KMRC

KOLKATA METRO RAIL CORPORATION LIMITED
EAST WEST METRO PROJECT

CONTRACT – UG- L & E (PHASE-II)

DETAILED DESIGN, DETAIL ENGINEERING, PROTOTYPE, MANUFACTURE, SUPPLY, DELIVERY AND STORAGE AT SITE, INSTALLATION, TESTING AND COMMISSIONING (INCLUDING INTEGRATED TESTING & COMMISSIONING), TRAINING OF PERSONNEL, DEMONSTRATION OF PERFORMANCE OFSYSTEM/ EQUIPMENT & ANNUAL MAINTENANCE CONTRACT OF LIFTS & ESCALATORS (L & E) OF FOUR UNDERGROUND STATIONS OF KOLKATA METRO EAST-WEST LINE PROJECT (PHASE - II)

TENDER DOCUMENTS

VOLUME 4

KMRCL CONDITIONS OF CONTRACT ON SAFETY, HEALTH AND ENVIRONMENT MANUAL (CD)

KOLKATA METRO RAIL CORPORATION LIMITED
KMRCL BHAWAN (2ND & 3RD FLOOR), HRBC COMPLEX,
MUNSHI PREMCHAND SARANI,
KOLKATA 700 021
INDIA

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KOLKATA METRO RAIL CORPORATION LIMITED
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KOLKATA METRO RAIL CORPORATION LIMITED

EAST WEST METRO PROJECT

CONDITIONS OF CONTRACT ON SAFETY HEALTH AND ENVIRONMENT

Version 1

August 2009

KOLKATA METRO RAIL CORPORATION LIMITED
KMRC BHAWAN (2ND & 3RD FLOOR), HRBC COMPLEX,
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PART – I : SHE MANAGEMENT

1.0 General

1.1 Scope

1.1.1 This document defines the principal requirements of the Employer on Safety, Health and Environment (SHE) associated with the contractor / sub-contractor and any other agency to be practiced at construction worksites at all time.

1.2 Definition / languages

1.2.1 In this document

i) The use of 'shall' indicates a mandatory requirement.

ii) The use of 'should' indicates a guideline that is strongly recommended.

iii) The use of 'may' indicates a guideline that is to be considered.

iv) 'SHE' means Safety, Health and Environment.

v) Employer means Kolkata Metro Rail Corporation Ltd., (KMRC).

vi) Chief Safety Officer means an officer nominated by KMRC who is overall responsible for monitoring all SHE functions prescribed in this document.

vii) BOCWA means Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996

viii) BOCWR means Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998

ix) DG means Director General of Ministry of Labour, Govt. of India.

1.3 Application of this document

1.3.1 This document applies to all aspects of the contractor's scope of work, including all aspects conducted by sub-contractors and all other agencies. There shall be no activity associated to the contract, which is exempted from the purview of this document.

1.3.2 Without giving any prior notice, the EMPLOYER shall from time to time be entitled to add/or amend any or all requirements of its Safety Health and Environmental Manual, with a view to improving safety and occupational health of personnel and safety of work, with immediate effect with no cost to the EMPLOYER, and the same shall be binding on the CONTRACTOR. The contractor agrees to implement all such amendments, which shall be laid down by the EMPLOYER.

1.4 Purpose of this document

1.4.1 The objective of these guidelines is to ensure that adequate precautions are taken to avoid accidents, occupational illness and harmful effects on the environment during construction.

1.4.2 This document:

i) Describes the SHE interfaces between Employer and the Contractor.
ii) Details the processes by which the contractor shall manage SHE issues while carrying out the work under the contract.
iii) Describes by reference, the practices and procedures as given in the KMRC Project Safety, Health & Environment manual for best SHE performance.

1.4.3 These requirements shall be read together with KMRC Project SHE Manual, SHE Manual Augment Guidance Implementation Language, general guidance of OHSAS 18001-1999 Occupational Health and Safety Management System and ISO 14001: 2004 Environmental Management Systems. Definition of key terms used in these requirements related to OHSAS 18001 and ISO 14001 standards are found in KMRC's Project SHE Manual.

2.0 'SHE' Targets and Goals

2.1 The SHE targets, goals and aim for the Works are to achieve:

i) Zero total recordable injuries.
ii) Zero reportable environmental incidents
iii) All personnel inducted in accordance with the approved contractor SHE plan
iv) Total compliance of conducting inspections and audits as per approved SHE plan
iv) 100% incident recording and reporting
v) 100% adherence of usage of appropriate PPEs at work.
vi) Executing construction work with least disturbance to the environment, adjoining road users and traffic.

3.0 Compliance

3.1 Memorandum of Understanding (MOU)

3.1.1 A Memorandum of Understanding placed at Appendix No.: 1 shall be executed before the award of contract by the contractor with regard to various provisions on Safety, Health and Environment to be practiced during the construction work.

3.2 KMRC's SHE Policy and Management Systems

3.2.1 The construction works shall be undertaken in accordance with KMRC's SHE Policy and Management Systems as amended from time to time provided in Project SHE Manual.

3.3 Indian statutory requirements

3.3.1 Primary statutory regulations

3.3.1.1 Contractor shall develop thorough understanding about Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996, Central Rules 1998; Building and Other Construction Workers' Welfare Cess Act, 1996 and Central Rules, 1998; not only to satisfy the Inspectors' perspective, but to use legislation as the strong tool for effective SHE management at construction worksites. Contractor is strongly advised to practice the principle of voluntary compliance.

3.3.1.2 In order to facilitate the contractor for better understanding on the various provisions of the above Acts, a tabulated information highlighting the Sections/Rules referring to the corresponding registration of contractors, maintenance of registers and records, hours of work and wages, welfare, medical facilities and safety requirements are given in Appendix No.: 2. It is an indicative one and not a limiting list.

3.3.2 In addition, the construction works shall be undertaken in accordance with all applicable legislation and Indian statutory requirements listed below but not limiting to:

i) Indian Electricity Act 2003 and Rules 1956
ii) National Building Code, 2005
iii) Factories Act, 1948.
iv) Motor Vehicles Act as amended in 1994 and The Central Motor Vehicles Rules, 1989.
v) Indian Road Congress Code IRC: SP: 55-2001 'Guidelines on Safety In Road Construction Zones.
vi) The Petroleum Act, 1934 and Rules 1976
vii) Gas Cylinder Rules, 2003
viii) Indian Explosives Act. 1884, along with the Explosives substance Act 1908 and the Explosives Rules 1983
ix) The (Indian) Boilers Act, 1923
x) The Public Liability Insurance Act 1991 and Rules 1991
xi) Minimum Wages Act, 1948 and Rules 1950
xii) Contract Labour Act, 1970 and Rules 1971
xiii) Child Labour (Prohibitions & Regulations) Act, 1986 and Rules 1950
xiv) Environment Protection Act, 1986 and Rules 1986
xv) Air (Prevention and control of Pollution) Act, 1981
xvi) Water (Prevention and Control of Pollution) Act, 1974
xvii) The Noise Pollution (Regulation & Control) Rules, 2000
xviii) Notification on Control of Noise from Diesel Generator (DG) sets, 2002
xix) Recycled Plastic Usage Rules, 1998
xx) Notification, Central Ground Water Board, Act January 1997
xxi) Manufacture, Storage & Import of Hazardous Chemicals Rules, 1989
xxii) The Hazardous Waste (Management & Handling) Rules, 1989
xxiii) Hazardous Waste Management Rules 1989 (as amended in 1999)
xxiv) Fly ash utilization notification, Sept 1999 as amended in August 2003
xxv) Batteries (Management and Handling) Rules

3.3.3 Workman Compensation Act, 1923 along with allied Rules

3.3.3.1 The contractor shall ensure that all his employees / workmen are covered under 'Workmen Compensation Act' and shall pay compensation to his workmen as and when the eventuality for the same arises.

3.3.3.2 Notwithstanding the above Act/Rules, whereby each employee/ workman is covered by Worker's Compensation Insurance, the contactor shall not resort to treating his injured employees (for the benefit of saving money) at government hospitals catered for the poor. Further, these do not provide the level of medical administration called for by the SHE requirements to establish medical fitness and category of injury.

3.3.4 Not withstanding the above Act/Rules, there is nothing in those to exempt the contractor from the purview of any other Act or Rule in Republic of India for the safety of men and materials.

3.3.5 If the requirements stated in this document are less stringent than or in conflict with the country's applicable legislation, the latter shall apply. Any discrepancy and ambiguity within these requirements that leads to a lack of understanding shall be brought to the attention of the Employer without delay for further claricication.

3.4 International Standards, Guidelines & ISO Certifications

3.4.1 The works should be undertaken in accordance with the applicable international guidelines, standards and specifications on SHE and every contract shall aim to achieve ISO certifications listed below during the currency of the contract:

OHSAS 18001-1999 : Occupational Health and Safety Management System.
ISO 14001-2004 : Environmental Management Systems.

3.4.2 The process of certification shall start immediately after the award of the work and complete within reasonable time. Towards this, the contractor shall undertake the required steps including appointment of ISO consultant for obtaining the certification on Occupational Health and Safety Management System and Environment Management System.

3.4.3 In case of failure on the part of the contractor, the Employer at the cost of the contractor shall do the same.

4.0 Contractor SHE Policy and Plan

4.1 The contractor as per Section 39 of the BOCW Act shall formulate a SHE policy and get it approved by the EMPLOYER respectively and display it at conspicuous places at work sites in Hindi and a local language understood by the majority of construction workers.

4.2 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 coordinating 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;

iv) 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

4.3 The Contractor shall, from time to time and as may be required by the Employer, produce supplements to the SHE Plan such that it is at all times a detailed, comprehensive and contemporary statement by the Contractor of his site safety, industrial health and environmental 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.

4.4 If, at any time in the Employer's opinion, the SHE plan is deemed insufficient or found to require 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.

4.5 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.

4.6 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.

4.7 The details of contents to be covered in the site SHE plan are given in ***Appendix No.: 3.***

5.0 Designer's role

5.0 Designer's role in Safety, Health and Environment

5.1 Designer's primary role includes to minimise the risk to health and safety of those who are going to construct, maintain, clean, repair, dismantle or demolish the structures and anyone else like adjoining road users/general public, who might be affected by the work.

5.2 General philosophy

5.2.1 When considering health and safety in designer's work, they shall be expected to do what is reasonable at the time the design is prepared. It may be possible for hazards, which cannot be addressed at the feasibility stage to be looked at during detailed design. In deciding what is reasonably practicable, the risk to health and safety produced by a feature of the design has to be weighed against the cost of excluding the feature. The overall design process does not need to be dominated by a concern to avoid all risks during the construction phase and maintenance. However, a judgment has to be made by weighing up one consideration against another so the cost is counted not just in financial terms, but also those of fitness for purpose, aesthetics, buildability or environmental impact. By applying these principles, it may be possible to make decisions at the design stage, which will avoid or reduce risks during construction work. In many cases, the large number of design considerations will allow a number of equally valid design solutions. What is important is the approach to the solutions of design problems. This should involve a proper exercise of judgment, which takes account of health and safety issues.

5.3 Hierarchy of Risk Control

5.3.1 Designers shall need, so far as reasonably practicable, to avoid or reduce risks by applying a series of steps known as the hierarchy of risk control or principles of prevention and protection. The steps to be adopted shall include the following:

i) consider if the hazard can be prevented from arising so that the risk can be avoided (e.g., alter the design to avoid the risk);

ii) if this cannot be achieved, the risk should be combated at source (e.g., ensure the design details of items to be lifted include attachment points for lifting);

iii) failing this, priority should be given to measures to control the risk that will protect all people;

iv) only as a last resort should measures to control risk by means of personal protection be assumed (e.g., use of safety harnesses).

5.4 Duty to provide health and safety risks in the drawing itself

5.4.1 In case of situations were the designers have carried out the design work and concluded that there are risks, which was not reasonably practicable to avoid, detailed information shall be given about the health and safety risks, which remain. This information needs to be included with the design to alert others to the risks, which they cannot reasonably be expected to know. This is essential for the parties who have to use the design information.

5.4.2 If the designers' basic design assumptions affect health or safety, or health and safety risks are not obvious from the standard design document, the designer shall provide additional information. The information shall include a broad indication of the assumptions about the precautions for dealing with the risks. The information will need to be conveyed in a clear manner; it shall be included on drawings, in written specifications or outline method statements. The level of detail to be recorded will be determined by the nature of the hazards involved and the associated level of risk.

5.5 Employer's approval

5.5.1 Every structure like scaffold, false work, launching girder, earth retaining structures etc. shall have its design calculations included in the method statements in addition to health

and safety risks. Employers' designer or his approved proof check consultants as applicable as per the contract conditions shall approve all these designs.

5.6 Any non-standard structures like trestles made up of re-bars or structures which are very old, corroded, repaired for many times etc. for which no design calculations can be made accurately from any national standards, shall not be allowed to be used at sites even for short duration.

5.7 If any of the above-mentioned clauses are not adhered penalty shall be imposed depending upon the gravity of the unsafe act and or condition

6.0 Contractor SHE Organisation

6.1 Education and Experience

6.1.1 The contractor shall appoint the required SHE personnel as prescribed in General Instruction ***KMRC/SHE/GI/001/MPR/281105*** (enclosed at the end) based upon the statutory requirement and establish the safety organisation based upon the contract value. The minimum educational qualification and the work experience are given in General Instruction ***KMRC/SHE/GI/002/QE/281105***.

6.1.2 In order to effectively interact on labour and welfare matters with the Employer and the statutory authorities enforcing the labour welfare legislation, every contractor shall employ a full time Labour and Welfare Officer, duly qualified and experienced as per clause *6.1.1.*

6.2 Conduct and competency

6. 2.1 The conduct and functions of the contractor's SHE personnel shall be monitored by the Employer. Any default or deficiency shall attract penalty as per details given under penalty clause ***56.0*** of this document.

6.2.2 The Contractor shall ensure that all personnel are competent to perform the job assigned to them. In the event that the Contractor is unable to demonstrate the competency of any person whose activities can directly impact on the Works' SHE performance, the Employer shall remove that person from the site without any procedural formalities.

6.3 Approval from Employer

6.3.1 The name, address, educational qualification, work experience and health condition of each personnel deployed for SHE jobs shall be submitted to the Employer in the format prescribed for the purpose for comments and approval well before the start of the work. Only on approval by the Employer these personnel are authorised to work. In case any of the SHE personnel leaves the contractor the same shall be intimated to the Employer. The contractor shall recruit new personnel and fill up the vacancy.

