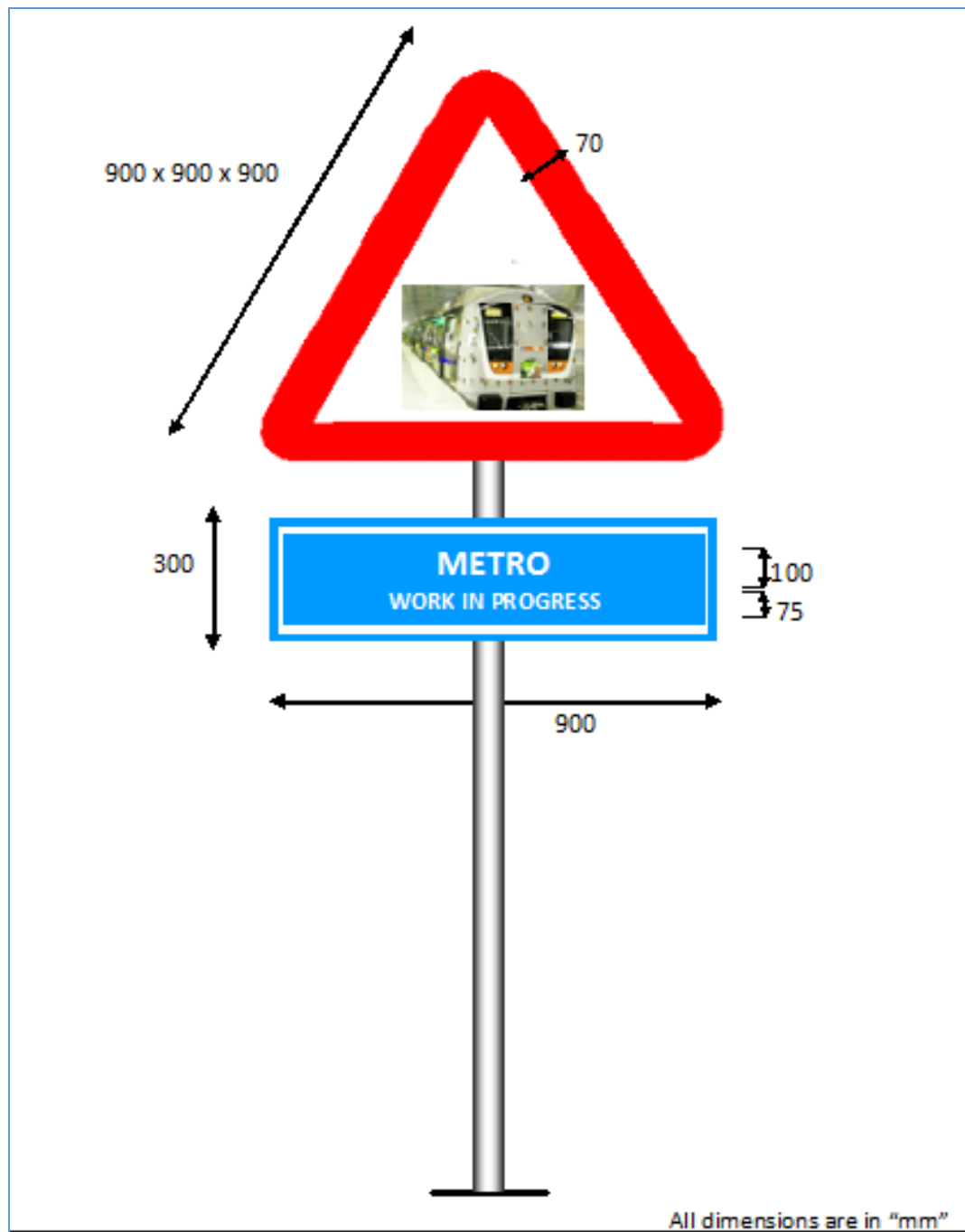
Minimum Lighting Requirements

SN	Facility or Function	Luminance – lx (lm/ft ²)
1.	<u>Administrative areas (offices, drafting and meeting rooms, etc.)</u>	<u>540 (50)</u>
2.	<u>Construction areas</u> <ul style="list-style-type: none"> <u>general indoor</u> <u>general outdoor</u> <u>tunnel and general underground work areas (minimum 110 lux required at tunnel and shaft heading during drilling, mucking and scaling)</u> 	<u>55 (5)</u> <u>33 (3)</u> <u>55 (5)</u>
3.	<u>Access ways</u> <ul style="list-style-type: none"> <u>exit ways, walkways, ladders, stairs</u> 	<u>110 (10)</u>
4.	<u>Maintenance / Operating areas / shops</u> <ul style="list-style-type: none"> <u>vehicle maintenance shop</u> <u>carpentry shop</u> <u>outdoors field maintenance area</u> <u>refueling area, outdoors</u> <u>shops, fine details work</u> <u>shops, medium detail work</u> <u>welding shop</u> 	<u>325 (30)</u> <u>110 (10)</u> <u>55 (5)</u> <u>55 (5)</u> <u>540 (50)</u> <u>325 (30)</u> <u>325 (30)</u>
5.	<u>Mechanical/electrical equipment rooms</u>	<u>110 (10)</u>
6.	<u>Hoists, Elevators, freight and passenger</u>	<u>215 (20)</u>
7.	<u>Warehouses and storage rooms/area</u> <ul style="list-style-type: none"> <u>indoor stockroom, active/bulk storage</u> <u>indoor rack storage</u> <u>outdoor storage</u> 	<u>110 (10)</u> <u>270 (25)</u> <u>33 (3)</u>
8.	<u>Health Centers and First aid stations and infirmaries</u>	<u>325 (30)</u>
9.	<u>Toilets, wash and dressing rooms</u>	<u>110 (10)</u>
10.	<u>Work areas – general (not listed above)</u>	<u>325 (30)</u>
11.	<u>Parking areas</u>	<u>33 (3)</u>
12.	<u>Visitor areas</u>	<u>215 (20)</u>
13.	<u>Laboratories</u>	<u>540 (50)</u>

PUNE METRO RAIL CORPORATION LIMITED

General Instruction: MAHA-METRO/SHE/GI/009

Warning Traffic Sign



SCHEDULE 2

EXAMPLES OF TOOL BOX TALKS

The purpose of the following Toolbox Talks is give guidance on the subject matter to be covered during the talk. The talk should be given to groups of workers no greater than twenty in number by their supervisor. Each talk should last between ten and fifteen minutes. An attendance sheet of each talk should be kept showing who presented the session, the workers who attended, and the duration. Form SAF 031 Safety Training Attendance Record should be used for this purpose.

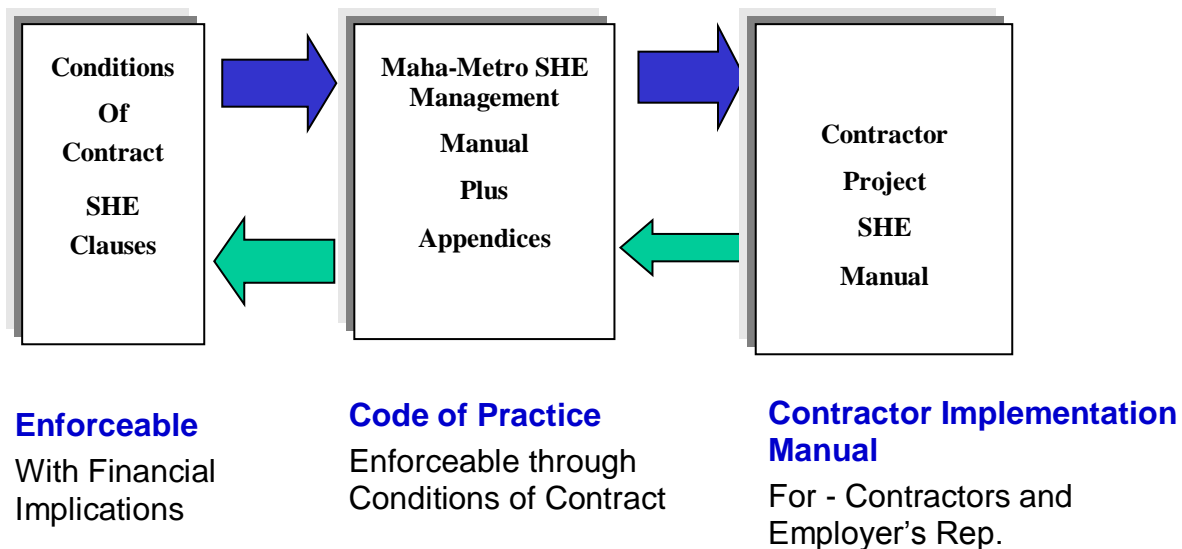
The following list shows the subjects that can be covered, but not limited to:

1. Personal Points (listed below)
2. Personal Protective Equipment
3. Manual Handling
4. Hand Tools
5. Woodworking Machinery
6. Ladders
7. Cartridge Tools
8. Compressed Air
9. Oxygen
10. Compressed gas Cylinders
11. Drilling Machines
12. Pre-permit activation job specific toolbox talk
13. Excavation
14. Electrical safety
15. Situational awareness
16. Other topics

PUNE METRO RAIL CORPORATION	TOOL BOX TALK NO 1
PERSONAL POINTS	
<ul style="list-style-type: none"> • Never take chances. • Carry out the instructions you have been given. • If you do not know or understand - Ask. • If you see an unsafe condition - Rectify it or report it. • If you have an accident make sure you report it and get it properly attended to. • Obey all safety signs and rules. • Do not distract others or “horseplay” around • Only operate plant and equipment that you are authorised to. • Never operate machinery unless all the guards are in place. • Always wear the protective clothing and equipment that you have been provided with. • Keep your work place clean and tidy. • Look after your tools, don't leave them on the ground where they can be damaged or where people can fall over them. 	

SCHEDULE 3

HIERARCY OF SAFETY HEALTH & ENVIRONMENTAL FOR MMRC CONTRACTORS



SCHEDULE 4

SAMPLE SAFETY FORMS

The purpose of this schedule is to provide a set of standardised forms for the Contractor to use when reporting information to the Engineer. The Contractor is free to adapt the forms for his own use, however when the form is being used to transmit information to the Engineer it must contain, as a minimum, the information shown on the following forms.

List of Forms:

SAF 001	Accident / Incident / Dangerous Occurrence Report Form
SAF 002	Accident Report - Injury Analysis Form
SAF 003	Accident Statistics – Monthly Report Form
SAF 004	Contractor's Monthly Safety Report
SAF 006	Formation of Site Safety Committee
SAF 007	Minutes of SHE Committee Meeting
SAF 010	Permit to Work – Confined Spaces
SAF 011	Permit to Work – Electrical
SAF 012	Permit to Work – Hot Work
SAF 020	Risk Assessment Work Sheet
SAF 021	Hazardous Substance Assessment Sheet
SAF 030	Site Safety and Emergency Standby Name List
SAF 031	Safety Training Attendance Record
SAF 032	Weekly Fire Fighting Equipment Check List
SAF 033	Scaffold Inspection Checklists
SAF 040	Contractor's Application for Approval of Safety Manager to Work

PUNE METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE :	SAF - 001
ACCIDENT/INCIDENT/DANGEROUS OCCURRENCE REPORT FORM		Accident No.
Name of Contractor		Contract No.
Instructions: <ol style="list-style-type: none"> 1. A copy of this form shall be completed for every Accident and Dangerous Occurrence. 2. It must be signed by a senior site management representative. 3. A copy shall be sent to the Engineer within 24 hours of the Accident. 		
Part A : Details of Injured Person		
Name : _____ Date of Birth : _____ Male <input type="checkbox"/> Female <input type="checkbox"/> Address : _____ _____ Job Title : _____ Name of Employer : _____		
Part B : Details of The Accident (use additional paper as necessary)		
Date : _____ Time : _____ Location : _____ ➤ Describe the task the injured person was doing at the time of the accident: ➤ Describe in details how the accident happened (Attach, sketch, plan photographs etc.): ➤ Was any plant or machinery involved yes/no : if yes give details: ➤ Name of any Witnesses:		
Part C : Details of the Inquiry		
What was the Injury ? (eg. Fracture, Lacerations) What part of the body was injured? Was the injury : Fatal <input type="checkbox"/> Major Injury <input type="checkbox"/> Minor Injury <input type="checkbox"/> Was the injured person sent to ; First Aid <input type="checkbox"/> Doctor <input type="checkbox"/> Hospital <input type="checkbox"/> Home <input type="checkbox"/> (If doctor or hospital, provide doctors/hospital reports say if/when the employee can return to work)		
Part D : Certification		
I have checked the above information and can confirm that it is a true record of the accident Signed _____ Safety Officer Date _____ Signed _____ Project Manager Date _____		