6.4 Responsibility of SHE personnel

6.4.1 For all works carried out by the contractor and his sub-contractors, the responsibility of ensuring the required SHE manpower lies with the main contractor only. The minimum required manpower indicated by the Employer includes the sub-contractors' work also. It shall be the responsibility of the main contractor to provide required SHE manpower for all the

works executed by all contractors. Necessary conditions shall be included in all sub-contract documents executed by the main contractor.

6.5 Employment status of SHE personnel

6.5.1 No contractor shall engage SHE manpower from any outsourcing agencies in which case the effectiveness would be lost. All SHE manpower shall be on the payroll of the main contractor only and not on the payroll of any subcontractor or outsourcing manpower agencies etc. This condition does not apply to positions like traffic marshals who are engaged almost on a daily requirement basis.

6.6 Reporting of SHE personnel

6.6.1 All SHE personnel are to report to the Chief SHE Manager who shall report directly to the Chief Project Manager. The Employer shall monitor adherence to this procedure at all times. In case of non-adherence penalty shall be levied as indicated in the penalty clause.

6.7 Inadequate SHE personnel

6.7.1 If the Contractor fails to provide the minimum required manpower as illustrated in General Instruction *KMRC/SHE/GI/001/MPR/281105*, or fails to fill up vacancies created within 14 days, the same may be provided by the Employer at the Contractor's cost. Any administrative expenses involved to provide this cover, e.g. newspaper advertisement or manpower consultant charges, etc., shall also be at the cost of the Contractor.

6.8 Prohibition of performance of other duties

6.8.1 No SHE personnel shall be required or permitted to do any work which is unconnected to, inconsistent with or detrimental to the performance of the SHE duties for respective category mentioned in General Information ***KMRC/SHE/GI/001/MPR/281105***

6.9 Facilities to be provided to SHE personnel

6.9.1 As per schedule VIII of BOCWR, the contractor shall provide all SHE personnel with such facilities, equipment and information that are necessary to enable him to carry out his duties effectively.

6.9.2 The minimum Employer's requirements of such facilities / equipments to be provided for SHE personnel are given in the General Instruction ***KMRC/SHE/GI/003/AVE/28112005***.

7.0 Contractor SHE Committee

7.1 All employees should be able to participate in the making and monitoring of arrangements for safety, industrial health and environment at their place of work. The establishment of site SHE committees in which employees and Contractor and sub-contractor management are represented can increase the involvement and commitment of employees. The contractor shall ensure the formation and monitor the functioning of contractor SHE committees.

7.2 Terms of Reference

7.2.1 The Terms of Reference for the committee shall be as follows;

i) To establish company safety policies and practices

ii) To monitor the adequacy of the contractor's site SHE plan and ensure its implementation

iii) To review SHE training

iv) To review the contractor's monthly SHE report.

v) To identify probable causes of accident and unsafe practices in building or other construction work and to suggest remedial measures.

vi) To stimulate interest of Employer and building workers in safety by organizing safety week, safety competition, talks and film-shows on safety, preparing posters or taking similar other measures as and when required or as necessary.

vii) To go round the construction site with a view to check unsafe practices and detect unsafe conditions and to recommend remedial measures for their rectifications including first-aid medical and welfare facilities.

viii) Committee team members should perform a site inspection before every committee meetings and to monitor SHE inspection reports.

ix) To bring to the notice of the Employer the hazards associated with use, handling and maintenance of the equipment used during the course of building and other construction work

x) To suggest measures for improving welfare amenities in the construction site and other miscellaneous aspect of safety, health and welfare in building or other construction work.

xi) 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.

xii) To review the last safety committee meeting minutes and to take action against persons/sub-contractors for non-compliance if any.

7.3 Within 14 days of award of contract, the SHE committee shall be constituted and notification regarding the same shall be communicated to the members and employees as per the format provided in ***Form No.: SF 001***

7.4 Site SHE Committee meeting shall be conducted at least once in a **month** with the minimum members listed below:

Chairman	Project Manager
Secretary	SHE Manager (In-charge)
Members	i) Labour Welfare Officer ii) In charge of plant and machinery iii) In charge of site electrics iv) In charge of stores. v) Senior Managers/ Engineers heading different sub functions. vi) Sub – contractor's representative vii) Labour Contractor's representative viii) Workers' representative ix) Co-contractor representative. x) SHE staffs
Employer's Representatives	KMRC SHE in charge and other representatives

7.5 Construction SHE Committee meeting shall be conducted at least once in a week with the minimum members listed below:

Chairman	Project Manager
Secretary	SHE Manager (In-charge)
Members	i) Labour Welfare Officer ii) In charge of plant and machinery iii) In-charge of site electricity iv) Senior Managers / Engineers heading different sub functions v) Sub- Contractor's representative vi) Labour contractor's representative vii) Workers' representatives viii) All SHE Staffs

7.6 **Co-contractors' participation**

7.6.1 In case of depot, station and other contiguous areas where more than one main contractors are working together, the Employer shall instruct the other contractors to join for the monthly SHE committee meeting of the main civil contractor, so as to discuss and decide about the common provision of security, lighting, toilet, drinking water etc. and sharing the maintenance cost of the same etc.

7.6.2 **The general principle for sharing the cost shall be either based on the contract value of works executed at the contiguous area or the daily average number of workmen employed by each contractor in the contiguous area.**

7.7 Minimum time between two monthly SHE Committee meetings

7.7.1 A minimum period of **21 days** shall be maintained between any two SHE monthly committee meetings.

7.8 Agenda

7.8.1 The Secretary shall circulate the agenda of the meeting at least seven working days in advance of the scheduled date of the meeting to all members.

7.8.2 The agenda should broadly cover the following:

i) Confirmation of minutes

ii) Chairman's review/overview of site SHE performance / condition

iii) Previous month SHE statistics

iv) Incident and Accident Investigation / dangerous occurrence / near miss report

iv) Site SHE inspection

v) Sub-contractors' SHE issues

vi) Safety presentation by Members

vii) Report from Employer

ix) Matters arising

ix) Any other business

7.9 Minutes of the meeting

7.9.1 The Minutes of the meeting shall be prepared as per the format provided at ***Form No.: SF-002*** and sent to all members within 2 working days preferably by mail/fax followed by hardcopy. Safety Committee meeting minutes shall also be displayed in the notice board for wider publicity to all concerned.

7.10 Disciplinary Action

7.10.1 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 monitory penalty as per the relevant contract clauses, the Employer shall ensure that the same is implemented.

8.0 ID Card and First day at work, SHE orientation training

8.1 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 ***KMRC/SHE/GI/004/OT/281105***.

8.2 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 ***KMRC/SHE/GI/005/IDC/281105***

8.3 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.

9.0 SHE Training

9.1 The behaviour of people at all levels of the contractor is critical for SHE performance.

9.2 The contractor shall organise quality SHE training to engage Managers, supervisors and other personnel in behavioural change and improve safety performance.

9.3 The Contractor shall analyse the training requirements for all the employees and initiate a training program to demonstrate that all persons employed, including subcontractors, are suitably qualified, competent and fit. This will include:

i) Detailed Job descriptions for all personnel, to include their specific SHE responsibilities
ii) Specification of qualifications, competency and training requirements for all personnel
iii) Assessment and recording of training needs for all personnel, including subcontractors' employees in the workforce, vendor representatives and site visitors
iv) A system for assessing new hirers e.g. previous training
v) A means of confirming that the system is effective
vi) A matrix and schedule of training requirements, covering general, task–specific and SHE-related training, showing the training frequency and interval between refresher courses
vii) Timely, competent delivery of training courses

9.4 The contractor shall arrange behavioural-based training programmes for all the executives to identify, recognise and eliminate unsafe act and unsafe conditions.

9.5 The minimum Employer's requirement of training needs for various categories of employees are given in general instruction ***KMRC/SHE/GI/006/TM/281105***

9.6 The contents of SHE training to Managers/Supervisors as given in general instruction ***KMRC/SHE/GI/007/TMS/281105*** shall be conducted.

9.7 The refresher-training programme shall be conducted for all employees once in every 12 months.

9.8 Toolbox talk as given in the Employer's Project SHE manual shall be conducted daily with all workmen undertaking high-risk activities.

9.9 On-the spot practical skill development training on safety issues, including working at heights, safety of scaffolding, crane safety, welding safety, electrical safety, traffic safety for marshals shall also be conducted with all foremen/ workmen associated with these activities.

9.10 NOT USED.

9.11 All vehicle drivers and operators shall be trained in defensive driving techniques, as may be provided by a West Bengal State Licensing Agency or equivalent agency approved by KMRC. All vehicle drivers shall also undergo refresher training on defensive driving provided by the same entity once in 6 months.

9.12 All the above listed training programmes except at clause 9.11 shall be organised by the contractor only after taking approval from the Employer for the training faculty / organisation, content and durations.

9.13 In case of failure on the part of the contractor to provide all the above-mentioned training programs to all employees in time, the same may be provided by the Employer through accredited agencies if required by formulating a common scheme to all contractors. Any administration expenses and training fee towards the same shall be at the cost of the Contractor.

10.0 SHE Inspection

10.1 The contractor shall evolve and administer a system of conducting SHE inspections and other risk management analysis on a periodical basis.

10.2 The purpose of SHE inspection is to identify any variation in construction activities and operations, machineries, plant and equipment and processes against the SHE Plan and its supplementary procedures and programs.

10.3 Following SHE inspections program shall be adopted.

i) Planned General Inspection

ii) Routine Inspection

iv) Specific Inspection

v) Other Inspection

10.3.1 Planned General Inspection

10.3.1.1 Planned general inspections are performed at predetermined intervals and it usually involves the representation from both Contractor and the Employer.

10.3.1.2 Inspections that will be classified under this inspection program are:

i) Monthly contractor and subcontractors site safety committee Inspection.

ii) Weekly safety inspection by construction supervisors (Contractors and Sub-contractors).

iii) Daily safety inspection by contractor site SHE team.

10.3.2 Routine Inspection

10.3.2.1 Routine inspections are often referring to the inspection of work site, equipment and temporary structures performed by site and equipment operators and temporary structure erectors.

Inspections that will be classified under this inspection program are:

i) Daily Inspection of plant and equipment by operator

ii) Weekly Inspection of scaffold by scaffolding supervisor

iii) Monthly Inspection of electrical hand tools by competent electrical supervisor

iv) Quarterly Inspection of temporary electrical systems by competent electrical supervisor

vi) Half-yearly inspection of lifting machinery, lifting appliances, equipment and gears by Govt. approved competent person.

10.3.2.2 The list mentioned above is not exhaustive. Contractor may add additional categories. Contractors' Site SHE Manager will ensure that a system of routine inspections are carried out periodically to all plants, equipment, powered tools and any other temporary structures that will pose a hazard to operators and workmen.

10.3.3 Specific Inspection

10.3.3.1 Specific inspections are performed on activities without a predetermined date. Competent supervisors usually perform inspections for ensuring an activity whether it is executed in accordance to a general set of rules; method statement submitted or developed procedures.

The following are examples that will be commonly performed as required on the construction site:

i) Inspection performed before a heavy lifting operation.
ii) Inspection performed before and after the entry of person into a confined space.
iii) Inspection performed before and after a welding and gas cutting operation.
iv) Inspection of formwork before concreting by formwork erector.

The list mentioned above is not exhaustive. The contractor shall ensure that a competent supervisor inspects all high-risk processes and activities.

10.3.4 Other Inspection

Other inspections include the following:

i) Mandatory Inspections by Labour Department of Government.
ii) KMRC site SHE management team

10.3.5 The contractor shall prepare all required safety inspection checklist for all activity operations and equipment. Checklists will be prepared based on the Indian standards, rules and regulations and Employer's requirements. The formats provided in the Project SHE manual may be referred.

10.3.6 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.

11.0 SHE Audit

11.1 General

11.1.1 The purpose and scope of SHE audit is to assess potential risk, liabilities and the degree of compliance of construction Safety, Health & Environmental plan and its supplementary procedures and programs against applicable and current SHE legislation regulations and requirements of the employer.

11.1.2 Project Manager holds the ultimate responsibility in ensuring implementation of SHE audit program during the construction work.

11.2 Monthly Audit Rating Score (M A R S)

11.2.1 Monthly Audit Rating Score (MARS) will be performed once in a month. A team consisting of Project Manager and Employer's representative will conduct this, based on a pre-designed score-rating format. The details of the pre-designed monthly audit score rating formats are given in the Project SHE manual.

11.2.2 This Monthly SHE Audit Rating Score (MARS) report will enable the Employer to evaluate the general compliance by the Contractor with the Conditions of Contract, the Employer's Project SHE Manual and the Contractor's site specific SHE Plan.

11.2.3 Monthly Audits will be conducted in accordance with KMRC Guidelines. The Project Manager accompanied by the Employer's representatives shall carry out the Audit. The Contractor's senior manager and SHE in-charge should also be invited to attend.

11.2.4 Timing

The Monthly Audit Rating Score (MARS) should be conducted at least 7 days prior to the scheduled date of Monthly SHE Committee meeting.

11.2.5 Evaluation

11.2.5.1 The numerical scoring has been weighed on a 1-10 scale. The audit team will use their observations noted in evaluating the points to be awarded against each of the elements of the audited section. Wherever some topics and sub-topics are not applicable the score rating need not be given. The overall audit ratings shall be achieved by:

$$\text{Overall Audit rating} = \frac{\text{Actual Score Achieved}}{\text{Maximum Possible Score}} \times 100$$

11.2.5.2 The criticality of the required actions for the respective sections of the Audit will be classified as:

Sl. No.	Score	Description	Action
1	< 60%	Immediate	Require Contractor to rectify within 24 hours
2	< 75%	Improvement Necessary	Contractor rectification within 7 days and confirmed in writing to Employer
3	< 90%	Improvement Desirable	Contractor rectification within one month and confirmed in writing to Employer

11.2.6 Report

A copy of each Audit Report will be sent to Employer and to all subcontractors, with whom it will then be discussed in detail at the Monthly SHE Committee Meeting in order to ensure that any corrective actions are agreed upon.