PUNE METRO RAIL CORPORATION		SAMPLE SAFETY FORM REFERENCE:		SAF - 002	
ACCIDENT REPORT – INJURY ANALYSIS FORM				ACCIDENT No	
NAME OF CONTRACTOR			CONTRACT NO		
Name of Injured Employer		Date of Birth / /		Male <input type="checkbox"/> Female <input type="checkbox"/>	
Address: _____					
Job Title: _____			Name of Employer: _____		
Date of Accident: __ / __ / __ Time: _____ hrs. Location: _____					
Cause of Accident					
<input type="checkbox"/> 01 Machinery	<input type="checkbox"/> 05 Falling objects	<input type="checkbox"/> 08 Hot or corrosive substances	<input type="checkbox"/> 11 Handling goods or equipments		
<input type="checkbox"/> 02 Electricity	<input type="checkbox"/> 06 Stepping on or Striking against objects	<input type="checkbox"/> 09 Gassing poisoning & other toxic substances	<input type="checkbox"/> 12 Transport		
<input type="checkbox"/> 03 Hand Tool	<input type="checkbox"/> 07 Falls of person	<input type="checkbox"/> 10 Explosions or fires	<input type="checkbox"/> 13 Miscellaneous		
<input type="checkbox"/> 04 Foreign Body in eye					
Severity of Injury					
<input type="checkbox"/> 01 First Aid	<input type="checkbox"/> 02 Medical Aid	<input type="checkbox"/> 03 Three days or less	<input type="checkbox"/> 04 Over or three days		
<input type="checkbox"/> 05 Discharged	<input type="checkbox"/> 06 Detained	<input type="checkbox"/> 07 Fatal	<input type="checkbox"/> 08 Days Lost		
Nature of Injury					
<input type="checkbox"/> 01 Amputation	<input type="checkbox"/> 05 Crush / Compression	<input type="checkbox"/> 09 Foreign Body (eye	<input type="checkbox"/> 13 Sprain/Strain		
<input type="checkbox"/> 02 Cut	<input type="checkbox"/> 06 Contusion / Bruise	<input type="checkbox"/> 10 Foreign Body (other)	<input type="checkbox"/> 14 Inhalation / Ingestion		
<input type="checkbox"/> 03 Location	<input type="checkbox"/> 07 Fracture	<input type="checkbox"/> 11 Puncture	<input type="checkbox"/> 15 Concussion		
<input type="checkbox"/> 04 Abrasion	<input type="checkbox"/> 08 Dislocation	<input type="checkbox"/> 12 Scald / Burn	<input type="checkbox"/> 16 Others		
Part of Body Injured (ENTER IN ORDER OF SERIOUSNESS)					
HEAD AND SHOULDER		TRUNK		UPPER EXTREMITIES	
<input type="checkbox"/> 01 Skull <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 11 Back <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 18 Shoulder <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 26 Hip/Buttock <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<input type="checkbox"/> 02 Scalp & Forehead <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 12 Chest <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 19 Upper arm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 27 Thigh <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<input type="checkbox"/> 03 Eye <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 13 Abdomen <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 20 Elbow <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 28 Knee <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<input type="checkbox"/> 04 Ear <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 14 Groin <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 21 Forearm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 29 Shank <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<input type="checkbox"/> 05 Nose <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 15 Respiratory System- <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 22 Wrist <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 30 Ankle <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<input type="checkbox"/> 06 Mouth, teeth, jaw <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 16 Digestive System <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 23 Hand & Figures <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 31 Heel/Sole/Instep <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<input type="checkbox"/> 07 Face & Cheek <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 17 Others <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 24 Thumb <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 32 Toes <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<input type="checkbox"/> 08 Neck & Shoulder <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> 25 Others <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 33 Others <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<input type="checkbox"/> 09 Brain <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 10 Others <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>				
Unsafe Conditions					
<input type="checkbox"/> 01 Rough Slippery	<input type="checkbox"/> 06 Improper dress	<input type="checkbox"/> 11 Inadequate procedure	<input type="checkbox"/> 14 Unsafe Process or Poor House Keeping		
<input type="checkbox"/> 02 Design effect	<input type="checkbox"/> 07 Improper guard	<input type="checkbox"/> 12 Inadequate aisle space job methods, exits etc	<input type="checkbox"/> 15 Overloading		
<input type="checkbox"/> 03 Worn frayed	<input type="checkbox"/> 08 Improper ventilation	<input type="checkbox"/> 13 Unsafe planning & / or layout.	<input type="checkbox"/> 16 Poor House Keeping		
<input type="checkbox"/> 04 No protective gear	<input type="checkbox"/> 09 Improper illumination		<input type="checkbox"/> 17 No unsafe conditions		
<input type="checkbox"/> 05 Defective protective gear	<input type="checkbox"/> 10 Improper procedure of job traffic or process operation etc.				
Personal Factor					
<input type="checkbox"/> 01 Attitude	<input type="checkbox"/> 02 Knowledge or skill person	<input type="checkbox"/> 03 Physical Defects	<input type="checkbox"/> 04 Unsafe Act by another	<input type="checkbox"/> 05 No unsafe personal factor	
Unsafe Act					
<input type="checkbox"/> 01 Operating without authority	<input type="checkbox"/> 05 Using unsafe equipment	<input type="checkbox"/> 06 Taking unsafe position or	<input type="checkbox"/> 09 Failure to use safe attire or		
<input type="checkbox"/> 02 Failure to secure or warn/ hands instead of posture personal protective equipment			<input type="checkbox"/> 10 Horseplay ,		
<input type="checkbox"/> 03 Making safety devices equipment / or equipments		<input type="checkbox"/> 07 Operating or working at	<input type="checkbox"/> 11 No unsafe act dangerous Equipment mixing		
<input type="checkbox"/> 04 Working on moving or unsafely		<input type="checkbox"/> 08 Unsafe loading, placing			
How would a similar accident be avoided?					
What has been done to prevent similar accidents?					
Comments:					
Safety Officer		Sign:	Name:	Date:	
Project Manager		Sign:	Name:	Date:	

PUNE METRO RAIL CORPORATION		SAMPLE SAFETY FORM REFERENCE:	SAF- 003
ACCIDENT STATISTICS – MONTHLY REPORT FORM			
NAME OF CONTRACTOR		CONTRACT NO	
REPORT FOR MONTH ENDING:			
COMMENCEMENT DATE:		SCHEDULED COMPLETION DATE:	
	ACCIDENT STATISTICS SUMMARY	FOR MONTH	CUMULATIVE
1.	Number of Manhours Worked		
2.	Number of Mandays Worked		
3.	Number of Reportable Fatal Accidents		
4.	Number of Reportable Non-Fatal Accidents		
5.	Number of Dangerous Occurrences		
6.	Number of Manhours Lost		
7.	Number of Mandays Lost		
8.	Number of Reportable Accidents per 100,000 Manhours Worked= $\left\{ \frac{[(3) + (4)]}{\text{Accident Frequency Rate}} \right\} \times 100,000 = (1)$		
9.	Average Number of Worker Daily		
REMARKS:			
Signed: _____ Safety Officer: _____ Date: / / Signed: _____ Project Manager: _____ Date: / /			
NOTE: This form must be completed and returned to the Engineer within 5 days after the end of each month.			

PUNE METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE:	SAF - 004
CONTRACTORS MONTHLY SAFETY REPORT		
NAME OF CONTRACTOR		CONTRACT NO.
<p>This report which shall be submitted to the Engineer within five days of the end of each month consists of two sections; Part A. and Part B.</p> <p>PART A: Accident Statistics</p> <ol style="list-style-type: none"> 1. Accident Statistics which shall be presented in the format shown on the Accident Statistics Monthly Report Form (SAF 003) 2. Highlights of serious accidents which have occurred during the Month. 3. Details of any Fires which have occurred during the Month. <p>PART B: Safety Activities</p> <ol style="list-style-type: none"> 1. Safety Committee. An extract of the salient points of the last month's meeting and any action taken. 2. Details of Tool Box Talks held during the month to include: <ul style="list-style-type: none"> • numbers up to date, • total number of workers attending each talk, • the safety topics covered, 3. Details of any other training provided either on site or by attendance to outside courses such as First-Aid, Crane Operator, Singer/Rigger's etc. 4. Safety promotion undertaken during the month, poster campaigns, competitions, etc. 5. Details of Safety Inspections carried out during the month. This information should show internal inspections and inspections by any outside bodies. 6. Details of Emergency Evacuation drills or exercises carried out during the month including the involvement, if any, of outside bodies. 7. Any other relevant information. 		

SAF – 006 : FORMATION OF SITE SHE COMMITTEE					
Contract No.					
Contractor Name					
Contract Title					
CIRCULAR					
<p>Committee</p> <p>The following SHE Committee is constituted with immediate effect:</p> <p>Chairman:</p> <p>Members:</p> <ol style="list-style-type: none"> 1. 2. 3. 4. 5. <p>Secretary</p>					
<p>Periodicity</p> <p>The committee will meet at least once in a month on the day (specify date)</p>					
<p>Agenda</p> <p>Secretary will circulate agenda of the meeting at least two days in advance of the schedule date of the meeting.</p>					
<p>Circulation</p> <p>Gist of the meeting will be minuted in the standard format and circulated to the following under the signature of the secretary</p> <table style="width: 100%;"> <tr> <td style="width: 50%;">1. Chairman</td> <td style="width: 50%;">3. MAHA-METRO Representatives</td> </tr> <tr> <td>2. Members</td> <td>4. Others concerned</td> </tr> </table>		1. Chairman	3. MAHA-METRO Representatives	2. Members	4. Others concerned
1. Chairman	3. MAHA-METRO Representatives				
2. Members	4. Others concerned				
<p>Date: _____ Signed By: _____</p> <p style="text-align: right;">CHAIRMAN</p>					

SAF – 007 : MINUTES OF SHE COMMITTEE MEETING		
Contract No.		
Contractor Name		
Contract Title		
Meeting No.		Date of Meeting
Location of Meeting		

MEMBERS PRESENT	INVITEES	MEMBERS ABSENT

REPORT SENT TO					
No. of Copies	Name / Dept.	No. of Copies	Name / Dept.	No. of Copies	Name / Dept.
Prepared by:		Location:		Date:	

MINUTES OF SHE MEETING

Item No.	Description of Discussion	Action By	Target	Remarks
1	Complaints received from Clients and corrective and preventive action			
2	Review of MOM of previous meeting			
3	NCR's / Observation from third party			
4	First - Aid cases / Reportable accident cases			
5	Future jobs and specific requirement			
6	Status of implementation of Safety plan			
7	Sub-contractor performance			
8	Analysis of first-aid cases			
9	Need for any specific system / training / PPE's / resources			
10	Observation of SHE committee during last walk down			

Next SHE Meeting is scheduled on:

Date:	Chief SHE Manager (Signature & Name)
Date:	Project Manager (Signature & Name)

PUNE METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE :	SAF - 010
PERMIT TO WORK – CONFINED SPACES		
NAME OF CONTRACTOR		CONTRACT NO
PERMIT NO. CF		DATE / /
PART 1. ISSUE		
Issue to (Name of Person) _____		Section _____
Details of Confined Space _____		
Location _____		
Work to be carried out _____		
Results of Confined Space Testing: _____		
Oxygen Content _____	Explosive Gas _____	LEL _____
Toxic Gas 1: _____	Toxic Gas 2: _____	
Date and Time Tests Conducted _____		
Type and Model of Equipment used _____		
Precautions Required _____		
<p>I hereby declare that the above Confined Space is safe to enter without the use of breathing apparatus, provided the conditions of this permit and the requirements of the Company Safety Rules and observed.</p> <p>THIS PERMIT ONLY VALID FOR THE PERIOD SPECIFIED, WHICH MUST NOT EXCEED 24 HOURS</p> <p>Date: _____ Time of Issue: _____ Date: _____ Time of Expiry _____</p> <p>Signed _____</p> <p>Being the Authorised Person (Confined Spaces)</p>		
PART 2. RECEIPT		
<p>I hereby declare that work by myself, or by any person under my control in the above Confined Space shall be carried out in accordance with the conditions of this permit and the requirements of the company Safety Rules. All persons permitted to enter the Confined Space have been or will be informed of when the safe period for entry will expire.</p> <p>Signed _____ Time _____ Date _____</p> <p>Being the Competent Person (Confined Spaces)</p>		
PART 3. CLEARANCE CERTIFICATE		
<p>I declare that all persons under my charge have been withdrawn and warned that it is no longer safe to work in the Confined Space detailed above, and that all gear, tools and other equipment have been removed.</p> <p>Signed _____ Time _____ Date _____</p> <p>Being the Competent Person (Confined Spaces)</p>		
PART 4. CANCELLATION		
<p>I acknowledge receipt of the clearance of the Permit</p> <p>THIS PERMIT IS NOW CANCELLED</p> <p>Signed _____</p> <p>Being the Authorized Person (Confined Spaces)</p> <p>Time _____ Date _____</p>		

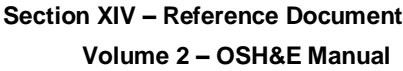
PUNE METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE :	SAF – 011
PERMIT TO WORK – ELECTRICAL		
Name of Contractor		Contract No.
PERMIT NO. E: _____ Date _____		
<p>Part 1 : Issue</p> <p>Issue to _____</p> <p>I hereby declare that it is safe to work on the following apparatus which is dead, is isolated from all live conductors and is connected to earth</p> <p>_____</p> <p>The apparatus is efficiently connected to earth at the following points _____</p> <p style="text-align: center;">All other apparatus is dangerous</p> <p>The following is the work to be carried out on the Apparatus.</p> <p>_____</p> <p>Caution Notices are posted at _____</p> <p>Special Keys required for access to enclosures _____</p> <p>Special Precautions to be taken _____</p> <p>This permit is valid only for the specified period which must not exceed 24 hours</p> <p>Signed _____ being an Authorized Person</p> <p>Possessing authority to issue a Permit for the work specified above.</p> <p>Time of issue _____ Date _____ Time of Enquiry _____</p>		
<p>Part 2 : Receipt</p> <p>I hereby declare that I accept responsibility for carrying out the work on the apparatus detailed on this permit, and that no attempt will be made by me, or by the men under my control, to carry out work on any other apparatus.</p> <p>Signed _____ Time _____ Date _____</p>		
<p>Part 3 : Clearance Certificate</p> <p>I hereby declare that the work for which this permit was issued is now suspended/completed and that all men under my charge have been withdrawn, and warned that it is no longer safe to work on the apparatus specified on this permit and that gear, tools and temporary earthing connections are all clear.</p> <p>I acknowledge return of authorised Key Nos _____</p> <p>Signature of person responsible for issue of permit _____</p> <p>Time _____ Date _____</p>		