11.3 **Monthly Electrical Safety Audit**

11.3.1 A team comprising of contractor's senior SHE (Electrical) engineer and Employer's representative shall conduct monthly electrical safety audit covering the following and submit the report to Employer.

i) Electrical accidents investigation findings and remedy

ii) Adequacy of power generation and power requirements

iii) Power distribution and transmission system in place

iv) Updated electrical single line diagram showing the current condition of power source and distribution including the IP44 DBs arrangement.

v) Electrical protection devices – selection, installation and maintenance.

vi) Earth or ground connection and earth pit maintenance details

vii) Education and training of electrical personnel undertaken

viii) Routine electrical inspection details

ix) Electrical maintenance system and register.

x) Name plate details of major electrical equipment

xi) Classified zones in the site, if any.

11.4 **External SHE Audit**

11.4.1 External SHE audits are to be conducted by external agencies that are competent with ISO qualified auditors with the prior approval of the Employer.

11.4.2 Areas of competence of Audit team

11.4.2.1 Practical understanding of BOCW Act and Rules, statutory requirements on health/medical and welfare of workmen, construction hazards and its prevention and control, traffic management, electrical safety, rigging, safety of construction equipment and environment management.

11.4.2.2 Audit shall be conducted as per the guidelines of ISO, ILO, and national standards. Audit report shall also be presented as per the above formats.

11.4.3 External SHE audit shall be conducted on a quarterly basis throughout the currency of the contract.

11.4.4 Targets of SHE Audit:

The contents and coverage of the external audit shall include the following items

11.4.4.1 SHE management:

i) Organization
ii) Communication and Motivation
iii) Time office
iv) Inspection
iv) Emergency preparedness
v) Budget allocation
vi) Education and Training
vii) Work permit system

11.4.4.2 Technical:

i) Building and Structure
ii) Construction operational safety
iii) Material safety
iv) Hand tools and Power tools
v) Electrical system
vi) Safety Appliances
vii) Fire prevention and control
viii) Housekeeping
ix) Maintenance and Machinery safety
x) First-aid and Medical Facilities
xi) Welfare measures
xii) Environmental Management

11.4.5 Audit Documents:

11.4.5.1 Contractor shall make the below listed documents available for the review by the Audit team.

i) SHE policy
ii) SHE manual
iii) SHE Rules and Regulation
iv) SHE organization chart
v) Annual SHE objectives / programs
vi) Accident / near miss statistics and analysis
vii) SHE Training program / records for all personnel
viii) Operating manuals and maintenance manual of all equipments
ix) Safe worthiness certificates of all lifting appliances and gears
x) Medical fitness record for all personnel
xi) Risk identification, assessment and control details
xii) Environmental management reports
xiii) Emergency management records including mock drill

11.4.6 Audit Preparation:

i) Audit team members are required to gather information by observations through interviews and by checks of hardware and documentation.
ii) Audit team shall prepare checklist to cover all parts based on SHE legislations rules and regulations and KMRC requirements.
iii) Audit team members shall verify the facts and findings leading to the identified gaps and weakness.
iv) Audit leader has overall responsibility for reaching a conclusion.

11.4.7 Reporting:

11.4.7.1 Audit report shall be prepared and directly sent to the Employer within 7 days of conducting the audit with a copy to the contractor.

11.4.8 Report contents:

i) Executing summary - based on the finalized checklists as written the findings to the Employer by the audit team members, the audit leader will compile a concise and accurate summary of observations and findings.

ii) Introduction - this will contain basic information regarding the facilities or organization audited, the specific audit dates (inclusion of those for preparation and post-audit activities).

iii) Principal positive findings - This will contain the summary of positive aspects as observed by the auditors. It will also contain highlights of those issue, which may warrant dissemination as best practice regarding methodology used or achievement.

iv) Audit Findings - All audit findings as detailed in the audit checklists shall be grouped together as priority 1 and 2 as detailed below in a separate listing.

a) Priority 1: Actions to rectify gaps or weakness should generally be implemented within two-weeks time, if risk potential is high or unacceptable.
b) Priority 2: Actions should be generally implemented or rectified with a maximum of 3 – 4 weeks, if not rectified would create a likelihood of minor injury or business loss.

11.4.9 Conformity Report & Action by Employer

11.4.9.1 The auditor shall inspect the site after 14 days of conducting initial audit for checking the adequacy of implementation of items maintained under priority 1 by the contractor and shall submit a conformity / non-conformity report to the Employer with a copy to the contractor.

11.4.9.2 The auditor shall again inspect after 28 days of conducting initial audit for checking the adequacy of implementation of items mentioned under priority 2 by the contractor and shall submit a conformity / non-conformity report to the Employer with a copy to the contractor.

11.4.9.3 In case of non-conformity of items mentioned by auditor, the Employer shall take necessary steps including stoppage of work and or imposing any penalty for getting the item implemented.

11.4.10 Failure of contractor to conduct External SHE Audit

11.4.10.1 If the contractor fails to conduct the external SHE audit in a timely manner, the Employer may arrange for this to be conducted by others, at the cost of the Contractor.

12.0 SHE Communication

12.1 The contractor shall take every effort to communicate the Safety, Occupational health and Environment management measures through posters campaigns / billboards / banners / glow signs being displayed around the work site as part of the effort to rise safety awareness amongst to the work force. Posters should be in Hindi, English and other suitable language deemed appropriate. Posters / billboards / banners/ glow signs should be changed at least once in a month to maintain the impact.

12.2 The contractor shall also observe important days as listed in General Instruction ***KMRC/SHE/GI/008/DAY/281105*** and printing and displaying safety signage and posters as listed in General Instruction ***KMRC/SHE/GI/009/PS/281105***.

12.3 The list indicated are the minimum requirements of the Employer and the contractor is encouraged to further the SHE communication activities by formulating suitable reward schemes for safety performers and any other activities, which deem fit for the purpose.

13.0 SHE Submittals to the Employer

13.1 The contractor's SHE management should send the following reports to the Employer periodically:

i) Daily Reporting of total no of workmen (as given in Clause ***13.2***)
ii) Monthly SHE Report (as given in Clause ***13.3***)
iii) SHE Committee Meeting Minutes (as given in Clause ***7.9.1***)
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

13.2 Daily Reporting of total workforce

13.2.1 The Contractor shall report the total number of workmen engaged in execution of the Works, including the employees of any subcontractor, to the Employer's Representative, by noon of the following day. Reports shall clearly indicate both day and night shift working, together with location and duties of all employees. This reporting shall be the primary duty of the Contractor's Chief SHE Manager Reports may be submitted by telefax / email, as agreed with the Employer's Representative. The onus of confirming the receipt of the same by the Employer's Representative shall lie with the Contractor. If the information is not received in the manner required, penalty shall be levied as per relevant clause.

13.3 Monthly SHE Report

13.3.1 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 under taken in the month indicating the number of posters displayed and balance availability in stock.

viii) Air quality / Noise monitoring details

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

14.0 Accident reporting and investigation

14.1 Reporting to Employer

14.1.1 All accidents and dangerous occurrences shall immediately be informed verbally to the Employer. This will enable the Employer to reach to the scene of accident / dangerous occurrences to monitor/assist any rescue work and/or start conducting the investigation process so that the evidence is not lost.

14.1.2 Reports of all accidents (fatal / injury) and dangerous occurrences shall also be sent within 24 hours as per format provided in the Employer's Project SHE manual.

14.1.3 No accident / dangerous occurrences is exempted from reporting to the Employer.

14.1.4 Any willful delay in verbal and written reporting to the Employer shall be penalised as per relevant clause.

14.2 Reporting to Govt. organisations

14.2.1 In addition to the above verbal and written reporting to the Employer, as per Rule 210 of OCWR, notice of any accident to a worker at the building or construction site that:

a) causes loss of life; or

b) disables a worker from working for a period of 48 hours or more immediately following the accident;

c) shall forthwith be sent by telegram, telephone, fax, or similar other means including special messenger within four hours in case of fatal accidents and 72 hours in case of other accidents, to:

i) the Regional Labour Commissioner (central), wherein the contractor has registered the firm/work

ii) the board with which the worker involved was registered as a beneficiary;

iii) Director General and

iv) the next of kin or other relative of the worker involved in the accident;

14.2.2 Further, notice of accident shall be sent in respect of an accident which

a) causes loss of life; or

b) disables the injured worker from work for more than 10 days to

i) the officer-in-charge of the nearest police station;

ii) the District Magistrate or, if the District Magistrate by order so desires, to

iii) the Sub-Divisional Magistrate

14.2.3 In case of an accident causing minor injury, first-aid shall be administered and the injured worker shall be immediately transferred to a hospital or other place for medical treatment.

14.2.4 Where any accident causing disablement that subsequently results in death, notice in writing of such death, shall be sent to the authorities mentioned in clause ***14.2.1*** and ***14.2.2*** above within 72 hours of such death.

14.2.5 Reporting of dangerous occurrences:

14.2.5.1 The following classes of dangerous occurrences shall be reported to the Inspector having jurisdiction, whether or not any disablement or death caused to the worker, namely:

a) collapse or failure of lifting appliances, or hoist, or conveyors, or similar equipment for handling of building or construction material or breakage or failure of rope, chain or loose gears; or overturning of cranes used in construction work;

b) falling of objects from height;

c) collapse or subsidence of soil, tunnel, pipe lines, any wall, floor, gallery, roof or any other part of any structure, launching girder, platform, staging, scaffolding or means of access including formwork;

d) explosion of receiver or vessel used for storage of pressure greater than atmospheric pressure, of any gas or gases or any liquid or solid used as building material;

e) fire and explosion causing damage to any place on construction site where building workers are employed;

f) spillage or leakage of any hazardous substance and damage to their container;

g) collapse, capsizing, toppling or collision of transport equipment;

h) leakage or release of harmful toxic gases at the construction site;

14.2.6 In case of failure of launching girder, lifting appliance, loose gear, hoist or building and other construction work, machinery and transport equipment at a construction site, such appliances, gear, hoist, machinery or equipment and the site of such occurrence shall, as far as practicable, be kept undisturbed until inspected by the Authorities;

14.2.7 Every notice given for fatal accidents or dangerous occurrences shall be followed by a written report to the concerned Authorities under Section 39 of BOCWA and the Director General in the specified Form XIV of BOCWR.

14.3 Accident investigation

14.3.1 **General**

14.3.1.1 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

14.3.1.2 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.

14.3.1.3 Near misses and minor accidents should also be investigated by the Contractor as soon as possible as they are signals that there are inadequacies in the safety management system.

14.3.2 **Procedure of incident investigation**

14.3.2.1 It is important after any accident or dangerous occurrence that information relating to the incident is gathered in an organised way. The following steps shall be followed;

a) take photographs and make sketches

b) examine involved equipment, workpiece or material and the environmental conditions

c) interview the injured, eye-witnesses and other involved parties

d) consult expert opinion where necessary

e) identify the specific contractor or sub-contractor involved.

14.3.2.2 Having gathered information, it is then necessary to make an analysis of incident

a) establish the chain of events leading to the accident or incident

b) find out at what stage the accident took place

c) consider all possible causes and the interaction of different factors that led up to the accident, and identify the most probable cause The cause of an accident should never be classified as carelessness. The specific act or omission that caused the accident must be identified.

14.3.2.3 The next stage is to proceed with the follow-up action

a) report on the findings and conclusions

b) formulate preventive measures to avoid recurrence

c) publicise the findings and the remedial actions taken

14.4 Employers' independent incident investigation

14.4.1 In case of fatal / dangerous occurrence the Employer shall also conduct independent investigation. Contractor and his staff shall extend necessary co-operation and testify about the accident.

14.4.2 The contractor shall take every effort to preserve the scene of accident till the Employer completes the investigation.

14.4.3 All persons summoned by the Employer in connection to witness recording shall obey the instructions without delay. Any wilful suppression of information by any person shall be removed from the site immediately and / or punishable as per relevant penalty clause.

15.0 Emergency preparedness plan

15.1 The Contractor shall prepare as required under Rule 36 of , an Emergency Response Plan for all work sites as a part of the Contractor SHE Plan. The plan shall integrate the emergency response plans of the Contractor and all other subcontractors. The Emergency Response Plan shall detail the Contractor's procedures, including detailed communications arrangements, for dealing with all emergencies that could affect the Site. This include where applicable, injury, sickness, evacuation, fire, chemical spillage, severe weather and rescue.

15.2 The contractor shall ensure that an Emergency Response Plan is prepared to deal with emergencies arising out of:

i) Fire and explosion
ii) Collapse of lifting appliances and transport equipment
iii) Collapse of building, sheds or structure etc.
iv) Gas leakage or spillage of dangerous goods or chemicals
v) Bomb threatening, Criminal or Terrorist attack
vi) Drowning of workers
vii) Landslides getting workers buried floods, Earthquake, storms and other natural calamities.

15.3 Arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.

15.4 Contractors shall require to liaise with the local hospitals and fire stations for prompt attendance to the casualties. The Contractor shall keep emergency vehicles on standby duty during all working hours for this purpose. The Contactor shall not resort to treating his injured employees (for the benefit of saving money) at government hospitals catering to the poor. These facilities do not generally provide the level of medical administration required by the SHE procedures, e.g. certification of medical fitness and category/nature of injuries.

15.5 Contractor shall conduct an onsite emergency mock drill once in every month for all his workers and his subcontractor's workers.

15.6 It shall be the responsibility of the contractor to keep the Local Law & Order Authorities informed and seek urgent help, as the case may be, so as to mitigate the consequences of an emergency. The Contractor shall make prompt communication to KMRC, initially by telephone and followed by a written report.

16.0 Experts / Agencies for SHE services

16.1 Contractors may utilise the services of experts/agencies empanelled under Rule 250 of BOCWR and Rule 297 of for the purpose of training, internal audit and any other SHE services with prior approval of the Employer.

16.2 As an aide to contractors, a list of experts/agencies and the offered service are given in General Instruction ***KMRC/SHE/GI/010/AE/281105*** for ready reference. In addition to it if the contractor would like to use any expert/agencies' services for any SHE activities the same can also be allowed provided that they are competent and meet to the

general requirements of Employer. In every case prior approval of the Employer is mandatory.

PART – II : SAFETY

17.0 Housekeeping

17.1 Housekeeping is the act of keeping the working environment cleared of all unnecessary waste, thereby providing a first-line of defense against accidents and injuries.