PUNE METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE:	SAF - 012
PERMIT TO WORK – HOT WORK		
NAME OF CONTRACTOR	CONTRACT NO.	
PERMIT NO. HW: _____ Date _____		
Part 1: Issue Issue to (Name of person) _____ Section _____ Details of Hot Work _____ Location _____ Work to be carried out _____		
I hereby declare that the above Hot Work is safe to carry out and that all appropriate fire precautions are in place including the issue of additional 5 kg Dry Powder Extinguisher on site and that all Company Safety Rules have been observed. Date: _____ Time of Issue _____ Time of Expiry _____ This permit is valid only for the period specified which must not exceed 24 hours Signed _____ Time _____ Date _____ Being the Authorized Person (Hot Work)		
Part 2 : Receipt I hereby declare that the work by myself, or by any person under my control or the above Hot Work shall be carried out in accordance with the conditions of this certificate and the requirements of the company Safety rules. All persons permitted to work on this Hot Work have been or will be informed of when the safe period for entry will expire. Signed _____ Time _____ Date _____ Being the Competent (Hot Work)		
Part 3: Clearance I declare that all Hot Work under my control has now been stopped and the area has been checked out found clear of any risk of fire and that all tools and other equipment have been removed. Signed _____ Time _____ Date _____ Being the Competent (Hot Work)		
Part 4 : Cancellation I acknowledge receipt of the clearance of this Certificate. This certificate is now cancelled Signed _____ Being the Authorized Person (Hot Work) Time _____ Date _____		

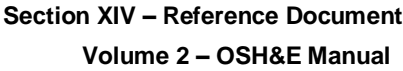
PUNE METRO RAIL CORPORATION			SAMPLE SAFETY FORM REFERENCE:		SAF - 020
RISK ASSESSMENT WORK SHEET					
NAME OF CONTRACTOR			CONTRACT NO.		DATE:
OPERATION:			METHOD STATEMENT Ref:	PAGE: OF	
HAZARDS	RISKS	DEGREE	CONTROL	MONITORING	

PUNE METRO RAIL CORPORATION		SAMPLE SAFETY FORM REFERENCE:	SAF - 021
HAZARDOUS SUBSTANCES ASSESSMENT SHEET			
NAME OF CONTRACTOR		CONTRACT NO.	
To be completed at Commencement and Revised Periodically and Updated as required			
Generally Assessed (For use outside or in well ventilated areas)		Others Specific assessments required	
<div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"> 1 <input type="checkbox"/> Cement 2 <input type="checkbox"/> Lime 3 <input type="checkbox"/> Plaster 4 <input type="checkbox"/> Artex 5 <input type="checkbox"/> Sand 6 <input type="checkbox"/> Aggregates 7 <input type="checkbox"/> Plasticisers 8 <input type="checkbox"/> Retarders 9 <input type="checkbox"/> Rapid Hardeners 10 <input type="checkbox"/> Colouring / Mortar 11 <input type="checkbox"/> Curing Agents 12 <input type="checkbox"/> Rapid 13 <input type="checkbox"/> Diesel / Gas Oil 14 <input type="checkbox"/> Engine Oils 15 <input type="checkbox"/> Hydraulic Oils 16 <input type="checkbox"/> Shutter Oils 17 <input type="checkbox"/> Greases 18 <input type="checkbox"/> Pipe Lubricants 19 <input type="checkbox"/> Epoxy Mortars 20 <input type="checkbox"/> Epoxy Adhesives 21 <input type="checkbox"/> Epoxy Sealants 22 <input type="checkbox"/> Epoxy Primers 23 <input type="checkbox"/> Epoxy Solvents </div> <div style="width: 50%;"> 24 <input type="checkbox"/> Epoxy Cleaners 25 <input type="checkbox"/> Butyl Mastic Sealants 26 <input type="checkbox"/> Acrylic Sealants 27 <input type="checkbox"/> Mastic Primers 28 <input type="checkbox"/> Mastic Solvents 29 <input type="checkbox"/> Elastomeric Sealants 30 <input type="checkbox"/> Elastomeric Primers 31 <input type="checkbox"/> Elastomeric Solvents 32 <input type="checkbox"/> Hot Mastic Sealants 33 <input type="checkbox"/> Bitumastics 34 <input type="checkbox"/> Coated Road Stone 35 <input type="checkbox"/> Contact Adhesives 36 <input type="checkbox"/> Contact Solvents 37 <input type="checkbox"/> Softwoods 38 <input type="checkbox"/> Hardwoods 39 <input type="checkbox"/> Fibreboards 40 <input type="checkbox"/> Paints / Primers 41 <input type="checkbox"/> Paint Solvents 42 <input type="checkbox"/> Brush Cleaners 43 <input type="checkbox"/> Bleaches 44 <input type="checkbox"/> Brick Cleaner 45 <input type="checkbox"/> Concrete Cleaner 46 <input type="checkbox"/> Liquified Petroleum Gas </div> </div>		<div style="text-align: center; padding-bottom: 5px;">SPECIFY:</div> 47 <input type="checkbox"/> _____ 48 <input type="checkbox"/> _____ 49 <input type="checkbox"/> _____ 50 <input type="checkbox"/> _____ 51 <input type="checkbox"/> _____ 52 <input type="checkbox"/> _____ 53 <input type="checkbox"/> _____ 54 <input type="checkbox"/> _____ 55 <input type="checkbox"/> _____ 56 <input type="checkbox"/> _____ 57 <input type="checkbox"/> _____ 58 <input type="checkbox"/> _____ 59 <input type="checkbox"/> _____ 60 <input type="checkbox"/> _____	
Completed by: _____ Sign: _____ Name: _____ Title: _____ Date: _____			

(- TICK AS APPLICABLE)

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PUNE METRO RAIL CORPORATION		SAMPLE SAFETY FORM REFERENCE:		SAF - 031
SAFETY TRAINING ATTENDANCE RECORD				
NAME OF CONTRACTOR			CONTRACT No.	
Title of Course : _____ Date: _____ Course Reference No. _____				
Duration : _____ Name of Trainer (s) _____				
No.	Name	Section / Sub-contractor	Signature	
1.				
2.				
3.				
4.				
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22.				
23.				
24.				
<p>CONFIRMED AS CORRECT BY:</p> <p>SIGNATURE: _____ (SAFETY MANAGER) DATE : / /</p> <p>SIGNATURE: _____ (PROJECT MANAGER) DATE: / /</p>				

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PUNE METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE :	SAF - 033																																																																																																																																																																																									
SCAFFOLD INSPECTION CHECKLIST																																																																																																																																																																																											
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<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 40%;">Location and description of scaffold, etc. and other plant or equipment inspected</td> <td style="width: 15%;">Date of inspection</td> <td style="width: 20%;">Result of inspection</td> <td style="width: 25%;">Signature of Person</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">4</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>			Location and description of scaffold, etc. and other plant or equipment inspected	Date of inspection	Result of inspection	Signature of Person	1	2	3	4																																																																																																																																																																																	
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PUNE METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE:	SAF - 040
CONTRACTOR'S APPLICATION FOR SAFETY MANAGER TO WORK FOR CONTRACT.....		
NAME OF CONTRACTOR	CONTRACT NO.	
<p>GENERAL PARTICULARS</p> <p>Name : _____</p> <p>(In Block Capitals)</p> <p>Date of Birth :</p>		

Maha Metro



Tender Documents

**UGC-02: DESIGN AND CONSTRUCTION OF UNDERGROUND STATIONS AT
BUDHWAR PETH, MANDAI AND SWARGATE AND ASSOCIATED TUNNELS**

PART IV – REFERENCE DOCUMENT

Section XIV – OSH&E MANUAL

Volume 2 – Environmental Manual

June 2018

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STATEMENT OF INTENT

The Maha Metro firmly believes in a “development which meets the needs of the present without compromising the ability of future generations to meet their own needs”. This commitment towards sustainable development is manifested clearly in our corporate culture, even as we continue to build a world-class metro.

It is the intent of MMRCL to demonstrate continual improvement in its environmental management system during construction of Pune Metro Project.

This manual represents the minimum standards that the Maha-Metro Rail Corporation Limited will accept on matters of Environment. It lays down the guidance for environmental protection measures to be adopted as part of mitigation strategy for overcoming adverse environmental impacts during construction. It suggests environmental friendly construction practices that the Contractors are encouraged to adopt in order to contain various types of pollutants and impacts that may be generated due to construction activities.

The Maha Metro Rail Corporation actively supports the efforts and initiatives that are instigated by the Contractors and sub-Contractors in their efforts for achieving good standards of Environment on the project. The Corporation will use its best endeavors to ensure that all of the Contractors employed on the Project achieve these Standards.

Managing Director/MMRCL

ENVIRONMENTAL MANAGEMENT MANUAL

1. INTRODUCTION

- 1.1 This Environmental Management Manual (EMM) forms an essential part of the overall Environmental protection system employed by Maha Metro Rail Corporation Limited for the construction of Metro Project in Pune.
- 1.2 This manual has been prepared to facilitate construction progress while ensuring fulfillment of environmental commitments. It provides systematic procedures for monitoring and minimizing environmental impacts that may arise from the construction activities.
- 1.3 This manual will apply to all construction works by the Maha Metro Rail Corporation Limited for surface, elevated and underground corridors carried out by the Contractors and Sub-Contractors.
- 1.4 The primary reason for adopting the Manual approach is to make the Contractor aware of his environmental responsibilities and to ensure his commitment to achieving the specified standards.
- 1.5 The MMRCL Environmental Manual is meant to be a living document that will be updated as design and construction progresses and when further environmental issues are identified.
- 1.6 Periodic reviews of the plan and procedures will be performed to ensure continual improvement of the Plan's adequacy and it will be expanded and updated during the project duration.
- 1.7 Because the work potentially involves design-bid-build and design/build contracts, this Manual is intended to be flexible and tailored to match highly variable construction activities and locations throughout the project.
- 1.8 This manual is set out as follows:
 - ◆ Section 2 highlights the purpose and scope of this Manual
 - ◆ Section 3 outlines the objectives of the manual which will form a basis for Environmental Management System
 - ◆ Section 4 lists the definitions and abbreviation of terms used in the manual
 - ◆ Section 5 sets out the responsibilities for application of the procedures
 - ◆ Section 6 provides guidance to the Contractor for preparation of his contract specific Site Environmental Plan
 - ◆ Section 7 commits the Contractor's Method Statement to incorporate Environmental issues during execution of works
 - ◆ Section 8 focuses on the Environmental Performance Review of Contractor's activities through Environmental Audits
 - ◆ Section 9 details measures to contain Air, Water, and Noise Pollution and management of Waste through Environmental Friendly Construction Practices
 - ◆ Section 10 specifies good Housekeeping measures
 - ◆ Section 11 is on Landscape and Aesthetics
 - ◆ Section 12 suggests measures to conserve energy through effective Energy Management
 - ◆ Section 13 deals with Traffic Management

- ◆ Section 14 focuses on requirements that the Contractor shall have to meet in case Archaeological and Historic Resources are encountered
- ◆ Section 15 on Environmental Monitoring lists the relevant monitoring equipment, compliance criteria and monitoring programme to be undertaken by the Contractor during construction
- ◆ Section 16 details requirements for impact monitoring for air quality including Air Monitoring and Control Plan
- ◆ Section 17 details requirements for impact monitoring for noise including Noise Monitoring and Control Plan
- ◆ Section 18 describes the Environmental Site Inspection process to be implemented by the Contractor
- ◆ Section 19 details the Environmental Audits which the Engineer may undertake as part of environmental performance review
- ◆ Section 20 details the Reporting requirement as related to submission of Contractor's Monthly Environmental Management Report under this manual
- ◆ Section 21 sets out the Complaint response process and finally,
- ◆ Section 22 mentions the requirements of Completion of the EMM programme

2. PURPOSE & SCOPE

- 2.1 The purpose of this Environmental Management Manual (EMM) is to make the Contractors aware of the environmental concerns of MMRCL, and to establish guidelines for the application of environmental controls during the construction of the current phase of the project.
- 2.2 This manual is intended to translate into practice, three important principles of MMRCL 's mandate – that construction activities should not:
 - ◆ Inconvenience or endanger public
 - ◆ Create a permanent visual eyesore
 - ◆ Result in unmitigated ecological or environmental degradation
- 2.3 This manual is intended to guide and assist the Contractors in exploring all reasonable and feasible means for reducing construction related environmental impacts as they prepare and produce contract-specific Site Environmental Plans as required by the Contract.
- 2.4 This manual stipulates environmental controls that, in lieu of alternative controls specified by the Contractor, must be applied.
- 2.5 Environmental controls adopted by the individual Contractors as an alternative to the measures identified herein must be as protective of the environment.
- 2.6 The scope of this manual is to establish procedures to :
 - ◆ Supervise Contractor's compliance with defined environmental control criteria by carrying out reviews of monitored impact data
 - ◆ Oversee the procedure for identification of mitigation measures, their design and implementation
 - ◆ Carry out environmental monitoring emissions during construction through an impact monitoring programme
 - ◆ Undertake additional ad hoc monitoring if required to address specific instances

3. OBJECTIVE

- 3.1 The various components included in this manual along with the Employer's requirement on Environment will form the basis of an Environmental Management System to be implemented by MMRCL, which will enable it to manage the environmental challenges and resolve environmental issues posed during construction of Pune Metro.
- 3.2 The main objectives are to:
- ◆ Provide database from which environmental impacts of the project can be determined.
 - ◆ Provide timely indication if any environmental control measure fails to achieve desired results.
 - ◆ Monitor effectiveness of environmental mitigation measures
 - ◆ Initiate remedial action if unacceptable impacts arise.
 - ◆ Determine Contractor's compliance with statutory and legal requirements.

4. DEFINITION & ABBREVIATIONS

- 4.1 **Air Monitoring and Control Plan** is abbreviated as AMCP.
- 4.2 **Auditor:** Person with the competence to conduct an audit.
- 4.3 **A – weighted** Noise levels in Decibels (referenced to 20 micro-Pascal) as measured with A-weighting network of standard sound level meter, abbreviated dB (A).
- 4.4 **Continual improvement:** Recurring process or enhancing the environmental management system in order to achieve improvements in overall environmental performance consistent with the organization's environmental policy.
- 4.5 **Corrective action:** Action to eliminate the cause of a detected nonconformity.
- 4.6 **Decibel** is measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power) with respect to a standardized reference quantity.
- 4.7 **Document:** Information and its supporting medium.
- 4.8 **Energy Equivalent Level (L_{eq})** is the level of a steady noise which has the same energy as the fluctuating noise level integrated over the period of measurement. L_{max} is the maximum Noise Level during the period of measurement. L_{10} and L_{90} are the percentile exceeding levels of sound which are exceeded 10% and 90% of the time of measurement.
- 4.9 **Environmental Pollutant** means any solid, liquid or gaseous substance present in such concentration as may be or tend to be injurious to environment.
- 4.10 **Environmental Pollution** means the presence in the environment of any environmental pollutant.
- 4.11 **Environment:** Surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation.

- 4.12 **Environmental Aspect:** Element of an organization's activities or products or services that can interact with the environment.
- 4.13 **Environmental Impact:** Any change to the environment whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects.
- 4.14 **Environmental Management Manual** is abbreviated as EMM.
- 4.15 **Environmental Management System:** Part of an organization's management system used to develop and implement its environmental policy and manage its environmental aspects.
- 4.16 **Environmental Objective:** Overall environmental goal, consistent with the environmental policy that an organization sets itself to achieve.
- 4.17 **Environmental Performance:** Measurable results of an organization's management of its environment aspects.
- 4.18 **Environmental Policy:** Overall intentions and direction of an organization related to its environmental performance as formally expressed by top management, under signature.
- 4.19 **Environmental Target:** Detailed performance requirement applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
- 4.20 **Interested Party:** Person or group concerned with or affected by the environmental performance of an organization.
- 4.21 **Internal audit:** Systematic, independent and documented process for obtaining audit evaluating it objectively to determine the extent to which the environmental management system audit criteria set by the organization are fulfilled.
- 4.22 **Ministry of Environment and Forest,** Government of India is abbreviated as MoEF.
- 4.23 **Monitoring** is the use of direct or indirect reading field instrumentation to provide information regarding the levels of pollutants released during construction.
- 4.24 **Noise** is any unwanted sound disturbance of the environment around the area of construction operations.
- 4.25 **Noise Monitoring and Control Plan** is abbreviated as NMCP.
- 4.26 **Nonconformity:** Non-fulfillment of a requirement.
- 4.27 **Nuisance** is annoyance, which results from any construction activity that affects the material comfort and quality of life of the inhabitants of the area surrounding the construction site.
- 4.28 **Organization:** Company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that

has its own functions and administration. It also includes the Contractor executing the Maha - Metro contract for Pune Metro Project.

- 4.29 **Preventive Action:** Action to eliminate the cause of a potential nonconformity.
- 4.30 **Prevention of pollution:** Use processes, practices, techniques, materials, products, services or energy to avoid, reduce or control the creation, emission or discharge of any type of pollutant or waste, in order to reduce adverse environmental impacts.
- 4.31 **Procedure:** Specified way to carry out an activity or a process.
- 4.32 **Record:** Document stating results achieved or providing evidence of activities performed.
- 4.33 **Respirable Particulate Matter** is abbreviated as RPM and is particulate matter with size less than 10 μm and is measured in $\mu\text{g}/\text{m}^3$ (microgram per cubic meter)
- 4.34 **Suspended Particulate Matter** is abbreviated as SPM and measured in $\mu\text{g}/\text{m}^3$ (microgram per cubic meter)
- 4.35 **Site Environmental Plan:** A document prepared by the Contractor that contains detailed procedures on implementing the Employer's requirement on Environment.
- 4.36 **Usage factor:** Expressed as the percent of time that the equipment is operated at full power while on site.
- 4.37 **Waste** is unwanted surplus substance arising from the application of all construction operations and any substance or articles, which is required to be disposed.
- 4.38 **Maharashtra Pollution Control Board (MPCB).**

5. RESPONSIBILITIES

- 5.1 The Contractor shall set up an environmental team to execute the environmental requirements.
- 5.2 The duties of the Contractor's Environmental Team will include (but not limited to):
- To monitor the various environmental parameters as required by the Manual
 - To inspect, investigate and audit the work methodology with respect to environmental mitigation and control
 - To anticipate environmental issues before they arise and plan for their mitigation
 - To audit and prepare audit reports, weekly/monthly reports on site environmental conditions for submission to the Engineer
- 5.3 Reporting to the Engineer, the Contractor shall:
- Work within the scope of contract and other tender condition.
 - Operate and strictly adhere to the requirements of his contract specific-SEP
 - Undertake any corrective actions as instructed by his Environmental Manager

- 5.4 To lead his Environmental team, the Contractor shall deploy an Environment Manager who shall be responsible for environmental control, pollution monitoring, and record keeping and be available to the Engineer for resolution of environmental issues.

6. SITE ENVIRONMENTAL PLAN

- 6.1 To effectively implement monitoring, mitigation and remedial requirements, an appropriate contractual and supervisory framework needs to be established.
- 6.2 The basis of framework within which implementation will be managed is through the preparation of contract-specific Site Environmental Plan by the Contractor. The Engineer will audit this contract-specific plan and advise the necessary remedial actions required through contractual means.
- 6.3 The Site Environmental Plan shall provide details of the means by which the Contractor (and all sub-contractors working for the Contractor) will implement the recommended mitigation measures and achieve the environmental performance standards defined both in Indian environmental legislation and in the Employer's Requirements.
- 6.4 Based on Environmental Management Plan outline given in this document, as Appendix – I. Each Tenderer shall prepare an outline Environmental Plan for submission as part of the tender process.
- 6.5 The outline Environmental Plan shall demonstrate the determination and commitment of Contractor's organisation towards environment and indicate how the environmental performance requirements laid out in the Employer's requirements will be met and, where appropriate exceeded.
- 6.6 Within two months of the date of Notice to Proceed, Contractor shall submit a draft contract – specific Site Environmental Plan for the approval of the Employer and a final version prior to the commencement of the works.).
- 6.7 The contract-specific Site Environmental Plan will contain description of all procedures developed to meet the requirement defined in sections 2.0, 3.0 and 7.0 of this document, to control environmental pollution. Elements of the plan must address the management of pollution, the monitoring programme, and the reporting requirements.

7. CONTRACTOR'S METHOD STATEMENT

- 7.1 It is common practice for the Contractor to prepare method Statement in advancement of actual works, for the approval of the Engineer.
- 7.2 The Contractor's Environmental Manager will be one of the signatories to the Method Statement, after assessing and verifying the environmental impact of the prepared construction activity and ensuring that effective control measures will be in place, timely.

8. ENVIRONMENTAL PERFORMANCE REVIEWS

- 8.1 Environmental Performance Reviews, through an Environmental Audit Programme, may be carried out quarterly by the Engineer to assess the

effectiveness of the Site Environmental Plan, and that the required mitigation measures are routinely implemented and environmental standards are maintained.

- 8.2 The preliminary objective of the audit programme will be to assess the effectiveness of management systems established by the Contractor to implement the environmental mitigation measures.
- 8.3 The reviews by Engineer shall focus on the effectiveness of the implemented measures to achieve the purpose not simply the fact that a measure has been implemented.
- 8.4 In such reviews, demonstrable evidence on the part of the environmental requirements will be sought.
- 8.5 The Contractor shall carry out daily, environment inspection of his works and submit a weekly report as per format for reporting suggested as Appendix – II.
- 8.6 The Contractor shall ensure that his weekly/monthly environmental reports and mandating audits are linked to respective previous submission. The Engineer will ensure that this procedure is followed by the institution of a monitoring and reporting system that provides information about the environmental performance of the construction Contractor throughout the duration of the contract.
- 8.7 The Engineer will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures as defined in this manual

9. ENVIRONMENTAL FRIENDLY CONSTRUCTION PRACTICES

9.1 Containment of Air Pollutants

9.1.1 During Transport of Material

- (a) The Contractor shall take precautions to minimise visible particulate matter from being deposited upon public roadways as a direct result of his operations. Precautions include removal of particulate matter from equipment before movement to paved streets or prompt removal of material from paved streets onto which such material has been dropped.
- (b) All construction equipment should be washed clean of visible dirt/mud before exiting the construction sites. Any deposition of material on public streets by construction equipment should be removed by manual sweeping, or by deploying electro – mechanical devices.
- (c) The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. At such facility, high-pressure water jets will be directed at the wheels of vehicles to remove all spoil and dirt. Water shall be pumped through an electrically operated pump set, to hydrants attached with rubber hoses, by activation of push button located at the hydrant, allowing for up to 10 minutes of wash time.
- (d) Wheel washing facilities will be provided with efficient drainage, incorporating silt traps to prevent any excessive build up of water. These facilities could include water re-circulation apparatus to minimise water consumption. At the wheel wash facility, water, dirt, gravel etc. shall be drained into precast trench drains with removable grated cover. This dirty

water shall flow, through a piping, into solids separator and from there to oil separator before final discharge.

- (e) Where wheel-washing facility is not possible, the Contractor shall ensure manual cleaning of wheels by wire brushes or similar suitable means.
- (f) The Contractor shall ensure that vehicles with an open load carrying area used for moving potentially dust-producing materials shall have properly fitting side and tailboards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be carried in vehicles fitted with covers.

9.1.2 At Dumping Sites

- (a) The Contractor shall place excavated materials in the dumping/disposal areas designated for this purpose.
- (b) The Contractor shall place material in a manner that will minimise dust production. Material shall be stabilised each day by watering or other accepted dust suppression techniques.
- (c) The heights from which materials are dropped shall be the minimum practical height to limit fugitive dust generation.
- (d) The Contractor shall stockpile material in the designated locations by the Employer/Engineer with suitable slopes. Access to the site shall be regulated for entry of men, material and machine.
- (e) During dry weather, dust control methods such as water sprinkling must be used daily especially on windy, dry day to prevent any dust from blowing. During rains, the stockpile may be covered with tarpaulin or similar material to prevent run off.
- (f) The Contractor shall provide water sprinkling at any time that it is required for dust control use.
- (g) Sufficient equipment, water, and personnel shall be available on dumping sites at all time to minimise dust formation and movements to prevent nuisance.
- (h) Dust control activities shall continue even during work stoppages.

9.1.3 At Construction Site

- (a) At each construction site, the Contractor shall provide storage facilities for dust generating materials and shall be closed containers/bins or wind protected shelters or mat covering or walled or any combination of the above to the satisfaction of the Employer/Engineer. The Contractor shall spray water at construction sites as required to suppress dust, during handling of excavation soil or debris or during demolition.
- (b) Stockpiles of sand and aggregate greater than 20m³ for use in concrete manufacture shall be enclosed on three sides, with walls extending above the stockpile and two (2) metres beyond the front of the stockpile.
- (c) Effective water sprays shall be used during the delivery and handling of all raw sand and aggregate and other similar materials, when dust is likely to

be created and to dampen all stored materials during dry and windy weather.

- (d) Areas within the Site such as construction depots and batching plants, where there is a regular movement of vehicles shall have an approved hard surface that is kept clear of loose surface material.
- (e) Unless the Engineer has given consent otherwise, the Contractor shall restrict all motorised vehicles on the Site to a maximum speed of 15 kilometers per hour and confine haulage and delivery vehicles to the designated roadways inside the site.
- (f) At the Batching plant the following additional conditions shall be complied with:
 - ◆ The Contractor shall undertake at all times the prevention of dust nuisance as a result of his activities.
 - ◆ The Contractor shall frequently clean and water the concrete batching plant and crushing plant sites and ancillary areas to minimise any dust emission.
- (g) The Contractor shall erect hoardings as specified in Employer's requirements – Construction, securely around all construction work sites during the main construction activity, to contain dust within the site area and also to reduce air turbulence caused by passing traffic. The hoarding shall be safely secured to the ground to prevent from toppling with minimum gap between the base of hoarding and ground surface.

9.1.4 During Drilling and Blasting

- (a) Water spray should be used to control dust during breaking of rock/concrete.
- (b) During blasting operations, appropriate precautions should be taken to minimise dust such as the use of blast nets, canvas covers and watering.
- (c) Wire mesh made of heavy-duty tyres or sand bags should be used over blast area on each shot to prevent flying rock and reduce dust.
- (d) Blasting technique should be consistent not only with nature and quantity of rock to be blasted but also the location of blasting.
- (e) The Contractor shall give due preference to explosives with better environmental characteristics.
- (f) Vibration shall be monitored during blasting and values shall not exceed as those given in this Environmental Management Manual

9.2 Containment of Water Pollutants

- (a) At construction depots and batching plants temporary drainage works should be maintained, removed and reinstated as necessary and all other necessary precautions should be taken for avoidance of damage by flooding and silt.
- (b) Sedimentation tanks or other acceptable measures, of sufficient capacity to trap silt-laden water before discharge into the outlet drain should be

provided. The system should be flexible and be able to handle multiple inputs from a variety of sources.

- (c) Temporary open storage of excavated materials from cut and cover-tunneling work used for backfill on site should be covered with tarpaulin or similar fabric during rainy season or at any time of the year when rainstorms are likely. Washout of construction or excavated materials should be diverted to drainage system through appropriate sediment traps.
- (d) Bentonite slurries or other grouts used in diaphragm wall construction piling and other concrete works should be collected in a separate slurry collection system. If reuse is not practicable then it should be disposed off at nearest landfill site after obtaining permission from agency owning the landfill and under the conditions imposed by the agency concerned, or to a different disposal location as advised by the Employer/Engineer.
- (e) The Contractor shall discharge wastewater arising from site offices, canteens or toilet facilities constructed by him into sewers after obtaining prior approval of agency controlling the system. A wastewater drainage system shall be provided by the Contractor to drain wastewater into the sewerage system.
- (f) Oil separator/interceptors shall be provided at Batching Plant and construction depot location for vehicle maintenance to prevent the release of oils and grease into the drainage system. These shall be cleaned on a regular basis.
- (g) A Spill Prevention and Control Procedure shall be prepared to identify project components such as storage areas, storage tanks that could allow discharge of oil grease or hazardous materials to the drainage system or ultimately in any water body during spillage. The volume of spill should be calculated as well as storage volume to contain spill within the materials storage containment areas. The procedure shall include measures to contain and mitigate transportation of oil, grease or hazardous materials to the drainage system or any water body.
- (h) Surface run-off from construction depots and batching plants should be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps silt traps or sediment basins.
- (i) Perimeter channels/drains should be constructed in advance of site formation works and earthworks. Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly, to ensure that these facilities are functioning properly at all times.
- (j) Construction works should be programmed to minimize soil excavation works in rainy seasons (June to September). If excavation in soil could not be avoided in these months or at any time of year when rain are likely, for the purpose of preventing soil erosion, temporarily exposed slope surfaces should be covered e.g. by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Arrangement should always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of rains.