17.2 Contractor shall understand and accept that improper housekeeping is the primary hazard in any construction site and ensure that a high degree of housekeeping is always maintained. Indeed "Cleanliness is indeed next to Godliness"

17.3 Housekeeping is the responsibility of all site personnel, and line management commitment shall be demonstrated by the continued efforts of supervising staff towards this activity.

17.4 General Housekeeping shall be carried out by the contractor and ensured at all times at Work Site, Construction Depot, Batching Plant, Labour Camp, Stores, Offices and toilets/urinals. Towards this the Contractor shall constitute a special group of housekeeping personnel as per General Instruction ***KMRC/SHE/GI/001/MPR/281105.*** This group shall ensure daily cleaning at work sites and surrounding areas and maintain a register as per the approved format by the Employer.

17.5 Adequate time shall be assigned to ensure that good housekeeping is maintained. Team of housekeeping squad shall carry out this.

17.6 The contractor shall be responsible to provide segregated containers for disposal of debris at required places and regular cleaning of the same.

17.7 Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the surrounding area from excavated soil, rubbish etc, which may cause inconvenience to and endanger the public. The barricade especially those exposed to public shall be aesthetically maintained by regular cleaning and painting as directed by the Employer. These shall be maintained in one line and level.

17.8 The structure dimension of the barricade, material and composition, its colour scheme, KMRC logo and other details shall be in accordance with specifications laid down in tender document.

17.9 All stairways, passageways and gangways shall be maintained without any blockages or obstructions. All emergency exits passageways, exits fire doors, break-glass alarm points, firefighting equipment, first aid stations, and other emergency stations shall be kept clean, unobstructed and in good working order.

17.10 Lumber with protruding nails shall be either bent / removed and properly stacked.

17.11 All surplus earth and debris are removed/disposed off from the working areas to officially designated dumpsites. Trucks carrying sand, earth and any pulverized materials etc. in order to avoid dust or odour impact shall be covered while moving. **The tyres of the trucks leaving the site shall be cleaned with water, wherever the possibility of spillage on carriageways meant for regular road traffic exists.**

17.12 No parking of trucks/trolleys, cranes and trailers etc. shall be allowed on roads, which may obstruct the traffic movement.

17.13 Roads shall be kept clear and materials like: pipes, steel, sand boulders, concrete, hips and brick etc. shall not be allowed on the roads to obstruct free movement of road traffic.

17.14 Water logging or bentonite spillage on roads shall not be allowed. If bentonite spillage is bserved on road endangering the safety of road users, the contractor shall be penalised as per relevant clause.

17.15 Proper and safe stacking of material are of paramount importance at yards, stores and such locations where material would be unloaded for future use. The storage area shall be well laid out with easy access and material stored / stacked in an orderly and safe manner.

17.16 Flammable chemicals / compressed gas cylinders shall be safely stored.

17.17 Unused/surplus cables, steel items and steel scrap lying scattered at different places within the working areas shall be removed to identified locations(s).

17.18 All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from work place to identified location(s).

17.19 Empty cement bags and other packaging material shall be properly stacked and removed.

17.20 The Contractor shall ensure that all his sub-contractors maintain the site reasonably clean through provisions related to house keeping

18.0 Working at Height

18.1 Definitions

18.1.1 “access” and “egress” include ascent and descent.

18.1.2 “fragile surface” means a surface, which would be able to fail if any reasonably foreseeable loading were to be applied to it.

18.1.3 “line” includes rope, chain or webbing

18.1.4 “personal fall protection” means -

a) a fall prevention, work restraint, work positioning, fall arrest or rescue system, other than a system in which the only safeguards are collective safeguards; or

b) rope access and positioning techniques;

18.1.5 "work at height" means -

a) work in any place, including a place at or below ground level;

b) obtaining access to or egress from such place while at work, except by a staircase in a permanent workplace, where, if protective measures were not taken, a person could fall a distance liable to cause personal injury;

18.1.6 "work equipment" means any machinery, appliance, apparatus, tool or installation for use at work (whether exclusively or not) and includes

a) a guard-rail, toe-board, barrier or similar collective means of protection

b) a working platform

c) a net, airbag or other collective safe guard for arresting falls.

d) personal fall protection system

e) ladders

18.1.7 "working platform"

a) means any platform used as a place of work or as a means of access to or egress from a place of work;

b) includes any scaffold, suspended scaffold, cradle, mobile platforms, trestle, gangway, gantry and stairway which is so used.

18.2 Organisation and planning

The contractor shall ensure that work at height is

i) properly planned for any emergencies and rescue

ii) appropriately supervised; and

iii) carried out in a manner, which is reasonably practicable safe.

18.3 The contractor shall ensure that work at height is carried out only when the weather conditions do not jeopardise the health or safety of persons involved in the work.

18.4 Competence
The contractor shall ensure that no person engages in any activity, including organization, planning and supervision, in relation to work at height or work equipment for use in such work unless he is competent to do so or, if being trained, is being supervised by a competent person.

18.5 Avoidance of risks from work at height
The contractor shall ensure that work is not carried out at height where it is reasonably practicable to carry out the work safely otherwise than at height.

18.6 Where work is carried out at height, the contractor shall take suitable and sufficient measures as given below to prevent, so far as is reasonably practicable, any person **falling a distance liable to cause personal injury.**

a) his ensuring that the work is carried out
   i) from an existing place of work; or
   ii) (in the case of obtaining access or egress) using an existing means, complying to the requirements as given in ***18.15***
   where it is reasonably practicable to carry it out safely and under appropriate ergonomic conditions; and

b) where it is not reasonably practicable for the work to be carried out in accordance with sub-paragraph (a), his providing sufficient work equipment for preventing, so far as is reasonably practicable, a fall occurring.

18.7 Where the measures taken under clause ***18.6*** do not eliminate the risk of a fall occurring, every contractor shall
a) so far as is reasonably practicable, provide sufficient work equipment to minimise -

   i) the distance and consequences; or

ii) where it is not reasonably practicable to minimise the distance, the consequences, of a fall; and

b) Without prejudice to the generality of clause ***18.4.*** provide such additional training and instruction or take other additional suitable and sufficient measures to prevent, so far as is reasonably practicable, any person falling a distance liable to cause personal injury.

18.8 Selection of 'work equipment' for work at height

1) the contractor, in selecting work equipment for use in work at height, shall

a) give collective protection measures priority over personal protection measures; and
b) take account of
i) the working conditions and the risks to the safety of persons at the place where the work equipment is to be used;
ii) in the case of work equipment for access and egress, the distance to be negotiated;
iii) the distance and consequences of a potential fall;
iv) the duration and frequency of use;
v) the need for easy and timely evacuation and rescue in an emergency; and
vi) any additional risk posed by the use, installation or removal of that work equipment or by evacuation and rescue from it;

2) The contractor shall select work equipment for work at height which:

a) has characteristics including dimensions which:
i) are appropriate to the nature of the work to be performed and the foreseeable loadings; and
ii) allow passage without risk; and
b) is in other respects the most suitable work equipment, having regard in particular to the purposes specified in ***18.5*** and ***18.6***.

18.9 Fragile surfaces

18.9.1 The contractor shall ensure that no person at work passes across or near, or working on, from or near, a fragile surface where it is reasonably practicable to carry out work safely and under appropriate ergonomic conditions without his doing so.

18.9.2 Where it is not reasonably practicable to carry out work safely and under appropriate ergonomic conditions without passing across or near, or working on, from or near, a fragile surface, every contractor shall,

a) ensure, so far as is reasonably practicable, that suitable and sufficient platforms, coverings, guard rails or similar means of support or protection are provided and used so that any foreseeable loading is supported by such supports or borne by such protection;

b) where a risk of a person at work falling remains despite the measures taken under the preceding provisions of this regulation, take suitable and sufficient measures to minimise the distances and consequences of his fall.

18.9.3 Where any person at work may pass across or near, or work on, from or near, a fragile surface, every contractor shall ensure that

a) prominent warning notices are so far as is reasonably practicable affixed at the approach to the place where the fragile surface is situated; or

b) where that is not reasonably practicable, such persons are made aware of it by other means.

18.10 Falling objects

18.10.1 The contractor shall, where necessary to prevent injury to any person, take suitable and sufficient steps to prevent, so far as is reasonably practicable, the fall of any material or object.

18.10.2 Where it is not reasonably practicable to comply with the requirements of 18.9, every contractor shall take suitable and sufficient steps to prevent any person being struck by any falling material or object which is liable to cause personal injury.

18.10.3 The contractor shall ensure that no material or object is thrown or tipped from height in circumstances where it is liable to cause injury to any person.

18.10.4 Every employer shall ensure that materials and objects are stored in such a way as to prevent risk to any person arising from the collapse, overturning or unintended movement of such materials or objects.

18.11 Danger areas

18.11.1 Without prejudice to the preceding requirements of these Regulations, every contractor shall ensure that

a) where a workplace contains an area in which, owing to the nature of the work, there is a risk of any person at work

i) falling a distance; or

ii) being struck by a falling object, which is liable to cause personal injury, the workplace is so far as is reasonably practicable equipped with devices preventing unauthorised persons from entering such area; and

b) such area is clearly indicated.

18.12 Inspection of work equipment

18.12.1 The contractor shall ensure that, where the safety of work equipment depends on how it is installed or assembled, it is not used after installation or assembly in any position unless it has been inspected in that position.

18.12.2 The contractor shall ensure that work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations is inspected

a) at suitable intervals; and

b) each time that exceptional circumstances which are liable to jeopardise the safety of the work equipment have occurred, to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.

18.12.3 Without prejudice to paragraph ***18.12.1***, the contractor shall ensure that a working platform

a) used for construction work; and

b) from which a person could fall 2 metres or more,

is not used in any position unless it has been inspected in that position or, in the case of a mobile working platform, inspected on the site, within the previous 7 days.

18.12.4 The contractor shall ensure that the reports of all inspections are properly maintained and shown to the Employer as and when required.

18.12.5 In this clause "inspection",

a) means such visual or more rigorous inspection by a competent person as is appropriate for safety purposes;

b) includes any testing appropriate for those purposes,

18.13 Inspection of places of work at height

18.13.1 The contractor shall so far as is reasonably practicable ensure that the surface and every parapet, permanent rail or other such fall protection measure of every place of work at height are checked on each occasion before the place is used.

18.14 Duties of persons at work

18.14.1 Any workmen employed by the contractor shall report to the supervisor about any defect relating to work at height which he knows is likely to endanger the safety of himself or another person.

18.14.2 Every workmen shall use any work equipment or safety device provided to him for work at height by the contractor, in accordance with

a) any training in the use of the work equipment or device concerned which have been received by him; and

b) the instructions respecting that use which have been provided to him by the contractor as per the requirements of the Employer

18.15 Requirements for existing places of work and means of access or egress at height Every existing place of work or means of access or egress at height shall

a) be stable and of sufficient strength and rigidity for the purpose for which it is intended to be or is being used;

b) where applicable, rest on a stable, sufficiently strong surface;

c) be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work to be carried out there;

d) possess suitable and sufficient means for preventing a fall;

e) possess a surface which has no gap

i) through which a person could fall;

ii) through which any material or object could fall and injure a person; or

iii) giving rise to other risk of injury to any person, unless measures have been taken to protect persons against such risk;

f) be so constructed and used, and maintained in such condition, as to prevent, so far as is reasonably practicable -

i) the risk of slipping or tripping; or

ii) any person being caught between it and any adjacent structure;

g) where it has moving parts, be prevented by appropriate devices from moving inadvertently during work at height.

18.16 Requirements for guardrails, toe-boards, barriers and similar collective means of protection

i) Unless the context otherwise requires, any reference in this section to means of protection is to a guardrail, toe-board, barrier or similar collective means of protection.

ii) Means of protection shall
   a) be of sufficient dimensions, of sufficient strength and rigidity for the purposes for which they are being used, and otherwise suitable;
   b) be so placed, secured and used as to ensure, so far as is reasonably practicable, that they do not become accidentally displaced; and
   c) be so placed as to prevent, so far as is practicable, the fall of any person, or of any material or object, from any place of work.

iii) In relation to work at height involved in construction work
   a) the top guard-rail or other similar means of protection shall be at least 950 millimetres above the edge from which any person is liable to fall;
   b) toe-boards shall be suitable and sufficient to prevent the fall of any person, or any material or object, from any place of work; and
   c) any intermediate guardrail or similar means of protection shall be positioned so that any gap between it and other means of protection does not exceed 470 millimetres.

iv) Any structure or part of a structure which supports means of protection or to which means of protection are attached shall be of sufficient strength and suitable for the purpose of such support or attachment.

18.17 Requirements for all Working Platforms

i) Every working platforms requires a supporting structure for holding it

ii) Any surface upon which any supporting structure rests shall be stable, of sufficient strength and of suitable composition safely to support the supporting structure, the working platform and any loading intended to be placed on the working platform.

iii) Stability of supporting structure
Any supporting structure shall

a) be suitable and of sufficient strength and rigidity for the purpose for which it is being used;

b) in the case of a wheeled structure, be prevented by appropriate devices from moving inadvertently during work at height;

c) in other cases, be prevented from slipping by secure attachment to the bearing surface or to another structure, provision of an effective anti-slip device or by other means of equivalent effectiveness;

d) be stable while being erected, used and dismantled; and

e) when altered or modified, be so altered or modified as to ensure that it remains stable.

f) Have suitable base plates and properly footed thereby.

iv). Stability of working platforms
A working platform shall
a) be suitable and of sufficient strength and rigidity for the purpose or purposes for which it is intended to be used or is being used;
b) be so erected and used as to ensure that its components do not become accidentally displaced so as to endanger any person;
c) when altered or modified, be so altered or modified as to ensure that it remains stable; and
d) be dismantled in such a way as to prevent accidental displacement.

v) Safety on working platforms
A working platform shall
a) be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work being carried out there;
b) possess a suitable surface and, in particular, be so constructed that the surface of the working platform has no gap
   i) through which a person could fall;
   ii) through which any material or object could fall and injure a person; or
   iii) giving rise to other risk of injury to any person, unless measures have been taken to protect persons against such risk; and
c) be so erected and used, and maintained in such condition, as to prevent, so far as is reasonably practicable
   i) the risk of slipping or tripping; or
   ii) any person being caught between the working platform and any adjacent structure.

vi) Loading
A working platform and any supporting structure shall not be loaded so as to give rise to a risk of collapse or to any deformation, which could affect its safe use.

vii) Additional requirements for scaffolding
Strength and stability calculations for scaffolding shall be carried out unless
a) a note of the calculations, covering the structural arrangements contemplated, is available; or
b) It is assembled in conformity with a generally recognised standard configuration.

viii) Depending on the complexity of the scaffolding selected, a competent person shall draw up an assembly, use and dismantling plan. This may be in the form of a standard plan, supplemented by items relating to specific details of the scaffolding in question.

ix) A copy of the plan, including any instructions it may contain, shall be kept available for the use of persons concerned in the assembly, use, dismantling or alteration of scaffolding until it has been dismantled.

x) The dimensions, form and layout of scaffolding decks shall be appropriate to the nature of the work to be performed and suitable for the loads to be carried and permit work and passage in safety.

xi) While a scaffold is not available for use, including during its assembly, dismantling or alteration, it shall be marked with general warning signs in accordance with and be suitably delineated by physical means preventing access to the danger zone.

xii) Scaffolding may be assembled, dismantled or significantly altered only under the supervision of a competent person and by persons who have received appropriate and specific training in the operations envisaged which addresses specific risks which the operations may entail and precautions to be taken, and more particularly in

a) understanding of the plan for the assembly, dismantling or alteration of the scaffolding concerned;

b) safety during the assembly, dismantling or alteration of the scaffolding concerned;

c) measures to prevent the risk of persons, materials or objects falling;

d) safety measures in the event of changing weather conditions which could adversely affect the safety of the scaffolding concerned;

e) permissible loadings;

f) any other risks which the assembly, dismantling or alteration of the scaffolding may entail.