- (k) Measures should be taken to minimize the ingress of rainwater into trenches. If excavation of trenches in wet seasons is necessary, they should be dug and backfilled in short sections. Rainwater pumped out from trenches or foundation excavation should be discharged into storm drains via silt removal facilities.
- (l) Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.
- (m) Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into sewers. Discharge of surface run-off into sewers must always be prevented in order not to unduly overload the sewerage system.
- (n) Groundwater pumped out of wells, etc. for the lowering of ground water level in basement of foundation construction, and groundwater seepage pumped out of
- (o) tunnels under construction should be discharged into storm drains after the removal of silt in silt removal facilities.
- (p) Wastewater from Concrete Batching & Precast Concrete Casting and that generated from the washing down of mixer trucks and drum mixers and similar equipment should wherever practicable be recycled. The discharge of waste water should be kept to a minimum.
- (q) The section of construction road between the wheel washing bay and the public road should be paved to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.
- (r) Surface run-off should be segregated from the concrete batching plant and casting yard area as much as possible and diverted to the storm water drainage system. Surface run-off contaminated by materials in a concrete batching plant or casting yard should be adequately treated before disposal into storm water drains.

9.3 Containment of Noise

- (a) Construction of facilities and structures would require the use of equipment, which may generate high noise levels and adversely affect noise sensitive receivers.
- (b) In assessing the impact of construction noise and hence its containment, the nature and level of activities that generate noise, the pathway through which noise travels, the sensitivity of the receptor, and the period of exposure should all be considered.
- (c) Environmental noise is measured in decibels (dB). To better approximate the range of sensitivity of the human ear to sounds of different frequencies, the A-weighted decibel scale (dBA) was devised. As the human ear is less sensitive to low frequency sounds, the A-scale de-emphasizes these frequencies by incorporating frequency weighting of the sound signal. When the A-scale is used, the decibel levels are represented by dBA.

- (d) On this scale, the range of human hearing extends from about 3 dBA to about 140 dBA. A 10-dBA increase is judged by most people as a doubling of the sound level.
- (e) To the extent required to meet the noise limits the Contractor shall use reasonable efforts to include noise reduction measures listed below to minimize construction noise emission levels. Noise reduction measures – include, but not limited to the following:
 - (i) Minimize the use of impact devices, such as jackhammers, and pavement breakers. Where possible, use concrete crushers or pavement saws for tasks such as concrete deck removal and retaining wall demolition.
 - (ii) Equip noise producing equipment such as jackhammers and pavement breakers with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise limitations.
 - (iii) Pneumatic impact tools and equipment used at the construction site shall have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise limitations.
 - (iv) Provide mufflers or shield paneling for other equipment, including internal combustion engines, recommended by manufacturers thereof.
 - (v) Employ prefabricated structures instead of assembling on-site.
 - (vi) Use construction equipment manufactured or modified to dampen noise and vibration emissions, such as:
 - Use electric instead of diesel-powered equipment.
 - Use hydraulic tools instead of pneumatic impact tools.
- (f) Maximize physical separation, as far as practicable, between noise generators and noise receptors. Separation includes following measures:
 - Provide enclosures for stationary items of equipment and barriers around particularly noisy areas on site.
 - Locating stationary equipment so as to minimize noise and vibration impact on community.
- (g) To the extent feasible, configure the construction site in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations and nearby buildings. Plant and equipment known to emit noise strongly in one direction should where possible, be oriented in a direction away from noise sensitive receptor and reduce the number of plant and equipment operating in critical areas close to noise sensitive receptors.
- (h) Scheduling truck loading, unloading, and hauling operations so as to minimize noise impact near noise sensitive locations and surrounding communities.
- (i) Minimize noise intrusive impacts during most noise sensitive hours.
 - Plan noisier operations during times of highest ambient noise levels.
 - Keep noise levels relatively uniform; avoid excessive and impulse noises.
- (j) Equipment and plant are not to be kept idling when not in use.

- (k) Use only well maintained plant at site, which should be serviced regularly.
- (l) Maintain equipment such that parts of vehicles and loads are secure against vibrations and rattling.
- (m) Grading of surfaced irregularities on construction sites to prevent the generation of impact noise and ground vibrations by passing vehicles.
- (n) Schedule work to avoid simultaneous activities that both generate high noise levels.
- (o) The construction of temporary physical noise barriers.
- (p) If back-up alarms are used on construction equipment, their noise emission level near noise sensitive receptors such as residences, schools, hospitals and similar areas where quiet is essential, should be regulated, especially at night time.
- (q) Select truck routes for muck disposal so that noise from heavy-duty trucks will have minimal impact on sensitive land uses (e.g., residential) and submit to the Engineer for approval:
 - Conduct truck loading, unloading and hauling operations in a manner such that noise and vibration are kept to a minimum.
 - Route construction equipment and vehicles carrying soil, concrete or other materials over streets and routes that will cause least disturbance to residents in vicinity of work.
 - Avoid operating truck on streets that pass by schools during school hours.
- (r) The maximum permissible sound pressure level for new generator sets (upto 1000 KVA) run on diesel, shall be 75 dB(A) at one metre from the enclosure surface.
- (s) For existing diesel generator sets, the noise from the DG set shall be controlled by providing an acoustic enclosure or acoustic treatment of the room for DG sets. Such acoustic enclosures/acoustically treated rooms, shall be so designed for minimum 25 dB(A) insertion loss or for meeting the ambient noise standards, whichever is on higher side.

9.4 Containment of Waste

- (a) Careful design, planning and good site management can minimise waste of materials such as concrete, mortars and cement grouts. The Contractor shall ensure regular maintenance and cleaning of the waste storage areas.
- (b) Construction activities are expected to generate a variety of waste such as:
 - (i) General refuse
 - (ii) Construction Waste including waste from excavated material
 - (iii) Chemical waste and
 - (iv) Hazardous waste
- (c) Handling and disposal of such waste may cause environmental degradation and nuisance. To prevent it, such waste has to be handled and disposed properly. As such, transportation and disposal of all waste shall be strictly managed.

(d) General Refuse

- (i) Each worksite would generate general refuse including paper and food waste. There is likely to be a concentration of such waste at batching plants on major worksite. The storage of general refuse has the potential to give rise to negative environmental impacts.
- (ii) Handling and disposal of general refuse should cope with the peak construction workforce during the construction period. Provided the refuse is stored and transported in accordance with good practice and disposed at licensed landfills, the negative environmental impacts would be minimal.
- (iii) General refuse should be stored in enclosed bins or units separate from construction and chemical wastes. An authorised waste collector should be employed by the Contractor to remove general refuse from the site, on a daily basis to minimise odour, pest and litter impacts.
- (iv) Office waste can be reduced through recycling of paper if volumes are large enough to warrant collection.

(e) Construction Waste

- (i) Construction Waste would mainly arise from the project construction activities and from the demolition of existing structures where necessitated. It includes unwanted materials generated during construction, rejected structures and materials, materials that have been over-ordered and materials, which have been used and discarded such as:
 - Material and equipment wrapping packaging material
 - Unusable/surplus concrete/grouting mixes
 - Damaged/contaminated/surplus construction materials; and
 - Wood from formwork and false work.
- (ii) Also, demolition of buildings and houses to accommodate station buildings and construction depots will generate concrete rubble, plastics, metal, glass, asphalt from surfaces, wood and refuse.
- (iii) Waste from excavation would comprise soil, rubble, sand, rock, brick etc.
- (iv) The majority of Soil Muck/spoil generated by construction activities should be used for filling purpose.

(f) Chemical Waste

- (i) Chemical waste is likely to be generated by construction activities. For those processes, which generate chemical waste, it may be possible to find alternatives, which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.
- (ii) The Contractor should explore the possibilities given in (i) above and produce evidence of acceptable disposal method (e.g. waste transfer) to the Engineer.
- (iii) Containers used for the storage of chemical waste should:
 - Be suitable for the substances they are holding, resistant to corrosion, maintained in good condition, and securely closed.

- Be of adequate capacity and
 - Display a label in local language and English as to the contents, quantity and safe method of disposal in accordance with instructions contained in Material Supply Data Sheet (MSDS).
- (iv) The storage area for chemical waste should:
- Be clearly labeled and used solely for the storage of chemical waste;
 - Be enclosed on at least three sides;
 - Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
 - Have adequate ventilation;
 - Be covered to prevent rainfall entering and
 - Be arranged so that incompatible materials are adequately separated.
- (v) Disposal of chemical waste should be via a licensed waste collector; duly authorized by MoEF or Maharashtra Pollution Control Board as the case may be. License of the waste collector shall be shown to the Engineer on demand.
- (vi) The Contractor should maintain an inventory of chemicals, solvents and adhesives. He should minimise disposal of excess material, reuse when applicable and dispose of chemical waste properly. He should prepare a plan that identifies proper ventilation, protected clothing and personal protective equipment.
- (vii) The Contractor should have a point of contact that will maintain the above information and conduct periodic inspections.
- (viii) The Contractor should have application matter in place that will ensure high transfer efficiency that reduces over spray or excess application.
- (g) Hazardous Waste
- (i) Classification of waste as Hazardous shall be in accordance with Hazards Waste (Management & Handling) Rules 1989, and 2003 or its latest amendment.
 - (ii) The Contractor shall identify all the hazardous waste generated as a result of his activities. If such waste is generated then the Contractor shall apply to State Pollution Control Board for 'authorisation' according to Form 1 of the Hazardous rules and dispose the same only to currently authorised recyclers(a list of which can be obtained from state pollution control board) under intimation to the Employer/Engineer.
 - (iii) The Rules given in (i) above shall govern the Classification, Handling, Storage and disposal of such Hazardous Waste.
 - (iv) Hazardous waste would mainly arise from the maintenance of equipment. These may include, but not be limited to, the following:

- Used engine oils, hydraulic fluids and waste fuel;
 - Spent mineral oils/cleaning fluids from mechanical machinery;
 - Scrap batteries or spent acid/alkali; and
 - Spent solvents/solutions, some of which may be derived, from equipment cleaning activities.
- (v) For disposal of waste requiring special attention and hazardous waste the Contractor shall enter into agreement with authorised agencies dealing with the same.
- (vi) The environmentally hazardous waste shall be stored on an impermeable surface with containment bunding to retain leaks, spills and ruptures.
- (vii) Waste oil and chemical containers shall be delivered to the Contractor's Storage yard. The Contractor is responsible for the correct storage and handling of waste oil/waste chemical containers unit such a time that they are transported to the chosen disposal area or waste oil containers.
- (viii) All waste collection containers shall be of appropriate size with a closed lid. Each container will be clearly labeled both with a color code system and labeled in local language and English. Original labels of empty containers should be completely covered over and the contents of the type of waste stored in the used containers clearly indicated.
- (ix) When the land fill has reached full capacity, vents are installed to evacuate gases, and a land fill covered by geo-membrane with a minimum thickness of 1mm, or a layer of compacted clay, and top layer of 1.5m of soil, which is revegetated.
- (h) Storage and Segregation of Waste
- (i) Disposal and collection points should be established around all construction work sites. The waste containers should be at least 50L/100L
- (ii) The burning of refuse at construction sites is not permitted.
- (iii) The Contractor shall enter into a contract with licensed Agencies to collect waste from Construction depots, Labour Colony etc. and dispose it at their landfill as per existing norms.
- (iv) The Contractor is responsible for the separation of construction and demolition material into re-usable and non-reusable materials, and transfer of these materials to low laying areas or landfills, depending on the type of material and the percentage of inert material.
- (v) Segregation of Waste should be done on site. All construction waste including debris should be sorted on site into inert and non-inert components as given in Table - 1. Different areas of the worksites should be designated for such segregation and storage wherever site conditions permit.

Table –1: Storage of Waste

Waste Container	Colour Code	Sign
Landfill / Biodegradable	Green	Waste
Recyclable	Blue	Paper & Plastic
Burning / Combustible	Red	Burning
Scrap Metal	Brown	Metal

- (vi) On-site measures promoting proper segregation and disposal of construction waste should be implemented e.g. provide separate containers for inert (rubber, sand, stone etc.) and non-inert (wood, organics etc.) wastes. The inert waste should be used on site before disposed of at filling area and the non-inert waste should be sorted for re-use or recycling before being transported to landfills.
- (vii) Non-inert materials such as wood, glass and plastic are acceptable for disposal to a landfill as a last resort if these can no longer be reused or recycled.
- (viii) Inert materials such as excavated materials comprising soil, rubble, sand, rock, brick and concrete should be separated and broken down to size suitable for subsequent filling in low lying areas, if it is determined that such material can no longer be reused at the site itself.

(i) Reuse and Recycle

- (i) If some good quality reusable topsoil is found from site clearance, it can also be stockpiled and used later in final landscaping works, thus saving on costs for such works and transportation and environmental impacts of disposal.
- (ii) The design of formwork should maximise use of wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork should be considered to increase the potential for reuse.
- (iii) The Contractor should recycle as much of the construction waste as possible on-site. Proper segregation of waste types on site will increase the feasibility of certain components of the waste stream by recycling Contractors.
- (iv) Excavated materials are usually inert such as soil and rock, and can normally be reused on site or in public filling areas.
- (v) Steel and other metals should be recovered from the construction waste and recycled as far as practical. If possible, scrap steel mills can use steel bars.

(j) Transportation of Waste

- (i) The transportation of construction spoil shall be allowed only to officially designated dumpsites after obtaining necessary permission from appropriate authority.
- (ii) A procedure to facilitate tracking of loads should be developed to prevent illegal disposal of waste. This procedure should include, inter alia, the name of driver, vehicle registration number, type and quantity of waste, place and time of origin, place of disposal and route of haulage.

- (iii) In orders to avoid dust or odour impacts, vehicles leaving a site carrying excavate should have their load covered. Vehicles should be routed as far as possible to avoid sensitive receivers in the area.
 - (iv) Contractors who produce significant quantities of scrap are obliged to enter into agreement with authorised dealers of scrap for its disposal. Copies of such agreements shall be shown to the Employer/Engineer on request.
- (k) Training
- (i) The Contractor's Environmental Department is responsible for training of workers and personnel involved in generation of waste.
 - (ii) The Contractor shall provide training for workers about the concepts of site cleanliness and appropriate waste management procedure, including waste separation, reduction, reuse and recycling. Failure to do so would result in poorly separated waste, resulting in difficulties in treating the waste correctly and/or a bad market for reuse /recycling.
 - (iii) The awareness will be created through briefings and toolbox talks. The personnel/workers should be trained in waste classification and separation. The training should include:
 - Organic waste
 - Combustible waste
 - Hazardous waste
 - Minimisation of waste
 - (iv) Separation awareness training shall be given to employees responsible for the separation of the waste and information regarding waste separation shall be posted at appropriate locations around the site.

10. HOUSEKEEPING

- 10.1 The Contractor shall constitute a special group of house keeping personnel in charge of each work section. Senior engineer of each section shall be responsible for house keeping at their respective sites.
- 10.2 Each section of work site shall maintain the site reasonably clean, keep free from obstruction and properly store any construction equipment, tools, and materials. Any wreckage, rubbish shall be temporarily stored in wreckage and rubbish bins. These wreckage and rubbish bins shall be cleaned at frequent intervals. Special house keeping group will ensure daily cleaning work at the site and its surrounding areas.
- 10.3 General Housekeeping shall be carried out and ensured at all times at work sites, Labour Camps, Stores and Offices.
- 10.4 Full height fence, barriers etc. will be installed at the site in order to preserve the surrounding area from excavated soil, rubbish etc which may cause inconvenience to public.
- 10.5 The Contractor will ensure that all sub-Contractors maintain the site reasonably clean through the sub-contract's provision related to house keeping.
- 10.6 The Contractor's designated department will, through daily pre-work meeting (tool box talk), safety meeting etc. will impart the necessary introduction and education to labor on house keeping. This will be done through toolbox talks. Other staff

such as supervisors and engineers working at the site will also be educated on the necessity of good house keeping.

10.7 Every individual would be responsible for house keeping in his area i.e.

- At Work Site: All workers should clean their work place after completion of their job. Supervisor should ensure good house keeping of their respective work area through their workers. Section Managers shall ensure house keeping in their area through their supervisors. Contractor's designate department will monitor this activity through section manager as well as site supervisor.
- At Labour Camp: All workers should be responsible to maintain good house keeping and hygienic condition in their respective rooms/dormitories. The Contractor should ensure the availability of dustbins at required place and regular cleaning of rooms, kitchens, toilet blocks and dustbins. Safe disposal of all waste materials, should also be ensured. Arrangement for regular fumigation should be made by the Contractor.
- At Store: Proper access and stacking shall be ensured at the Stores. A list will display daily stock of materials. All work material should be stored in clearly marked containers or at designated storage area.
- At Office: Every one is responsible to maintain house keeping of their work station. Disposal of waste materials (i.e. stationary, cigarette butts, tea bags etc.) must be in dustbin only.

10.8 Avoidance of Nuisance

- (a) The Contractor shall take all precautions to avoid any nuisance arising from his operations. This shall be accomplished, wherever possible by suppression of nuisance at source rather than abatement of the nuisance once generated.
- (b) Following site clearing and before construction, the Contractor shall remove all trash, debris and other weeds.
- (c) The Contractor shall ensure that the work place is free of trash, garbage, debris and weeds.
- (d) The Contractor shall provide at site, metal or heavy-duty plastic 'Refuse Containers' with tight fitting lids for disposal of all garbage or trash associated with food. The containers shall not have openings that allow access by rodents.
- (e) To keep the area free of litter and garbage, specific locations shall be designated for consuming food and snacks to prevent random disposal of waste. All waste shall be deposited in the refuse containers. Suitable all weather signage shall be prominently displayed for compliance of these requirements.
- (f) The refuse containers shall be kept upright with their lids shut. These containers shall be emptied at least once daily by the Contractor to maintain site sanitation. There shall be different containers for bio-degradable/recyclable and hazardous (flammable) wastes.
- (g) All plants/equipment/machinery shall be well maintained by regular servicing and kept free from oil/grease dripping. Drip pans of suitable size shall be used to collect oil leakages and spills. The area shall be cleaned

after completion of maintenance/repair and generated waste disposed off in approved manner.

- (h) The Contractor shall make available Material Supply Data Sheet (MSDS) for material/chemicals/substances used, to the Engineer when requested.
- (i) Such material/chemicals/substances used shall be treated, handled, stored, transported and disposed off, by the Contractor, in a manner specified in the MSDS.

10.9 Prevention of Mosquito Breeding

- (a) Measures shall be taken to prevent mosquito breeding at site. The measures to be taken shall include, but not limited to, the following:
 - (i) Construction run off shall not be allowed to stagnate at work sites specially at construction depots and batching plant locations, by executing an efficient drainage system and/ or leveling off low lying areas;
 - (ii) Empty cans, oil drums, packing and other receptacles which may retain water shall be deposited at a central collection point and shall be removed from the Site regularly;
 - (iii) Still waters shall be treated at least once every week with oil in order to prevent mosquito breeding;
 - (iv) Contractor's Equipment and other items on the Site, which may retain water, shall be stored, covered or treated in such a manner that water could not be retained.
- (b) Posters in both local language and English which draw attention to the dangers of permitting mosquito breeding shall be displayed prominently on the site.

11. LANDSCAPE AND AESTHETICS

- 11.1 The Contractor should be able to demonstrate evidence that the landscape and aesthetics quality during construction have been considered and appropriate actions have been taken to mitigate negative impacts due to construction.
- 11.2 The construction of metro system will have negative but temporary impacts on the landscape and aesthetics due to loss of amenities and stress. Large-scale construction activity will impact negatively on roadside areas and residential communities immediately adjacent to the construction sites.
- 11.3 However, transplanting, replanting of trees and additional landscape treatment is likely to result in long-term beneficial impacts. The Contractor should contact local forest department for selection of appropriate species to be planted.
- 11.4 Light used for construction lighting can illuminate adjacent areas in undesired ways. Such lighting and glare shall be prevented from striking adjacent areas, where feasible, through directional shielding.
- 11.5 The other measures include but not limited to:
 - (a) Erection of decorative screen hoarding prominently displaying the logo of Pune Metro Rail Corporation.
 - (b) Minimising height of temporary buildings.
 - (c) Careful positioning of construction equipment.
 - (d) Eliminating the possibility of stockpiles of material from being visible to public.

- (e) Strategically placing high visibility site markings at construction sites indicating facilities, offices and stores.
 - (f) Adequate and properly managed parking of vehicles at construction depots and batching plants.
- 11.6 Consent for height of stacks of Diesel Engines with rating more than 800 KV shall be obtained by the Contractor from statutory Government agency. Where the calculated height of stack is obtrusive and does not blend with the neighborhood, the Contractor will provide either alternative source of power or provide a solution that is acceptable to the Employer/Engineer. This may include but not limited to providing appropriate cladding for the stack.

12. ENERGY MANAGEMENT

- 12.1 By using energy efficiently, the same services can be delivered with less energy, which helps protect the environment by preventing pollution.
- 12.2 Most of the energy including electrical, required during construction, would be generated by burning fossil fuels. When we use less energy, fewer fossil fuels are consumed which means less pollution. Thirty percent of energy consumed in buildings is used unnecessarily or inefficiently according to ENERGY STAR.
- 12.3 The Contractor should optimize the use of tools and plants and equipment to perform tasks with correct power. Optimizing cable sizes and joints can control voltage drops.
- 12.4 The Contractor should use energy efficient pumps (at least 80% efficiency) and motors (95% efficiency or more). The efficiency should be measured during installation and also periodically.
- 12.5 The Contractor should use Diesel Generating sets that have specific fuel consumption of at least 3.5 units per litre of diesel. The Contractor should rigorously follow the maintenance regime of his DG sets.
- 12.6 The Contractor should maximize the use of energy efficient luminaries such as CFLs and T5 florescent tubes, metal halide lamps and similar and ensure optimum illumination levels to save energy. The Contractor shall make provision of Earth Leakage Circuit Breakers (ELCBS) to prevent loss of excessive earth currents which are unsafe.
- 12.7 The Contractor should plan in advance and select locations to receive and store material such that these are at the least distance from place of use. Such an approach will result in less energy being consumed since optimum energy will be expended for transport of material.
- 12.8 The Contractor should plan works in a manner as to avoid reworking especially during meeting the interface requirements of systems Contractor.

13. TRAFFIC MANAGEMENT

- 13.1 Traffic Management for the project includes public roadways and sidewalks and the maintenance of access to residence, business and public services throughout

the construction area. Traffic delays and reduction in roadways capacity are anticipated during aspects of the construction of the Pune Metro

- 13.2 Even though vehicular, pedestrian and surface transit traffic will be impacted at a few locations, the Contractor should minimize such impacts through the development of Traffic Management Plans, which will be submitted in advance to the Engineer for his approval. These plans will provide specific guidance on traffic management for various portions of construction zones and staging.
- 13.3 The types of mitigation measures to be implemented by the Contractors will be on a site-specific basis and will include
- Signage and barriers for protecting and guiding pedestrians
 - Detour signs placed at strategic locations
 - Relocation of bus stops at construction sites
 - Provision of side walks of least 1.5m where feasible
 - Physical separation between construction zone and side walks of concrete barriers or wood fencing or mesh fencing
- 13.4 Wherever heavy equipment like cranes or dozers have to be moved on public roads and the normal moving dimensions are infringed, these shall be moved under advice to traffic police, and with adequate precautions and at low speed.

14. ARCHAEOLOGICAL AND HISTORIC RESOURCES

- 14.1 During the construction period, archaeological or historic resources may potentially be affected by direct or indirect construction activity. If any such structures are likely to be affected, special measures will have to be taken by the Contractor to protect such resources with the prior approval of Employer/Engineer
- 14.2 Prior to the initiation of construction Employer/Engineer shall review without objection a resource protection plan for historic structures where it appears they may be affected by the project. This plan will be developed by the Civil Contractor in consultation with The Archaeological Survey of India (ASI)/ other relevant agencies.
- 14.3 The plan will identify the sensitive resources as well as specify the construction monitoring requirements. These requirements may include ground vibration monitoring and recording any components inadvertently subjected to impact.
- 14.4 In the event the project will affect a previously unidentified historic property, work in the area of discovery shall cease until actions that will take into account the effect of the undertaking on the property can be implemented. The Ministry of Environment/Other relevant agencies and MMRCL shall determine how to proceed.

15. ENVIRONMENTAL MONITORING - GENERAL

- 15.1 The Contractor's Environmental Team shall carry out the monitoring of environmental impacts during construction. Representative sensitive receivers in the vicinity of the works shall be monitored for noise and air quality impacts.
- 15.2 For carrying out impact monitoring for noise and air, equipment shall be provided, operated and maintained by the Contractor. The equipment shall be kept in a good state of repair in accordance with the manufacturer's recommendations and

maintained in proper working order with sufficient spare equipment available in the event of breakdown to maintain the planned monitoring programme.

- 15.3 The calibration of monitoring instruments and their respective calibrators shall be carried out in accordance with the manufacturer's requirement to ensure they perform to the same level of accuracy as stated in the manufacturer's specifications.
- 15.4 Suspended Particulate Matter (SPM) levels shall be measured by following the standard high volume sampling method as set out in High Volume Method for Suspended Particulate, BIS: 5182-1981. Respirable Particulate Matter (RPM) shall be measured in underground station and tunnels in accordance with BIS 5182 Part 4, on the direction of Engineer.
- 15.5 24-hour average SPM concentration shall be measured by drawing air through a High Volume Sampler (HVS) fitted with pre-weighted Glass Fiber filter paper at an average flow rate not less than 1.1m^3 per minute. Similarly for RPM, respirable dust sampler, fitted with pre-weighted Glass Fiber and average flow rate of not less than $1.1\text{m}^3/\text{min}$ shall be used. The duration of monitoring of RPM shall be 24 hrs.
- 15.6 The minimum requirements to the specifications of sound level meter are given in IS: 9779-1981.
- 15.7 Employer will undertake baseline monitoring to establish background levels. Action Level of the Contractor shall be based on the results of baseline monitoring programme, which will be made available to him.
- 15.8 The Contractor's monitoring programme is summarised in Table –3, and shall be in accordance with the said National Ambient Air Quality Standards 2009 for the SPM notified by the MoEF

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Table –3: Summary of Contractor’s Environmental Monitoring Programme

Parameter	Noise	Air	
Sampling	Day Time (6 AM – 10PM) L_{max} , L_{eq} , L_{10} , L_{90} Night Time (10PM – 6AM) L_{max} , L_{eq} , L_{10} , L_{90}	SPM 24 hour	RPM 24 hour
Frequency at each location	Once a week (when noise-generating activities are underway).	Two 24 hours samples every fifteen days.	One 24 hours sample every 15 days
Locations and number	To be determined, by the Contractor and approved by the Engineer based on noise sensitive receptors, but at least at all metro station sites, Batching Plant and sensitive sites such as school, hospital archeological sites etc.	To be determined by the Contractor and approved by the Engineer, based on air sensitive receptors, but at least all metro station sites, Batching Plant and sensitive location like school hospital archeological site etc.	Inside tunnel and station box as directed by Engineer
Duration of Monitoring by Contractor	During Civil Construction	During Civil Construction	
Additional Monitoring	As directed by the Employer	As directed by the employer.	