18.18 Requirements for collective safeguards for arresting falls

i) Collective safeguard are a safety net, airbag or other collective safeguard for arresting falls

ii) A safeguard shall be used only if

a) a risk assessment has demonstrated that the work activity can so far as is reasonably practicable be performed safely while using it and without affecting its effectiveness;

b) the use of other, safer work equipment is not reasonably practicable; and

c) a sufficient number of available persons have received adequate training specific to the safeguard, including rescue procedures.

iii) A safeguard shall be suitable and of sufficient strength to arrest safely the fall of any person who is liable to fall.

iv) A safeguard shall

a) in the case of a safeguard which is designed to be attached, be securely attached to all the required anchors, and the anchors and the means of attachment thereto shall be suitable and of sufficient strength and stability for the purpose of safely supporting the foreseeable loading in arresting any fall and during any subsequent rescue;

b) in the case of an airbag, landing mat or similar safeguard, be stable; and

c) in the case of a safeguard, which distorts in arresting a fall, afford sufficient clearance.

v) Suitable and sufficient steps shall be taken to ensure, so far as practicable, that in the event of a fall by any person the safeguard does not itself cause injury to that person.

18.19 Requirements for personal fall protection systems

i) A personal fall protection system shall be used only if

a) a risk assessment has demonstrated that

i) the work can so far as is reasonably practicable be performed safely while using that system; and

ii) the use of other safer work equipment is not reasonably practicable; and

b) the user and a sufficient number of available persons have received adequate training specific to the operations envisaged, including rescue procedures.

ii) A personal fall protection system shall

a) be suitable and of sufficient strength for the purposes for which it is being used having regard to the work being carried out and any foreseeable loading;

b) where necessary, fit the user;

c) be correctly fitted;

d) be designed to minimise injury to the user and, where necessary, be adjusted to prevent the user falling or slipping from it, should a fall occur; and

e) be so designed, installed and used as to prevent unplanned or uncontrolled movement of the user.

iii) A personal fall protection system designed for use with an anchor shall be securely attached to at least one anchor, and each anchor and the means of attachment thereto shall be suitable and of sufficient strength and stability for the purpose of supporting any foreseeable loading.

iv) Suitable and sufficient steps shall be taken to prevent any person falling or slipping from a personal fall protection system.

18.20 Requirements for Ladders

1) Every contractor shall ensure that a ladder is used for work at height only if a risk assessment has demonstrated that the use of more suitable work equipment is not justified because of the low risk and

i) The short duration of use; or

ii) Existing features on site, which he cannot alter.

2) Only metal ladders shall be allowed. Bamboo ladders are prohibited.

3) Any surface upon which a ladder rests shall be stable, firm, of sufficient strength and of suitable composition safely to support the ladder so that its rungs or steps remain horizontal, and any loading intended to be placed on it.

4) A ladder shall be so positioned as to ensure its stability during use

5) A suspended ladder shall be attached in a secure manner and so that, with the exception of a flexible ladder, it cannot be displaced and swinging is prevented.

6) A portable ladder shall be prevented from slipping during use by -

i) securing the stiles at or near their upper or lower ends;

ii) an effective anti-slip or other effective stability device; or

iii) any other arrangement of equivalent effectiveness.

7) A ladder used for access shall be long enough to protrude sufficiently above the place of landing to which it provides access, unless other measures have been taken to ensure a firm handhold.

8) No interlocking or extension ladder shall be used unless its sections are prevented from moving relative to each other while in use.
9) A mobile ladder shall be prevented from moving before it is stepped on.
10) Where a ladder or run of ladders raises a vertical distance of 9 metres or more above its base, there shall, where reasonably practicable, be provided at suitable intervals sufficient safe landing areas or rest platforms.
11) Every ladder shall be used in such a way that

    a) a secure handhold and secure support are always available to the user; and
    b) the user can maintain a safe handhold when carrying a load unless, in the case of a step ladder, the maintenance of a handhold is not practicable when a load is carried, and a risk assessment has demonstrated that the use of a stepladder is justified because of
        i) the low risk; and
        ii) the short duration of use.

19.0 Overhead protection

All contractors shall provide overhead protections as per Rule 41 of BOCWR

i) Overhead protection should be erected along the periphery of every building which is under construction and the building height shall be 15m or above after construction.
ii) Overhead protection shall be minimum 2m wide and the outer edge shall be 150mm higher than the inner edge and an angle not more than 200 to its horizontal sloping into the building.
iii) Overhead protection shall not be erected more than a height of 5m from the base of the building.
iv) Areas of inadvertent hazard of falling of material shall be guarded or barricaded or roped-off thereby by the contractor.

20.0 Slipping, Tripping, Cutting, Drowning and Falling Hazards

As per Rule 42 of BOCWR,

i) All places should be free from dust, debris or similar materials.
ii) Sharp projections or any protruding nails or similar objects shall be suitably guarded or shall even be avoided to make the place safe to work.
iii) Contractor shall not allow workmen to work or use platforms, scaffolds/passageways or any walkways, which has water, or oil or similar substances spilt and has a slipping hazard, unless it is cleaned off or covered or sanded or saw dusted or make it safe with any suitable material.
iv) When workers are exposed to areas where fall into water is possible, the contractor shall provide suitable and adequate equipment for saving the workers from drowning and rescuing from such hazard. If the Employer considers, the contractor shall provide well-equipped boat or launch, manned with trained personnel at the work place.
iv) Open side or opening where worker, equipment, vehicle or lifting appliance may fall at a building or outside shall be guarded suitably except in places of free access by reasons of nature of work.
v) Suitable safety net shall be provided at places of material / man falling is possible in accordance with national standards.

21.0 Lifting Appliances and Gear

21.1 Lifting appliances means a crane, hoist machinery, derrick, winch, gin pole, sheer legs, jack, hoist drum, slewing machinery, slewing bearing fasteners, loffing machinery

sheaves, pulley blocks, hooks or other equipment used for lifting materials, objects or building workers and lifting gears means ropes, chain slings, shackles, hooks, lifting lugs, wire ropes, lifting eyebolts and eyenuts and other accessories of a lifting appliance.

21.2 No machine shall be selected to do any lifting on a specific job until its size and characteristics are considered against:

i) the weights, dimensions and lift radii of the heaviest and largest loads
ii) the maximum lift height, the maximum lift radius and the weight of the loads that must be handled at each
iii) the number and frequency of lifts to be made
iv) how long the crane will be required on site
v) the type of lifting to be done (for example, is precision placement of loads important?)
vi) the type of carrier required (this depends on ground conditions and machine capacity In its operating quadrants) capacity is normally greatest over the rear, less over the side, and non-existent over the front
vii) whether loads will have to be walked or carried
viii) whether loads will have to be suspended for lengthy periods
ix) the site conditions, including the ground where the machine will be set up, access roads and ramps it must travel, space for erection and any obstacles that might impede access or operation

21.3 The contractor shall ensure that a valid certificate of fitness issued as per clause 21.5 is available for all lifting appliances including synchronised mobile jacks, pre-stressing hydraulic jacks, jacks fitted with launching girders etc. and Employers approval before inducting to the site. Only after obtaining the approval from the Employer any lifting appliances and gear shall be used.

21.4 The laminated photocopies of fitness certificate issued by competent person, the Employers' approval letter, the operators' photo, manufacturer's load chart and competency certificate shall always be either kept in the operator cabin or pasted on the visible surface of the lifting appliances.

21.5 All lifting appliances and loose gears shall be clearly marked for its safe working load and identification by stamping or other suitable means.

21.6 The contractor shall also maintain a register containing a system of identification of all tools and tackles, its date of purchase, safe working load, competent person date of examination etc.

21.7 Test and periodical examination of lifting appliances and gears

21.7.1 All lifting appliances including all parts and gears thereof, whether fixed or movable shall be thoroughly tested and examined by a competent person once at least in every six months or after it has undergone any alterations or repairs liable to affect its strength or stability. Within the validity, if the lifting appliances are shifted to a new site, re-examination by the same competent person for ensuring its safety shall also be done.

21.7.2 Contractors can utilise the services of any competent person as defined in Factories Act, 1948 and approved by Chief Inspector of Factories with the permission of the Employer.

21.7.3 All alarms and signals like automatic safe load indicators (SLI), boom angle indicators, boom extension indicators, over lift boom alarm, swing alarm, hydraulic safety valves, mechanical radius indicators, load moment indicators etc. shall be periodically examined and maintained always in working condition

21.8 Automatic safe load indicators

21.8.1 As stipulated in Rule 57 of DBOCW Rules, every lifting appliances and gears like cranes, hydras etc, if so constructed that the safe working load may be varied by raising or lowering of the jib or otherwise shall be attached with an automatic indicator of safe working loads approved by Bureau of Indian standards/ International certifying bodies which gives a warning to the operator and arrests further movements of the lifting parts.

21.9 Qualification of operator of lifting appliances and of signaller etc

21.9.1 The contractor shall not employ any person to drive or operate a lifting machine like crane, hydra etc whether driven by mechanical power or otherwise or to give signals to work as a operator of a rigger or derricks unless he

i) is above twenty-one years of age and possesses a valid heavy transport vehicle driving licence as per Motor Vehicle Act and Rules.

ii) is absolutely competent and reliable

iii) possesses the knowledge of the inherent risks involved in the operation of lifting appliances by undergoing a formal training at any institution of national importance acceptable to Employer

iv) is medically examined periodically as specified in schedule VII of BOCW Rules.

21.10 General requirements of appliances

21.10.1 Out-of level

21.10.1.1 One of the most severe effects of being out-of fit level is that side loads develop in the boom. Because of side loads all mobile cranes lose capacity rapidly as the degree of out-of-level increases and therefore

21.10.2 Boom

i) The boom is one of the more critical elements of the crane and must be in perfect condition at all time. No boom section with a bent lattice member shall be allowed

ii) All welds shall be crack and corrosion free

iii) No member of the boom shall be bent

iv) All telescopic boom shall be free from cracks, rust, flaking or cracked paint, bulges, greases or varnishes

21.10.3 The sweep area (work area) of the construction machinery shall be always free from obstructions.

21.10.4 All hydraulic piping and fittings shall be maintained leak proof.

21.10.5 The operator cab shall posses good and safe:

i) Structure, windows and windshield wipers

ii) Drivers chair and foot rest

iii) Control handles

iv) Cab instrumentation

v) Telecommunication

vi) Cab out fitting

vii) wind indicator with an adjustable set point shall be in a position representative for the wind on the crane. The indicator shall give continuous information regarding constant speeds and gusts.

21.11 Mandatory rigging requirements

21.11.1 Rigging shall be done under experienced and qualified rigger only.

21.11.2 The primary requirement in rigging shall be to assess the weight of load before attempting any lift.

21.11.3 All hooks shall be fitted with Master Rings having certificate of fitness from the competent person, so that the hooks are subjected to balanced vertical loading only.

21.11.4 Only four legged slings shall be allowed which includes master link (ring), intermediate master link (ring) if necessary, chain / wire rope sling, sling hook or other terminal fitting.

21.11.5 Hand spliced slings up to 32mm diameter shall not be used at site for any lifting purpose.

21.11.6 No load shall be slewed over public areas without stopping the pedestrians and road traffic first.

21.11.7 Requirements of outriggers

i) All outriggers shall be fully extended and at all tyres are clear of the ground

ii) Heavy duty blocking having large bearing area shall be necessary to prevent sinking of floats

21.11.8 All loads shall have tag-lines attached in order to ensure that the load can be controlled at all times.

21.11.9 No close working to any live overhead power line is permitted without the operation of a strict Permit to Work.

21.11.10 Minimum lighting is to be ensured at all lifting operations.

21.12 Failure to do any of the above shall attract penalty from the Employer as per relevant clause

22.0 Launching Operation

22.1 As launching operation is one of the riskiest job, the contractor shall take utmost precaution at all stages like; planning, establishing casing yard, casting segments, transporting segments, fabrication and erection of launching girders, launching of segments, pre-stressing, auto launching of girders and dismantling of launching girders.

22.2 The contractor shall prepare a comprehensive Method Statement for the launching operation, adhering to the SHE conditions laid down in conditions of contract on SHE and project SHE manual. Particular reference shall be made to the provisions on working at height. As the entire process of launching has to be undertaken at an elevated level the safety of workers and the girder is paramount important. The following general guidelines shall be adhered throughout the launching operation.

i) Necessary 'working platforms' and fall protection anchorage arrangement shall be provided in the launching girder itself.

ii) Provisions for mounting light fittings shall also be made available in the launching girder.

iii) The casting yard shall be established ensuring the provision given in clause 38.0

iv) The workmen engaged in fabrication of reinforcement, concreting the segment shall be provided with necessary PPEs including compulsory hand protection gloves.

v) Casting and curing of segment shall be undertaken under the direct supervision of the responsible engineer of the contractor.

vi) Trucks with valid registration, licence, safe worthiness certificate, Employer's approval certificate, and pollution under check certificate shall only be used for transport of segments

vii) Drivers engaged for driving these trucks, shall be trained once in 6 months on defensive driving.

viii) Drivers shall also have undergone proper medical examination as per relevant clause mentioned under 'Medical Facilities'.

ix) The segments shall rigidly secured to the truck with necessary wooden wedges and necessary red indicators/safety tapes provided so that the vehicle is clearly seen by other road users both in day / night time.

x) Every launching girder shall have a responsible engineer on duty all the time.

xi) All the time from erection to dismantling the area between the two piers wherein launching is in progress shall always be barricaded.

xii) Unloading of segments from trucks, lifting of segments, shifting of segments, gluing shall be done under the direct supervision of the approved engineer of the contractor.

xiii) Auto launching shall be done only after approval from the Employer. After every auto launching the stability of launching girder shall be ensured.

xiv) The vertical deflection of launching girder shall be monitored at all critical stages like with/without loads and after every auto launching.

xv) A register containing all important operational details from erection to dismantling of launching girders shall be maintained and made available to Employer whenever called for.

xvi) Test certificate for all lifting gears including Macalloy bars shall be maintained at a location closer to the launching girder itself so that it can be referred during all inspections.

xvii) Adequate lighting at all time shall be ensured in the entire area of operation.

xviii) Access to drinking water & toilet shall be ensured to all workmen engaged for launching process.

xix) Proper access ladders/stairways shall be maintained for safe ascending / descending of workmen / engineers.

22.3 Non-adherence to any of the clauses mentioned above shall be viewed seriously by the Employer and penalty levied as per relevant clause.

23.0 Construction machinery

23.1 Construction machineries may include dumpers and dump trucks, lift trucks and telescopic handlers piling rigs, vibro hammers, rail welding equipments, mobile elevating work platforms, cranes, tipper lorries, lorry loaders, skip wagons, 360° excavators, 180° backhoe loaders, crawler tractors, scrapers, graders, loading shovels, trenchers, side booms, pavers, planers, chippers, road rollers, locomotives, tankers and bowsers, trailers, hydraulic and mechanical breakers etc.

23.2 Safe worthiness certificate

23.2.1 Every construction equipment shall be in sound mechanical working condition and certified by either competent person under Factories Act or manufacturers' warranty in case of brand new equipments or authorized persons / firms approved by Employer before induction to any site.

23.2.2 Every such certificate shall have the date of purchase, main overhauling undertaken in the past, any accident to the equipment, visual examination details, critical components safety check, list of safety devises and its working condition, manufacturer's maintenance checklist, past projects wherein the equipments were used etc as its minimum content.

23.3 Reverse Horns

23.3.1 All Vehicles shall be fitted with audible reverse alarms and maintained in good working condition. Reversing shall be done only when there is adequate rear view visibility or under the directions of a banksman

23.4 General operating procedures

i) Drivers entering site shall be instructed to follow the safe system of work adopted on site. These shall be verbal instructions or, preferably, written instructions showing the relevant site rules, the site layout, delivery areas, speed limits, etc.

ii) No passengers shall be carried, unless specific seating has been provided in accordance with the manufacturers recommendations.

iii) Working on gradients beyond any equipments capability shall not be allowed.

iv) Prevention of dumper and dump truck accidents should be managed by providing wheel stops at a sufficient distance from the edges of excavations, spoil heaps, pits, etc.

v) The manufacturer's recommended bucket size must not be exceeded in excavators.

vi) If excavators operating on a gradient which cannot be avoided, it must be ensured that the working cycle is slowed down, that the bucket is not extended too far in the downhill direction, and that travel is undertaken with extreme caution. A large excavator must never be permitted to travel in a confined area, or around people, without a banksman to guide the driver, who should have the excavator attachment close in to the machine, with the bucket just clear of the ground. On wheeled excavators, it is essential that the tyres are in good condition and correctly inflated. If stabilizing devices are fitted, they should be employed when the machine is excavating.

vii) When the front shovel of the 1800 backhoe loaders is being employed, the backhoe attachment shall be in its "travel" position, with the safety locking device in place.

viii) When operating the backhoe in poor ground conditions, the stabilisers tend to sink into the surface of the ground, reducing stability. Therefore frequent checks shall be made for the stability of the machine. The loading shovel should always be lowered to the ground to stabilise the machine when the backhoe is employed.

ix) The netting operation of the skip wagons should be carried out prior to lifting the skip to reduce the risks of working on the rear platform

x) If a tractor dozer is employed on clearing scrub or felling trees, it shall be provided with adequate driver protection.

xi) When two or more scrapers are working on the same job, a minimum distance of at least 25m shall be kept between them.

xii) Incase of hydraulic breakers, hydraulic rams and hoses shall be in good working condition

23.5 All wood working machines shall be fitted with suitable guards and devices such as top guard, riving knife, push stick, guards for drive belts and chains, and emergency stop switch easily accessible by the operator.

23.6 Penalty

23.6.1 If any of the above clauses are not adhered, penalty shall be imposed as per relevant clause depending upon the gravity of the unsafe act and or condition.

24.0 Machine and general area guarding

24.1 The contractor shall ensure at the construction site all motors, cogwheels, chains and friction gearing, flywheels, shafting, dangerous and moving parts of machinery are securely fenced or legged. The fencing of dangerous part of machinery is not removed while such machinery is in motion or in use.

25.0 Manual lifting and carrying of excessive weight

25.1 The contractor shall ensure at his construction site of a building or other construction work that no building worker lifts by hand or carries overhead or over his back or shoulders any material, article, tool or appliances exceeding in weight as said below as per Rule 38 of BOCWR, Unless aided by another building worker or device.

Person	Maximum weight in kg
Adult Man	55
Adult woman	30

25.2 No building worker aided by other building worker shall lift or carry weight higher than or exceeding the sum of total of maximum limits set out for each building worker separately as mentioned in the table above.

26.0 Site Electricity

26.1 Competency of Electrical personnel:

26.1.1 The contractor shall employ qualified and competent electrical personnel as specified in general instruction ***KMRC/SHE/GI/001/MPR/281105.***

26.2 Assessment of power

26.2.1 The contractor shall assess the size and location of the electrical loads and the manner in which they vary with time during the currency of the contract.

26.2.2 The contractor shall elaborate as to how the total supply is to be obtained / generated. The details of the source of electricity, earthing requirement, substation / panel boards, distribution system shall be prepared and necessary approval from Employer obtained before proceeding of the execution of the job.

26.2.3 The Contractor shall take into consideration the requirements of the sub / petty contractors' electric power supply and arrive at the capacity of main source of power supply from diesel generators.

26.2.4 As the sub / petty contractors' small capacity generators create more noise and safety hazard, no small capacity diesel generators shall be allowed for whatsoever the type of job to be executed under this contract.

26.2.5 If any unsafe noise making small capacity diesel generators are found used by sub / petty contractors the main contractor shall only be penalised.

26.3 **Work on site**

26.3.1 The contractor shall also submit electrical single line diagram, schematic diagram and the details of the equipment for all temporary electrical installation and these diagrams together with the temporary electrical equipment shall be submitted to the Employer's for necessary approval. Failure to do so shall invite penalty as per relevant clause.

26.4 Strength and capability of electrical equipment

26.4.1 No electrical equipment shall be put into use where its strength and capability may be exceeded in such a way as may give rise to danger.

26.5 Adverse or hazardous environments

26.5.1 Electrical equipment, which may reasonably foreseeably be exposed to-

(a) mechanical damage;
(b) the effects of the weather, natural hazards, temperature or pressure;
(c) the effects of wet, dirty, dusty or corrosive conditions; or
(d) any flammable or explosive substance, including dusts, vapours or gases, shall be of such construction or as necessary protected as to prevent, so far as is reasonably practicable, danger arising from such exposure.

26.6 Distribution system:

26.6.1 The contractor shall provide distribution system for control and distribution of electricity from a main AC supply of 50Hz for typical appliances,

i) Fixed plant – 400V 3 phase

ii) Movable plant fed via trailing cable over 3.75 kW – 400 3 phase

iii) Installation in site buildings – 230V single phase

iv) Fixed flood lighting – 230V single phase

iv) Portable and hand tools – 115V single phase

v) Site lighting - 115V single phase

vi) Portable hand lamps – 115V single phase

26.7 Electrical protection circuits

26.7.1 Precautions shall be taken, either by earthing or by other suitable means, to prevent danger arising when any conductor (other than a circuit conductor) which may reasonably foreseeable become charged as a result of either the use of a system, or a fault in a system, becomes so charged. A conductor shall be regarded as earthed when conductors of sufficient strength and current-carrying capability to discharge electrical energy to earth connect it to the general mass of earth.

If a circuit conductor is connected to earth or to any other reference point, nothing which might reasonably be expected to give rise to danger by breaking the electrical continuity or introducing high impedance shall be placed in that conductor unless suitable precautions are taken to prevent that danger.

26.7.2 Appropriate electrical protection shall be provided for all circuits, against over load, short circuit and earth fault current.

26.7.3 The contractor shall provide sufficient ELCBs (maintain sensitivity 30 mA) / RCCBs for all the equipments (including Potable equipments), electrical switchboards, distribution panels etc. to prevent electrical shocks to the workers.

26.7.4 All protection devices shall be capable of interrupting the circuit without damage to any equipments and circuits in case of any fault may occur.

26.7.5 Rating of fuses and circuit breakers used for the protection of circuits should be coordinate with equipment power ratings.

26.7.6 Protection against lightning shall be ensured to all equipment kept in open at sites.

26.8 Cables:

26.8.1 Cables shall be selected after full consideration of the condition to which they shall be exposed and the duties for which they are required. Supply cable up to 3.3 kV shall be in accordance with BS 6346.

26.8.2 For supplies to mobile or transportable equipment where operating of the equipment subjects the cable to flexing, the cable shall conform to any of these codes BS 6007 / BS 6500 / BS 7375.

26.8.3 Flexible cords with a conductor cross sectional area smaller than 1.5 mm2 shall not be used and insulated flexible cable shall conform to BS 6500 and BS 7375.

26.8.4 Where low voltage cables are to be used, reference shall be made to BS 7375. The following standards shall also be referred to particularly for underground cables BS 6346 and BS 6708

26.8.5 Cables buried directly in the ground shall be of a type incorporating armour or metal sheath or both. Such cables shall be marked by cable covers or a suitable marking tape and be buried at a sufficient depth to avoid their being damaged by any disturbance of the ground. Cable routes shall be marked on the plans kept in the site electrical register.

26.8.6 Cabling passing under the walk way and across way for transport and mobile equipment shall be laid in ducts at a minimum depth of 0.6 meters.

26.8.7 Cables that need to cross open areas, or where span of 3m or more are involved, a catenary wire on poles or other supports shall be provided for convenient means of suspension. Minimum height shall be 6 m above ground.

26.8.8 Cables carrying a voltage to earth in excess of 65V other than supply for welding process shall have metal armour or sheath, which has been effectively earthed and monitored by the contractor. In case of flexible and trailing cables such earthed metal sheath and/or armour should be in addition to the earth core in the cable and shall not be used as the protective conductor.

26.8.9 Armoured cables having an over-sheath of polyvinyl chloride (PVC) or an oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring

26.9 Plugs, socket-outlets and couplers:

26.9.1 The contractor shall ensure plugs, socket-outlets, and couplers available in the construction site as “splash proof” type. The minimum degree of Ingress Protection should be of IP44 in accordance with BS EN 60529.

26.9.2 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.

26.10 Connections

26.10.1 Every joint and connection in a system shall be mechanically and electrically suitable for use to prevent danger. Proper cable connectors as per national/international standards shall only be used to connect cables.

26.10.2 No loose connections or tapped joints shall be allowed any where in the work site, office area, stores and other areas. Penalty as per relevant clause shall be put in case of observation of any tapped joints.

26.11 Portable and hand-held equipments:

26.11.1 The contractor shall ensure the use of double insulated or all-insulated portable electrical hand equipment may be used without earthing (i.e. two core cables), but they shall still be used only on 110V because of the risk of damage to trailing leads.

26.12 Other equipments:

26.12.1 All equipment shall have the provision for major switch/cut-off switch in the equipment itself.

26.12.2 All non-current carrying metal parts of electrical equipment shall be earthed through insulated cable

26.12.3 Isolate exposed high-voltage (over 415 Volts) equipment, such as transformer banks, open switches, and similar equipment with exposed energized parts and prevent unauthorised access.

26.12.4 Approved perimeter markings shall be used to isolate restricted areas from designated work areas and entryways and shall be erected before work begins and maintained for entire duration of work. Approved perimeter marking shall be installed with either red barrier tape printed with the words "DANGER—HIGH VOLTAGE" or a barrier of yellow or orange synthetic rope, approximately 1 to 1.5 meter above the floor or work surface.

26.13 Work on or near live conductors

26.13.1 No person shall be engaged in any work activity on or so near any live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise unless-

a) it is unreasonable in all the circumstances for it to be dead; and

b) it is reasonable in all the circumstances for him to be at work on or near it while it is live; and

c) suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.

26.14 Inspection and Maintenance

26.14.1 All electrical equipment should be permanently numbered and a record kept of the date of issue, date of last inspection and recommended inspection period.

26.14.2 Fixed installations shall be inspected at least at three monthly intervals; routine maintenance being carried out in accordance with equipment manufactures recommendations.

27.0 Lighting:

27.1 The contractor shall provide sufficient site lighting, of the right type and at the right place for it to be properly effective. Lighting ought not to introduce the risk of electric shock. Therefore, 230V supplies should be used for those fittings, which are robustly installed, and well out of reach e.g. flood lighting or high-pressure discharge lamps.