The above indicated Contractor’s Environmental Monitoring Programme is mandatory and any additional monitoring, with respect to additional environmental attributes (like surface water & ground water, soil etc.), additional locations, frequency, parameters etc., as directed by the Engineer, will have to be undertaken by the Contractor.

16. AIR MONITORING

- 16.1 Construction activities that will generate dust impacts include excavation, material handling and stockpiling, vehicular movement, and wind erosion of unpaved work areas.
- 16.2 The impact of fugitive dust on ambient air pollution depends on the quantity generated, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and smaller particles are likely to undergo dispersal over greater distance from the sources and impeded setting. SPM and RPM levels will be monitored to evaluate the dust impact during the construction phase of the Project.
- 16.3 The Air Quality Monitoring and Control Plan (AMCP) in contract-specific Site Environmental Plan prepared by the Contractor shall establish procedures to monitor impact on air quality and measures to control air pollution including dust suppression due to construction activities at work sites. This plan shall contain

description of activities that will cause degradation in air quality, environmental procedures to manage pollutants, monitoring programme record keeping and reporting.

- 16.4 The Engineer shall monitor Contractor's performance of tasks specified and will inspect necessary records, reports and procedures related to the control of air quality given in AMCP.
- 16.5 Information gathered during the AMCP will be catalogued and maintained by the Contractor and shall be available for review by the Engineer.
- 16.6 The exact location of the air monitoring stations located near air sensitive receptors adjoining the construction sites, such as residences, schools, and hospitals and placement of monitoring equipment thereat shall be agreed with the Engineer prior to commencement of air monitoring programme.
- 16.7 Impact monitoring during the course of the Works shall be carried out at the monitoring stations for two days (continuous twenty-four hours) every fifteen days and where there is a perceived air quality problem.
- 16.8 The Contractor should construct suitable fence, lockable gate, 220V AC power point and suitable access at each air monitoring station. Monitoring stations should be free from local obstructions or sheltering.
- 16.9 Should impact monitoring record dust levels which are:
 - ◆ Indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
 - ◆ When in the opinion of the Engineer additional measurements are required in view of deteriorating air quality;

Then, the Employer/Engineer may require the Contractor to increase the frequency of impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of air quality.

- 16.10 The Contractor shall keep records of air quality monitoring (including location, date, time). The Contractor shall submit a copy of monitoring results to the Engineer. The results should represent a statistical evaluation of data by calculating maximum, minimum, mean, for valuation of trends, and comparison with emission standards.
- 16.11 The National Ambient Air Quality Standards given in Air (Prevention and Control of Pollution) Act, 1981 may be referred by the Contractor for Limit Levels of SPM and RPM in ambient air which may be followed in estimating the pollution level caused by Contractor's activities.
- 16.12 Where the Engineer determines that the recorded SPM level is significantly greater than the Limit levels, the Engineer may direct the Contractor to take effective remedial measures including, but not limited to, reviewing dust sources and modifying working procedures.
- 16.13 Where the recorded baseline levels exceed the ambient air quality standards, then at such locations the limit level is the recorded base line. Contractor shall take all effective remedial measures to contain the levels to their baseline value

as a result of his activities. The action level may be varied by and at the sole discretion of the Employer/Engineer .

- 16.14 The Contractor should inform the Engineer of all steps taken to investigate cause of exceedance and immediate action taken to avoid further exceedance through written reports and proposals for action.

17. NOISE MONITORING

- 17.1 The activities which are expected to cause noise during the construction of Pune Metro project include noise from construction equipment, construction activities such as portal construction, earthwork excavation, Tunnel/Station excavation particularly in rocks, concreting, and removal of spoil and movement of construction vehicles and delivery vehicles traveling to and from the construction and disposal sites.
- 17.2 The level of impact of these noise sources depends upon the noise characteristics of the equipment and activities involved, the construction schedule, and the distance from noise sensitive receptors.
- 17.3 The Noise Monitoring and Control Plan (NMCP) in contract specific site Environmental Management Plan prepared by the Contractor shall establish procedures to monitor construction noise and determine when to apply measures to control noise pollution due to construction activities at works site.
- 17.4 The NMCP will provide site description, define acceptable noise monitoring equipment, provide siting and operating procedures for noise equipment, indicate reports and record keeping on noise monitoring data.
- 17.5 The NMCP will provide guidance for construction activity. It shall also address noise performance criteria used in the selection of construction equipment. In defining the requirements of the NMCP, available measures for noise control, such as, the use of equipment with special exhaust silencers or enclosures, and the construction of temporary enclosures or noise barriers around specific construction site activity areas shall be considered.
- 17.6 The NMCP will be reviewed on a regular basis and updated as necessary to assure current construction activities are addressed.
- 17.7 The Engineer shall monitor Contractor's performance of tasks specified, and will inspect necessary records, report and procedures related to the control of noise.
- 17.8 Noise monitoring shall be carried out at noise sensitive receptor locations within 200 feet of the construction site once each week and after a change in construction activity. Construction noise measurements shall coincide with daytime and nighttime periods of maximum noise generating construction activities.
- 17.9 The appropriate parameter for measuring construction noise impacts shall be the equivalent A-weighted sound pressure level (L_{eq}) measured in decibels (dB). The two statistical sound levels L_{10} and L_{90} ; the level exceeded for 10 and 90 percent of the time respectively, shall also be recorded during monitoring. The L_{90} may be considered as the ambient level into which the L_{10} as average peak level intrudes. The L_{max} , L_{eq} , L_{10} and L_{90} values will be reported in the noise

measurement form along with allowable noise limit. The duration of monitoring shall be for a minimum of 30 minutes.

- 17.10 In no case shall the Contractor expose the public to construction noise levels exceeding 90dBA(slow) or to impulsive noise levels with a peak sound pressure level exceeding 140dB as measured on an impulse sound level meter.
- 17.11 Limit for construction noise is based on the existing ambient noise levels in areas adjoining the construction sites. If the measured noise levels exceed the noise limits, the noise levels shall be reduced by appropriate abatement measures.
- 17.12 The noise levels emanating from any source during construction, shall not exceed 10 dB (A) or more above existing ambient pre-construction noise levels when measured at a point outside the premises of the location of source. The same may be varied from time to time by and at the sole discretion of the Employer/Engineer.
- 17.13 Where there are no ambient noise measurements, the construction activities shall be limited to levels measured at a distance of 200 feet from the construction limits or at the nearest affected building, whichever is closer, as given in **Table - 4**.

Table- 4: Allowable Construction Noise

LAND USE	MAXIMUM NOISE LEVELS – L _{max} dB (A)	
Residential	Day Time 75	Night Time 65
Commercial	At all Times 85	
Industrial	90	

- 17.14 The ground borne noise levels within building structures due to tunnel boring machine and any other underground and tunneling construction activities shall not cause interior noise levels to exceed the levels given below as measured in the inside of the affected noise sensitive structure:

Residential: L_{max} 55dB(A)

Commercial: L_{max} 60dB(A)

- 17.14 At the surface of the construction site during nighttime hours, the Contractor shall use only equipment that operating under full load meets the noise limits specified in **Table-5**, if a sensitive receptor would be affected.

Table 5: Noise emission limits for construction equipment measured at 50 feet from construction equipment*

Equipment Category	L _{max} Level dB(A)
Backhoe	80
Bar Bender	75
Chain Saw	81
Compactor	80
Compressor	80
Concrete Mixer	85

Concrete Pump	82
Crane	85
Dozer	85
Front End Loader	80
Generator	82
Gradall	85
Grader	85
Paver	85
Pneumatic Tools	85
Scraper	85
Tractor	84

- 17.15 The adjustments for close in equipment noise measurement shall be made in accordance with **Table - 6**.

**Table – 6: Adjustments for close-in equipment noise measurements
(Measurement Values to be subtracted from Measured Sound)**

<u>Distance (Feet)</u>	<u>Level to Estimate Sound Level at 50 Feet dB (A)</u>
19-21	8
22-23	7
24-26	6
27-29	5
30-33	4
34-37	3
38-42	2
43-47	1
48-50	0

- 17.16 Should the impact monitoring record noise levels which are:
- indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
 - when in the opinion of the Employer/Engineer additional measurements are required in view of deteriorating noise environment,
- Then, the Employer/Engineer may require the Contractor to increase the frequency of impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of noise.
- 17.17 The Contractor shall inform the Engineer of all steps taken to investigate cause of exceedance and immediate action taken to avoid further exceedance through written reports and proposals for action.
- 17.18 The Contractor shall submit a copy of monitoring results. The results should represent a statistical evaluation of data for evaluation of trends and comparison with noise emission standards.

- 17.19 Where the Engineer determines that the recorded Noise level is significantly greater than the acceptable levels, the Engineer may direct the Contractor to take effective remedial measures including, but not limited to, reviewing noise sources and modifying working procedures.
- 17.20 Protection against the effects of occupational noise exposure should be provided when the sound levels exceed those shown in Table No. 7 below when measured on the A-scale of a standard sound level meter at slow response.
- 17.21 When employees are subjected to sound levels exceeding those listed in the Table No. 7 feasible administrative or engineering controls should be utilized.
- 17.22 If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

Table 7: Permissible Noise Exposures

Duration per day, Hours	Sound level (slow Response)
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

- 17.23 When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. Exposure to different levels for various periods of time shall be computed according to the formula as given below.

$$F_e = (T_1/L_1) + (T_2/L_2) + \dots + (T_n/L_n) \text{ where:}$$

F_e = The equivalent noise exposure factor.

T = The period of noise exposure at any essentially constant level.

L = The duration of the permissible noise exposure at the constant level (from Table)

If the value of F_e exceeds unity (1) the exposure exceeds permissible levels.

- 17.24 A sample computation showing an application of the above formula is as follows. An employee is exposed at these levels of these periods:

110 db A ¼ hour.

100 db A ½ hour.

90 db A 1 ½ hours.

Then,

$$Fe = (1/4 / 1/2) + (1/2 / 2) + (1 1/2 / 8)$$

$$Fe = 0.500 + 0.25 + 0.188$$

$$Fe = 0.938$$

Since the value of Fe does not exceed unity, the exposure is within permissible limits.

- 17.25 The vibration level limits at work sites adjacent to the alignment shall conform to permitted values of peak particle velocity as give in Table No. 8.

Table 8: Permitted Values of PPV

Sl. No.	Condition of Structure	Max. PPV in mm/sec
1.	Most structures in “good condition”	25
2.	Most structures in “fair condition”	12
3.	Most structures in “poor condition”	5
4.	Water supply structures	5
5.	Heritage structures/bridge structures	5

- 17.26 When Diesel Generator (DG) Sets are used for operation of equipment and machinery, then Ministry of Environment and Forest notification dated 17th May 2002, issued under Environment Protection Act (Protection) Rules, 1986, on noise limits shall apply.

18. ENVIRONMENTAL SITE INSPECTION

- 18.1 Site inspection shall be undertaken by the Contractor’s staff to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control measures are properly followed and implemented. The frequency of site inspection shall be at least once a week.
- 18.2 The Contractor shall prepare an ‘Environmental Inspection and Action Reporting System’, submit to the Engineer for approval and make amendments as suggested. It shall contain a contract specific comprehensive Environment Inspection checklist as requirement of Site Environmental Plan.
- 18.3 The area of inspection shall not be limited to environmental compliance within the site but areas outside the site which are likely to be affected, directly or indirectly by activities at site.
- 18.4 Results of inspection shall be discussed with Engineer and his recommendations on better environmental protection shall be notified to the Contractor for taking immediate action and rapid resolution of identified non-compliance.
- 18.5 If significant environmental problems are identified or if there is an environmental complaint or as a part of investigation work, then the Engineer shall also carry

out Ad hoc site inspection which shall be attended by Contractor's Representative.

19. ENVIRONMENTAL AUDITS

- 19.1 As indicated earlier in this Manual, the Engineer may undertake regular audits at quarterly intervals, of the Contractor's onsite practices and procedures as a means of assessing the ongoing performance of the Contractor.
- 19.2 A checklist of environmental requirements will be prepared and amended as necessary, throughout the construction phase to focus on areas of frequent non-compliance and to reflect the potential impacts associated with specific activities within the construction programme
- 19.3 The criteria against which the review will be undertaken will be derived from (but not be limited to :
- (a) The approaches, procedures and commitments given by the Contractor in the 'Site Environmental Plan'
 - (b) The clauses contained within the Employer's Requirement on Environment.
 - (c) The allocation of responsibility for fulfilling environmental requirements and the effective lines of communication with regard to environmental issues;
 - (d) Compliance with procedures established to enable and effective response to environmental incident, exceedance or non-compliance;
 - (e) The extent and accuracy of record-keeping related to environmental performance indicators;
 - (f) The effectiveness of ensuring high levels of awareness with regard to environmental requirements; and
 - (g) The effectiveness of environmental management activities, including the speed and effectiveness of responses to complaints.
- 19.4 The likely protocol will include (but not limited), the auditing of the following activities.
- The allocation of responsibility for fulfilling environmental requirements and effectiveness of lines of communication.
 - Compliance with procedures established to enable effective response to environmental issues.
 - The extent and accuracy of record keeping related to environment.
 - The effectiveness of staff training ensuring high levels of awareness with regard to environmental requirements.
 - The speed and effectiveness of responses to complaints.
- 19.5 The criteria against which the audits will be undertaken shall be derived from the clauses within the Employer's Requirements contract-specific Site Environmental Plan and previous site inspection results.

20. REPORTING SYSTEM

- 20.1 Reporting under the Environmental Management System will contain results of monitoring and inspection programmes.
- 20.2 In Site Environmental Plan, the Contractor shall prepare and submit monthly Environmental Management Reports in accordance with Employer's Requirements.