27.2 Selection of Luminaries:

The contractor shall select the luminaries as per the area requirement indicated below:

Sl. No.	Type of Lighting	Area of Requirement	Luminaries
1.	Area Lighting	Work and vehicles to move about in safely.	i) Shovel type : non-symmetrical ii) Symmetrical or non-symmetrical tungsten halogen
2.	Bean flood lighting	Concentrated light over an area for a relatively great distance.	i) Portable flood light (Conical beam) ii) Wide angle flood (fan shaped beam) iii) Medium or narrow angle flood (conical beam)

Sl. No.	Type of Lighting	Area of Requirement	Luminaries
3.	Dispersive lighting	Lighting for indoor	i) Dispersive (Mercury florescent) ii) Cargo cluster iii) Florescent trough
4.	Walkway lighting	Lighting for stairways, ladder ways, corridors, scaffold access routs, etc.	i) Well glass unit ii) Bulkhead unit (Tungsten filament) iii) Bulk head unit (Florescent)
5.	Local lighting	Lighting on sites and fittings are generally accessible to operatives	i) PAR (Parabolic Aluminised Reflector) lamp cluster ii) Festoons (with or without shades) iii) Adjustable florescent work lamp iv) Portable flood lamp (mounted on own cable drum)

27.3 The contractor shall ensure that luminaries should always be placed so that no person is required to work in their own shadow and so that the local light for one person is not a source of glare for the others. Strongly made clamps should be available for attaching luminaries to poles and other convenient supports.

27.4 Luminaries should be robust, resistant to corrosion and rain proof especially at the point of the cable entry.

27.5 The correct type of lamp for each luminaries should always be used and when lamps need to be replaced if shall be in accordance with the supply voltage.

27.6 Lamp holders not fitted with a lamp should be capped off.

27.7 The contractor shall take every effort to illuminate the work site as per the Employer's requirement illustrated in general instruction ***KMRC/SHE/GI/0011/ILL/281105***.

28.0 Hand Tools and Power Tools

28.1 General

28.1.1 The contractor is wholly responsible for the safe condition of tools and equipment used by his employees and that of his sub-contractors.

28.1.2 Use of short / damaged hand tools shall be avoided and the contractor shall ensure all his hand tools used at his worksite are safe to work with or stored and shall also train his employees (including his sub-contractors) for proper use thereby.

28.1.3 All hand tools and power tools shall be duly inspected before use for safe operation.

28.1.4 All hand tools and power tools shall have sufficient grip and the design specification on par with national/international standards on anthropometrics.

28.2 Hand tools

28.2.1 Hand tools shall include saws, chisels, axes and hatches, hammers, hand planes,screw drivers, crow bars, nail pullers.

28.2.2 The contractor shall ensure that,

i) For crosscutting of hardwood, saws with larger teeth points (no. of points per inch) shall be preferred to avoid the saw jumping out of the job.
ii) Mushroom headed chisels shall not be used in the worksite where the fragments of the head may cause injury.
iii) Unless hatchet has a striking face, it shall be used as a hammer.
iv) Only knives of retractable blades shall be used in the worksite.
v) No screwdrivers shall be used for scraping, chiselling or punching holes.
vi) A pilot hole shall always be driven before driving a screw.
vii) Wherever necessary, usage of proper PPEs shall be used by his employees.

28.3 Power tools

28.3.1 Power tools include drills, planes, routers, saws, jackhammers, grinders, sprayers, chipping hammers, air nozzles and drills.

28.3.2 The contractor shall ensure that

i) Electric tools are properly grounded or / and double insulated.
ii) GFCIs/ RCCBs shall be used with all portable electric tool operated especially outdoors or in wet condition.
iii) Before making any adjustments or changing attachments, his workers shall disconnect the tool from the power source.
iv) When operating in confined spaces or for prolonged periods, hearing protection shall be required. The same shall also apply to working with equipments, which gives out more noise as mentioned in clause ***43.0*** of this contract document.
v) Tool is held firmly and the material is properly secured before turning on the tool.
vi) All drills shall have suitable attachments respective of the operations and powerful for ease of operation.
vii) When any work / operation need to be performed repeatedly or continuously, tools specifically designed for that work shall be used. The same is applicable to detachable tool bit also.
viii) Size of the drill shall be determined by the maximum opening of the chuck n case of drill bit.
ix) Attachments such as speed reducing screwdrivers and buffers shall be provided to prevent fatigue and undue muscle strain to his workers.
x) Stock should be clamped or otherwise secured firmly to prevent it from moving.
xi) Workers shall never stand on the top of the ladder to drill holes in walls / ceilings, which can be hazardous, instead standing on the fourth or fifth rung shall be recommended.
xii) Electric plane shall not be operated with loose clothing or long scarf or open jacket.
xiii) Safety guards used on right angle head or vertical portable grinders must cover a minimum of 1800 of the wheel and the spindle / wheel specifications shall be checked.
xiv) All power tools / hand tools shall have guards at their nip points.
xv) Low profile safety chain shall be used in case of wood working machines and the saw shall run at high rpm when cutting and also correct chain tension shall be ensured to avoid “kickback”.
xvi) Leather aprons and gloves shall be used as an additional personal protection auxiliary to withstand kickback.
xvii) Push sticks shall be provided and properly used to hold the job down on the table while the heels moves the stock forward and thus preventing kickbacks.
xviii) Air pressure is set at a suitable level for air actuated tool or equipment being used. Before changing or adjusting pneumatic tools, air pressure shall be turned off.

xix) Only trained employees shall use explosive actuated tools and the tool shall also be unloaded when not in use.
xx) Usage of such explosive actuated tools shall be avoided in case of places where explosive/flammable vapours or gases may be present.
xxi) Explosive actuated tools and their explosives shall be stored separately and be taken out and loaded only before the time of immediate use.
xxii) Misfired cartridges of explosive actuated tools must be placed in a container of water and be removed safely from the project.
xxiii) No worker shall point any power operated / hand tool to any other person especially during loading / unloading.

29.0 Welding, Gouging and Cutting

29.1 Gas cylinders in use shall be kept upright on a custom-built stand or trolley fitted with a bracket to accommodate the hoses and equipment or otherwise secured. The metal cap shall be kept in place to protect the valve when the cylinder is not connected for use.

29.2 Hose clamp or clip shall be used to connect hoses firmly in both sides of cylinders and torches.

29.3 All gas cylinders shall be fixed with pressure regulator and dial gauges

29.4 Non-return valve and Flashback arrester shall be fixed at both end of cylinder and torch.

29.5 Domestic LPG cylinders shall not be used for Gas welding and Cutting purpose.

29.6 DCP or CO2 type Fire Extinguisher not less than 5 kg shall be fixed at or near to welding process zone in an easily accessible location. Fire Extinguisher should confirm to IS 2190: 1992.

29.7 Use firewatchers if there is a possibility of ignition unobserved by the operator (e.g. on the other side of bulkheads).

29.8 Oxygen cylinders and flammable gas cylinders shall be stored separately, at least 6.6 meters (20 feet) apart or separated by a fire proof, 1.5 meters (5 feet) high partition. Flammable substances shall not be stored within 15 meters of cylinder storage areas.

29.9 Transformer used for electrical arc welding shall be fixed with Ammeter and Voltmeter and also fixed with separate main power switch.

29.10 Welding grounds and returns should be securely attached to the work by cable lugs, by clamps in the case of stranded conductors, or by bolts for strip conductors. The ground cable will not be attached to equipment or existing installations or apparatus.

29.11 Use a low voltage open circuit relay device if welding with alternating current in constricted or damp places.

29.12 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.

29.13 Avoid being in contact with water or wet floors when welding. Use duckboards or rubber protection.

29.14 All electrical installations shall meet the IS: 5571: 1997 and NFPA 70 for gas cylinder storage area and other hazardous areas.

29.15 The current for Electric arc welding shall not exceed 300 A on a hand welding operation.

30.0 Dangerous and harmful environment

As per BOCWR Rule 40,

i) When internal combustion engines are to be used into a confined space or excavation or tunnel or any other workplace where neither natural or artificial ventilation system is inadequate to keep carbon monoxide below 50ppm, exposure of building workers shall be avoided unless suitable measures are taken and provided by the contractor.

ii) No worker shall be allowed into any confined space or tank or trench or excavation wherein there is given off any dust, fumes / vapours or other impurities which is likely to be injurious or offensive, explosive or poisonous or noxious or gaseous material or other harmful articles unless steps are carried out by the contractor and certified by the responsible person to be safe.

31.0 Fire prevention, protection and fighting system

31.1 The contractor shall ensure that construction site is provided with fire extinguishing equipment sufficient to extinguish any probable fire at construction site. An adequate water supply is provided at ample pressure as per national standard.

31.2 Recharging of fire extinguishers and their proper maintenance should be ensured and as a minimum should meet Indian National Standards

31.3 All drivers of vehicles, foreman, supervisors and managers shall be trained on operating the fire extinguishers and fire fighting equipment.

31.4 The contractor shall also 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

31.5 As per the DBOCW Rules 2002, Rule 63(a)(vii), all lifting appliances' driver cabin should be provided with a suitable portable fire extinguisher.

31.6 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.

31.7 Every fire, including those extinguished by contractor personnel, shall be reported to the Employer representatives.

31.8 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 and as a part of the programme, the Telephone Number of the local fire brigade should be prominently displayed near each telephone on site.

32.0 Corrosive substances

32.1 As per BOCWR Rule 44, corrosive substances including alkalis and acids shall be stored and used by a person dealing with such substances at a building / construction site in a manner that it does not endanger the building worker and suitable PPE shall be provided by the contractor to the worker during such handling and work. In case of spillage of such substances on building worker, the contractor shall take immediate remedial measures.

33.0 Demolition

33.1 The Contractor shall ensure that

i) all demolition works be carried out in a controlled manner under the management of experienced and competent supervision.

ii) the concerned department of the Government or local authority be informed and permission obtained wherever required. Media shall also be informed regarding this concern.

iii) all glass or similar materials or articles in exterior openings are removed before commencing any demolition work and all water, steam, electric, gas and other similar supply lines are put-off and such lines so located or capped with substantial coverings so as to protect it from damage and to afford safety to the building workers and public.

iv) examine the walls of all structures adjacent to the structure to be demolished to determine thickness, method of support to such adjacent structures

v) no demolishing work be performed if the adjacent structure seems to be unsafe unless and until remedial measures life sheet piling, shoring, bracing or similar means be ensured for safety and stability for adjacent structure from collapsing.

vi) debris / bricks and other materials or articles shall be removed by means of
a) chutes
b) buckets or hoists
c) through openings through floors or
d) any other safe means

vi) no person other than building workers or other persons essential to the operation of demolition work shall be permitted to enter a zone of demolition and the area be provided with substantial barricades.

34.0 Excavation and Tunnelling:

34.1 Excavation

34.1.1 The contractor shall ensure

i) where any construction building worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than one 1.5 m above his footing, such worker is protected by adequate piling and bracing against such bank or side.

ii) where banks of an excavation are undercut, adequate shoring is provided to support the material or article overhanging such bank.

iii) excavated material is not stored at least 0.65 m from the edge of an open excavation or trench and banks of such excavation or trench are stripped of loose rocks and the banks of such excavation or trench are stripped of loose rocks and other materials which may slide, roll or fall upon a construction building worker working below such bank

iv) metal ladders and staircases or ramps are provided, as the case may be, for safe access to and egress from excavation where, the depth of such excavation exceeds 1.5 m and such ladders, staircases or ramps comply with the IS 3696 Part 1&2 and other relevant national standards.

v) trench and excavation is protected against falling of a person by suitable measures if the depth of such trench or excavation exceeds 1.5 m and such protection is an improved protection in accordance with the design and drawing of a professional engineer, where such depth exceeds 4m.

34.2 Tunnelling

34.2.1 The contractor shall inform in writing to the Director General within 30 days, prior to the commencement of any tunnelling work.

34.2.2 The contractor shall appoint a responsible person for safe operation for tunnelling work as per Rule 121 & 125 of BOCWR.

34.2.3 The contractor shall ensure

i) every compressed air system in a tunnel is provided with emergency power supply for maintained continued supply of compressed air as per Rule 155 of BOCWR

ii) watertight bulkhead doors are installed at the entrance of a tunnel to prevent flooding.

iii) reliable and effective means of communication such as telephone or walkie-talkie are provided and maintained for arranging better effective communication at an excavation or tunnelling work as per Rule 136 of BOCWR.

iv) all portable electrical hand tools and inspection lamp used in underground and confined space at an excavation or tunnelling work is operated at a voltage not exceeding 24V.

v) only flame proof equipment of appropriate type as per IS:5571:2000 and or other relevant national standard is used inside the tunnel

vi) petrol or LPG of any other flammable substances are not used, stored inside the tunnel except with prior approval from Employer, and also no oxy-acetylene gas is used in a compressed air environment in excavation or tunnelling

vii) adequate number of water outlets provided for firefighting purpose, an audible fire alarm and adequate number and types of fire extinguishers are provided and maintained.

viii) temperature in any working chamber in an excavation or tunnelling work where workers employed does not exceed 29°C as per Rule 165 of BOCWR.

ix) all working areas in a free air tunnel are provided with ventilation system as approved by the Director General and the fresh air supplied in such tunnel is not less than 6 m3/ min for each worker employed in tunnel as per Rule 153 of BOCWR.

34.3 Warning signs and notices:

34.3.1 The contractor shall ensure that

i) suitable warning signs or notices, required for the safety of building workers carrying out the work of an excavation or tunnelling, shall be displayed or erected at conspicuous places in Hindi and in a language understood by majority of such building workers at such building such excavation or tunnelling work

ii) such warning signs and notices with regard to compressed air working shall include
   a) the danger involved in such compressed air work
   b) fire and explosion hazard
   c) the emergency procedures for rescue from such danger or hazards.

35.0 Work Permit system

35.1 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.

35.2 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

35.3 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;

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

35.5 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.

36.0 Traffic Management

36.1 The basic objective of the following guidelines is to lay down procedures to be adopted by contractor to ensure the safe and efficient movement of traffic and also to ensure the safety of workmen at construction sites.

36.2 All construction workers should be provided with high visibility jackets with reflective tapes as most of viaduct /tunnelling and station works or either above or under right-of-way. The conspicuity of workmen at all times shall be increased so as to protect from speeding vehicular traffic.

36.3 The guiding principles to be adopted for safety in construction zone are to

i) Warn the road user clearly and sufficiently in advance.

ii) Provide safe and clearly marked lanes for guiding road users.

iii) Provide safe and clearly marked buffer and work zones

iv) Provide adequate measures that control driver behaviour through construction zones.

36.4 Legal permission

36.4.1 In all cases, the contractor shall employ proper precautions. Wherever operations undertaken are likely to interfere with public traffic, specific traffic management plans shall be drawn up and implemented by the contractor in consultation with the approval of local police authorities and/or the concerned metropolitan/civil authorities as the case may be.