- 20.3 The monthly report shall include (but not limited to) the following:
- Executive Summary
 - Brief mention of construction activities
 - Monitoring results under AMCP, and NMCP
 - Interpretation of monitoring results, significance and influencing factors
 - Graphical representation of monitored results over past four reporting periods.
 - Details on Fly ash consumption as given in Appendix-III.
 - Raw material consumption details such as electricity, diesel, water
 - Generation of scrap during the month and sold to authorised recyclers
 - Generation of other type of waste and sold to respected authorised buyers.
 - Measures to control spills
 - Action taken on recommendation under site inspection programme or specific directions.
 - Summary of complaints, results of investigations and follow-up action
 - Future key issues.

21. COMPLAINT RESPONSE PROCESS

- 21.1 Enquiries, complaints and requests for information can be expected from a wide range of individuals and organisations both private and government. The majority of complaints are likely to be received by MMRCL, although the site offices are also likely to be contacted.
- 21.2 The objective of complaint process is to ensure that public and agency complaints are addressed and resolved consistently and expeditiously.
- 21.3 The Contractor's Site Manager will be notified immediately on receipt of complaint that may relate to environmental impacts. The Site Manager will immediately inform the Engineer
- 21.4 Field investigation should determine whether the complaint has merit, and if so action should be taken to address the impact.
- 21.5 The outcome of the investigation and the action taken shall be documented on a complaint Performa prepared by the Contractor and approved by the Engineer in advance of the works.
- 21.6 Where possible, a formal response to each complaint received shall be prepared by the Contractor within seven days in order to notify the concerned person(s) that action has been taken.

22. COMPLETION OF THE EMM PROGRAMME

- 22.1 The construction of Pune Metro Project will be undertaken as a series of individual construction contracts with necessarily different construction programme and completion dates.
- 22.2 The Engineer shall maintain an overview of the 'impact causing potential' of each site, monitoring parameter or contract with a view to maintaining the most cost effective use of the environmental resources dedicated to the Project.
- 22.3 For release of final bill the Contractor shall ensure
- (i) Closure of all non-conformance reports

- (ii) Submittal of all environment related documents and records pertaining to monitoring and trend analysis on key parameters such as but not limited to consumption/efficient use of resources such as energy, water material such as cement, fly ash, iron and steel, recycle/reuse of waste etc that shall demonstrate continual improvement in the implementation of Environmental Management System

Appendix –I SITE ENVIRONMENTAL PLAN OUTLINE

S.No	SITE ENVIRONMENTAL PLAN OUTLINE
1	GENERAL
(i)	The Environmental Policy of the Contractor is clearly defined in the Site Environmental Plan, which, inter-alia, commits the Contractor to follow national and state environmental legislation and regulations.
(ii)	The Contractor is committed to MMRCL 's Environmental Management System and shall provide desired manpower and financial resources for its success
(iii)	The person responsible for day-to-day environmental matters is identified and vested with authority to execute the Site Environmental Plan. The Contractor has environmental lines of communication.
(iv)	Procedure is available for Contractor's system of enforcing good environmental practices of its Sub-Contractor.
(v)	The Site Environmental Plan contains procedures for screening material used in the contract, for their environmental friendliness.
2	ENVIRONMENTAL FRIENDLY CONSTRUCTION PRACTICES
(i)	The Site Environmental Plan must contain specific procedures for achieving environmental performance requirements as given in the Employer's requirement on Environment and MMRCL Environmental Management Manual.
(ii)	Procedures for carrying out Aspect/Impact analysis of Contractor are proposed works and their affect on environment.
(iii)	Procedures for setting up Objectives and Targets commensurate with Employer's requirement on Environment and MMRCL Environmental Management Manual and how these shall be met.
(iv)	Procedures for formulating Environmental Management Plans and Operational Control Procedures to meet contractual requirements.
(v)	Procedures for offering environmental training and methods for promoting environmental awareness amongst his employees.
(vi)	The SEP must contain details on Air Monitoring and Control Plan which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.
(vii)	The SEP must contain details on Noise Monitoring and Control Plan which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.
(viii)	The SEP must contain procedures on prevention and control of water pollution from sanitary surface runoff and process wastewater.
(ix)	The SEP must contain details on procedures for Storage, handling and disposal of waste including, municipal, construction, chemical and hazardous wastes.
(x)	The SEP must contain procedures for reuse/recycle of waste, selling to authorised recyclers and records thereof.
(xi)	The SEP must contain procedures for preservation of landscape disturbed due to construction, house keeping and traffic management as required under the contract.

(xii)	The SEP must contain procedures for dealing with unforeseen environmental situations under Environmental Emergency.
3	MONITORING, AUDITS AND RECORDS
(i)	The Contractor keeps records of environmental monitoring and the SEP contains provision for reporting results of environmental monitoring in a manner as specified in the contract.
(ii)	The Contractor carries out weekly inspection under the 'Environmental Inspection and Action Reporting System' through Environmental Inspection checklist and submits to the Engineer.
(iii)	The SEP contains procedures for mandatory audits by the Contractor as given in the contract.
(iv)	The SEP contains provisions for submitting monthly Environmental Quality Management reports.
(v)	The SEP contains procedures for recording environmental complaints and response process.

Appendix – II Weekly Environmental Inspection Checklist

SUMMARY SHEET

1. Major issues of non-conformity in the past week are:

	Issue	Reason
(i)	Air (Specify)	
(ii)	Water (Specify)	
(iii)	Noise (Specify)	
(iv)	Waste (Specify)	
(v)	Storage (Specify)	
(vi)	Housekeeping (Specify)	
(vii)	Roads (Specify)	

2. Over the last week have been able to implement environmental management requirements as per contract

☐

Yes

☐

No

if not yes reasons are

- (i)
- (ii)
- (iii)

3. Following issues have not been resolved for more than past two weeks

- (i)
- (ii)
- (iii)

4. Support/Clarification from Employer/Engineer required in the following:

- (i)
- (ii)
- (iii)

5. Complaints received in the past week.

	From	Action Taken	Reasons for
(i)	Delay		
(ii)	Public		
(iii)	Client		
(iv)	Statutory Agency		

Auditor:

Project Manager

Contract Number:

Contractor:

Environmental Manager	Project Director	Document No.:
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Weekly Environmental Inspection

Report No.:	Inspection Date:	Inspected by :
Inspection Area:		
Participants:		

SL NO	ITEM	OBSERVATION	REMARKS	ACTION	
				By Date	By whom
1.0	AIR POLLUTION				
1.1	Dust (Approach roads, adjacent roads, working area, cement handling etc.)	<input type="checkbox"/> Site Satisfactory <input type="checkbox"/> Site Dusty <input type="checkbox"/> Sprinkling carried out as required <input type="checkbox"/> Excavate removal within 2 days			
1.2	Generators	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Maintenance regime followed <input type="checkbox"/> Black smoke <input type="checkbox"/> Leaking oil <input type="checkbox"/> Drip Pans not available			
1.3	Vehicles	<input type="checkbox"/> Satisfactory <input type="checkbox"/> PUC certificate available <input type="checkbox"/> Black smoke <input type="checkbox"/> Wheel Washed /Cleaned <input type="checkbox"/> Leaking oil <input type="checkbox"/> Side of vehicle clear of mud <input type="checkbox"/> Material transported in closed manner			
1.4	Air Monitoring	<input type="checkbox"/> Carried out as per contract <input type="checkbox"/> Results reported as per contract <input type="checkbox"/> Remedial measures in place where required			
2.0	WATER POLLUTION				
2.1	Site Drains	<input type="checkbox"/> Drainage system functional <input type="checkbox"/> No Contamination <input type="checkbox"/> Not blocked by debris/ garbage <input type="checkbox"/> No indications of Oil spilled in drains <input type="checkbox"/> Storage of chemical waste not			

SL NO	ITEM	OBSERVATION	REMARKS	ACTION	
		nearby			
2.1	Site Drains	<input type="checkbox"/> storage of refuse/ excavate muck not near the drains			
2.2	Adjacent Drains	<input type="checkbox"/> Not damaged <input type="checkbox"/> No signs of pouring bentonite <input type="checkbox"/> No signs of pouring Chemicals <input type="checkbox"/> Signs of discharging Silt/ debris			
2.3	Separator Tanks	<input type="checkbox"/> Tank not full of silt <input type="checkbox"/> Tank regularly emptied			
3.0	NOISE POLLUTION				
3.1	Noise control measures	<input type="checkbox"/> All powered mechanical equipments are sound reduced <input type="checkbox"/> Acoustic / enclosures constructed in areas of excessive noise <input type="checkbox"/> Equipment located and directed away from noise receptors			
3.2	Generators Provided with acoustic enclosures	<input type="checkbox"/> Effective <input type="checkbox"/> Not effective <input type="checkbox"/> Not provided			
3.3	Noise Monitoring	<input type="checkbox"/> Carried out as per contract <input type="checkbox"/> Not exceeded baseline values <input type="checkbox"/> Remedial measures in place <input type="checkbox"/> Results evaluated statistically for inclusion in Monthly report			
4.0	WASTE MANAGEMENT				
4.1	Waste Identified	<input type="checkbox"/> Chemical Flammable Corrosive Construction related/ oil/ Filters/ Batteries <input type="checkbox"/> Hazardous <input type="checkbox"/> Other (Specify)			

SL NO	ITEM	OBSERVATION	REMARKS	ACTION	
4.2	Storage Containers & Bins	<input type="checkbox"/> Adequate number and properly place <input type="checkbox"/> Proper quality <input type="checkbox"/> Emptied regularly <input type="checkbox"/> Labeling proper <input type="checkbox"/> No spillage on container surface noticed			
4.2	Storage Containers & Bins	<input type="checkbox"/> Pollutants (e.g. waste chemical), not dumped in bins <input type="checkbox"/> Recyclable (e.g. metal) not dumped in garbage bins			
4.3	Oil Waste	<input type="checkbox"/> Drip pans available <input type="checkbox"/> No oil stains on ground <input type="checkbox"/> Spill absorption material available <input type="checkbox"/> Waste oil poured in to designated waste drums <input type="checkbox"/> Used oil filters not dumped in garbage bins			
4.4	Excavate/Muck	<input type="checkbox"/> Storage satisfactory/ properly secured <input type="checkbox"/> Dumping in authorized areas <input type="checkbox"/> No interference with nearby drainage			
5.0	STORAGE				
5.1	Diesel Storage	<input type="checkbox"/> Extensive diesel spillage on ground not visible <input type="checkbox"/> Drip pans used when pumping diesel <input type="checkbox"/> Pipes / connectors/ pumps not leaking <input type="checkbox"/> Not located close to storm water drains <input type="checkbox"/> transfer arrangement satisfactory			
6.	AESTHETICS & CLEANLINESS				

SL NO	ITEM	OBSERVATION	REMARKS	ACTION	
6.1	Housekeeping & Hygiene	<input type="checkbox"/> Designated storage area for materials <input type="checkbox"/> Scraps/brickbats/rubbish scattered at site <input type="checkbox"/> Proper space for handling waste <input type="checkbox"/> Area Clean and dry <input type="checkbox"/> Stagnant water treated weekly <input type="checkbox"/> Proper stacking of drums <input type="checkbox"/> Barricades are clean, in line, firmly secured and proper earthing <input type="checkbox"/> Water not allowed to accumulate in work area for any reason			
7.0	ROADS				
7.1	Access Roads	<input type="checkbox"/> Satisfactory Maintenance <input type="checkbox"/> In urgent need of Maintenance			
7.2	Public Roads used by Contractor	<input type="checkbox"/> Satisfactory maintenance <input type="checkbox"/> Repair not carried out			

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APPENDIX - III - DETAILS ON FLY ASH

The Employer/Engineer shall give his consent to the Civil Contractor for using Fly Ash in concrete or brick works. The Contractor shall record all relevant details on the consumption of Fly Ash from the data of initial consumption to date of final use.

The details on Fly Ash consumption shall be reported on a monthly basis in the Contractor's monthly Environmental Management Report required to be submitted to the Engineer.

The details on Fly Ash shall be reported in groups and sub groups as noted below: -

F1 Data required from the Concrete Production Contractor

F1.1 Concrete Production

- Daily records of concrete production
- Mix Design

F1.2 Material consumption from Daily production Records:

- Cement delivery records
- Fly ash delivery records

F1.3 Transportation Cement

- Load capacity of cement delivery vehicles (tons)
- Distance of batching plants to cement plant (km)
- Fuel consumption of delivery vehicles (km/l)

F1.4 Transportation (Fly Ash)

- Load capacity of fly ash delivery vehicles (tons)
- Distance of batching plants to fly ash source (km)
- Fuel consumption of delivery vehicles (km/l)

F2 Data required from Cement Manufacturer (to be obtained by the Contractor and submitted to the Engineer, on a monthly basis)

F2.1 Process Emission from daily production records

- Quantity of calcareous raw material (limestone etc.) consumed
- % of CaO in raw material
- % of MgO in raw material
- % of CaO in clinker
- % of MgO in clinker
- Quantity of clinker produced

F2.2 Kiln fuel emissions from Monthly Consumption Records

- Quantity of each type of fuel used in the kiln
- CO₂ Emission factor (tons CO₂/MJ) and specific heat for each fuel type (MJ/Kg)
Or % carbon and density (if liquid) for each fuel type

F2.3 Non- Kiln Fuel emission from Monthly consumption records

- Quantity and specific uses for each type of non-kiln fuel used
- CO₂ emissions factor (tons CO₂/MJ) and specific heat for each fuel (MJ/kg)
Or % carbon and density (if liquid) for each fuel type

F2.4 Emission from Electricity consumption in clinker production from Monthly electricity consumption records

- Electricity consumption of equipment related to cement production (kWh)
- Grid electricity supplier
- Quantity of electricity drawn from grid
- Quantity of electricity self generated
- Fuel consumption of generating plant
- Waste heat capture from kiln

F2.5 Additives from daily production records

- Quantities of all additives blended with clinker at cement plant

F2.6 Cement Delivery

Monthly records of cement delivery to batching plants