36.4.2 Such traffic management plans shall include provision for traffic diversion and selection of alternative routes for transport of equipment. If necessary, the contractor shall carry out road widening before commencement of works to accommodate the extra load

36.5 The primary traffic control devices used in work zones shall include signs, delineators, barricades, cones, pylons, pavement markings and flashing lights.

36.6 The road construction and maintenance signs which fall into the same three major categories as do other traffic signs, that are Regulatory Signs, Warning Signs and Direction (or guidelines) Signs shall only be used. The IRC: 67 (Code of Practice for Road Signs) provide a list of traffic signs. The size, colours and placement of sign shall confirm to IRC: 67.

36.7 Regulatory signs

36.7.1 Regulatory signs impose legal restriction on all traffic. It is essential, therefore, that they are used only after consulting the local police and traffic authorities.

36.8 Warning signs

36.8.1 Warning signs in the traffic control zone shall be utilised to warn the drivers of specific hazards that may be encountered.

36.8.2 The contractor shall place detour signage at strategic locations and install appropriate warning signs. In order to minimize disruption of access to residences and business, the contractor shall maintain at least one entrance to a property where multiple entrances exist.

36.8.3 A warning sign as given in general instruction ***KMRC/SHE/GI/012/WS/281105*** shall be installed an 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'.

36.8.4 Materials hanging over / protruded from the chassis / body of any vehicle especially during material handling shall be indicated by red indicator (red light/flag) to indicate the caution to the road users.

36.9 Delineators

The delineators are the elements of a total system of traffic control and have two distinct purposes:

i) To delineate and guide the driver to and along a safe path
ii) As a taper to move traffic from one lane to another.

36.9.1 These channelising devices such as cones, traffic cylinders, tapes and drums shall be placed in or adjacent to the roadway to control the flow of traffic. These should normally be retro-reflectors complying to IRC: 79 - Recommended Practice for Road Delineators.

36.9.2 Traffic cones and cylinders

36.9.2.1 Traffic cones of 500mm, 750mm and 1000mm high and 300mm to 500mm in diameter or in square shape at base and are often made of plastic or rubber and normally have retro-reflectorised red and white band shall be used wherever required.

36.9.3 Drums

36.9.3.1 Drums about 800mm to 1000mm high and 300mm in diameter can be used either as channelising or warning devices. These are highly visible, give the appearance of being formidable objects and therefore command the respect of drivers.

36.9.4 Barricades

36.9.4.1 Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the working area from the risk of accidents due to speedy vehicular movement. Same the way barricades protect the road users from the danger due to construction equipment and other temporary structures.

36.9.4.2 The structure dimension of the barricade, material and composition, its colour scheme, KMRC logo and other details shall be in accordance with specifications laid down in tender document.

36.9.4.3 All barricades shall be erected as per the design requirements of the Employer, numbered, painted and maintained in good condition and also Barricade in-charge maintains a barricade register in site.

36.9.4.4 All barricades shall be conspicuously visible at night. This shall be ensured by affixing retro reflective stripes of required size and shape at appropriate angle at the bottom and

middle portion of the barricade at a minimum gap of 1000mm. In addition minimum one red light or red light blinker should be placed at the top of each barricade.

36.9.5 The contractor shall ensure that all his construction vehicles plying on public roads (like dump trucks, trailers, etc.) have proper license to ply on public roads from the State Transport Authority. Drivers holding proper valid license as per the requirements of Motor Vehicles Act shall drive these vehicles

36.9.6 The contractor shall not undertake loading and unloading at carriageways obstructing the free flow of vehicular traffic and encroachment of existing roads by the contractor applying the excuse of work execution.

36.9.7 Tow away vehicle

36.9.7.1 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.

36.9.8 Cleaning of roads

36.9.8.1 The contractor shall avoid impact on the cleanliness of public roads and footpaths due to his works, by deploying proper manpower for sweeping, cleaning, washing, including proper disposal of dust and debris arising.

37.0 Work to adjacent railways

37.1 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 should be followed.

(b) No persons are allowed to encroach onto the railway unless the owner has given specific authority.

(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 railways shall be strictly observed

38.0 Batching Plant and Casting Yard layout

i) The batching plant / casting yard shall be effectively planned for smooth flow of unloading and stacking the aggregates reinforcements and cement, batching plant, transport of concrete, casting the segment, stacking the segment and loading the segments to the trucks. As far as possible the conflicts should be avoided.

ii) The batching plant / casting yard shall be barricaded and made as a compulsory PPE zone

iii) If in case of material unloading area is not maintainable as PPE zone, the same shall be segregated properly and made as a non-PPE zone with appropriate barrications.

iv) Electrical system shall also be suitably planned so that location of diese generator, if any, location of DBs, routing of cables and positioning of area lighting poles/masts does not infringe on any other utility and pose danger.

v) Drainage shall be effectively provided and waste water shall be disposed after proper treatment
vi) Time office, canteen, drinking water, toilet and rest place shall be suitably located for the easy access to workers. All the facilities shall be properly cleaned and maintained during the entire period of operation.
vii) Manual handling of cement shall be avoided to a larger extent. Whenever it is absolutely necessary the workmen shall be given full body protection, hand protection and respiratory protection as a basic measure of ensuring better health.
viii) The PPEs provided to cement handling workmen shall conform to international standards.
ix) Access roads and internal circulation roads shall be well laid and maintained properly at all time.
x) Non-adherence to any of the above provision shall be penalised as per relevant penalty clause.

39.0 Personal Protective Equipments (PPEs)

39.1 The contractor shall provide required PPEs to workmen to protect against safety and / or health hazards. Primarily PPEs are required for the following protection

i) Head Protection (Safety helmets)
ii) Foot Protection (Safety footwear, Gumboot, etc)
iii) Body Protection (High visibility clothing (waistcoat/jacket), Apron, etc)
iv) Personal fall protection (Full body harness, Rope-grap fall arrester, etc)
v) Eye Protection (Goggles, Welders glasses, etc)
vi) Hand Protection (Gloves, Finger coats, etc)
vii) Respiratory Protection. (Nose mask, SCBAs, etc)
viii) Hearing Protection (Ear plugs, Ear muffs, etc)

39.2 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.

39.3 All construction workers should be provided with high visibility jackets with reflective tapes confirming to the requirement specified under BS EN 471: 1994 as most of viaduct /tunnelling and station works are executed either above or under right-of-way. The conspicuity of workmen at all times shall be increased so as to protect them from speeding vehicular traffic.

39.4 The contractor shall provide safety helmet, safety shoe and high visibility clothing for all employees including workmen, traffic marshal and other employees who are engaged for any work under this contract as per the following requirement.

All employees of Contractor including workmen	Traffic marshals
i) Hard hat with company Logo ii) Safety boots iii) Hi-visibility waistcoat covering upper body and meeting the following requirements as per BS EN 471:1994: a) Background in fluorescent orange-red in colour b) Two vertical green strips of 5cm wide on front side, covering the torso at least 500 cm^2 c) Tow diagonal strips of 5 cm wide on back in an 'X' pattern covering at least in 570cm^2 d) Horizontal strips not less than 5cm wide running around the bottom of the vertical strip in front and 'X' pattern at back. e) The bottom strip shall be at a distance of 5cm from the bottom of the vest. f) Strips must be retro reflective and fluorescent g) Waistcoat shall have a side adjustable fit and a side and front tear-away feature on vests made of nylon.	i) Hard hat with reflective tape ii) Safety boots iii) Hi-visibility **jacket** covering upper body and meeting the following requirements as per BS EN 471:1994: a) Background in fluorescent orange-red in colour b) Jackets with full-length sleeves with two bands of retro reflective material, which shall be placed at the same height on the garment as those of the torso. The upper band shall encircle the upper part of the sleeves between the elbow and the shoulder; the bottom of the lower band shall not be less than 5cm from the bottom of the sleeve. c) Tow vertical green strips of 5cm wide on front side, covering the torso at least 500 cm^2 d) Two diagonal strips of 5 cm wide on back in an 'X' pattern covering at least 570 cm^2 e) Horizontal strips not less than 5cm wide running around the bottom of the vertical strip in front and 'X' pattern at back. f) The bottom strip shall be at a distance of 5cm from the bottom of the vest. g) Strips must be retro reflective and fluorescent.

39.4.1 Colour coding for helmets

Safety Helmet Colour Code (Every Helmet should have the LOGO* affixed / painted)	Person to use
White	KMRC Staffs
Grey	All Designers, Architect, Consultants, etc.
Violet	Main Contractors (Engineers / Supervisors)
Blue	All Sub-contractors (Engineers / Supervisors)
Red	Electricians (Both Contractor and Sub-contractor)
Green	Safety Professionals (Both Contractor and Sub-contractor)
Orange	Security Guards / Traffic marshals
Yellow	All workmen
White (with "VISITOR" sticker)	Visitors

Note: LOGO*

1. Logo shall have its outer dimension 2"X2" and shall be conspicuous
2. Logo shall be either painted or affixed
3. No words shall come either on Top / Bottom of Logo

Logo of the corresponding main contracting company for their employees and sub-contracting company for their employees shall only be used.

39.5 In addition to the above any other PPE required for any specific jobs like, welding and cutting, working at height, tunnelling etc shall also be provided to all workmen and also ensure that all workmen use the PPEs properly while on the job.

39.6 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.

39.7 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.

39.8 It is always the duty of the contractor to provide required PPEs for all visitors. Towards this required quantity of PPEs shall be kept always at the security post.

40.0 Visitors to site

40.1 No visitor is allowed to enter the site without the permission of the Employer. All authorised visitors should report at the site office. Contractor shall provide visitor's helmet (White helmet with visitor sticker) and other PPEs like Safety Shoe, reflective jacket, respiratory protection etc. as per requirement of the site.

40.2 All Visitors shall be accompanied at all times by a responsible member of the site personnel.

40.3 The contractor shall be fully responsible for all visitors' safety and health within the site..

PART – III: OCCUPATIONAL HEALTH AND WELFARE

41.0 Physical fitness of workmen

41.1 The contractor shall ensure that his employees/workmen subject themselves to such medical examination as required under the law or under the contract provision and keep a record of the same.

41.2 The contractor shall not permit any employee/workmen to enter the work area under the influence of alcohol or any drugs.

42.0 Medical Facilities

42.1 Medical Examination

42.1.1 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.

i) The Contractor shall maintain the confidential records of medical examination or the physician authorized by the Employer.

ii) 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.

iii) 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

42.1.2. If the contractor fails to get the medical examination conducted as mentioned above, the employer will have the right to get the same conducted by through an agency with intimation to the contractor and deduct the cost and overhead charges.

42.2 Occupational Health Centre

42.2.1 The contractor shall ensure at a construction site an occupational health centre, mobile or static is provided and maintained in good order. Services and facilities as per the scale lay down in Schedule X of BOCWR. A construction medical officer appointed in an occupational health centre possess the qualification as laid down in Schedule XI of BOCWR.

42.3 Ambulance van and room

42.3.1 The contractor shall ensure at a construction site of a building or other construction work that an ambulance van and room are provided at such construction site or an arrangement is made with a nearby hospital for providing such ambulance van for transportation of serious cases of accident or sickness of workers to hospital promptly and such ambulance van and room are maintained in good repair and is equipped with standard facilities specified in Schedule IV and Schedule V of BOCWR.

42.4 First-aid boxes

42.4.1 The contractor shall ensure at a construction site one First-aid box for 100 workers provided and maintained for providing First-aid to the building workers. Every First-aid box is distinctly marked “First-aid” and is equipped with the articles specified in Schedule III of BOCWR.

42.5 HIV/ AIDS prevention and control

42.5.1 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.*

42.5.2 The Employer will engage a professional agency for implementing the guidelines laid down in the policy and communicate to the contractor.

42.5.3 The Contractor shall extend necessary support to the appointed agency by deputing the workmen to attend the awareness creation programmes.

42.5.4 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.

42.5.5 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.

42.5.6 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.

42.5.7 The peer educators will be paid a monthly honorarium as fixed by the Employer for rendering his services in addition to his regular duty.

42.5.8 The total number of peer educators (1 for 100 workers) shall always be maintained by the contractor.

42.5.9 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.

42.5.10 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.

42.6 Prevention of mosquito breeding

42.6.1 Measures shall be taken to prevent mosquito breeding at site. The measures to be taken shall include:

i) 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.
ii) Still waters shall be treated at least once every week with oil in order to prevent mosquito breeding.
iii) 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.
iv) Water storage tanks shall be provided.

42.6.2 Posters in both Hindi and English, which draw attention to the dangers of permitting mosquito breeding, shall be displayed prominently on the site.

42.6.3 The contractor at periodic interval shall arrange to prevent mosquito breeding by fumigation / spraying of insecticides. Most effective insecticides shall include SOLFAC WP 10 or Baytex, The Ideal Larvicide etc.

42.7 Alcohol and drugs

42.7.1 The contractor shall ensure at all times that no employee is working under the influence of alcohol / drugs which are punishable under Govt. regulations.

42.7.2 Smoking at public worksites by any employee is also prohibited as per Govt. regulations.

43.0 Noise

43.1 The Contractor shall consider noise as an environmental constraint in his design, planning and execution of the Works and provide demonstrable evidence of the same on Employer's request. The Contractor shall, at his own expense, take all appropriate measures to ensure that work carried out by the Contractor and by his sub-Contractors, whether on or off the Site, will not cause any unnecessary or excessive noise which may disturb the occupants of any nearby dwellings, schools, hospitals, or premises with similar sensitivity to noise.

43.1.1 Without prejudice to the generality of the foregoing, noise level reduction measures shall include the following:

i) The Contractor shall ensure that all powered mechanical equipment used in the Works shall be effectively sound reduced using the most modern techniques available including but not limited to silencers and mufflers.
ii) The Contractor shall construct acoustic screens or enclosures around any parts of the Works from which excessive noise may be generated.

43.1.2 The Contractor shall ensure that noise generated by work carried out by the Contractor and his sub-Contractors during daytime and night time shall not exceed the maximum permissible noise limits, whether continuously or intermittently, as given in the project SHE Manual. The same may be varied from time to time by and at the sole discretion of the Employer, In the event of a breach of this requirement, the Contractor shall immediately re-deploy or adjust the relevant equipment or take other appropriate measures to reduce the noise levels and thereafter maintain them at levels which do not exceed the said limits. Such measures may include without limitation the temporary or permanent cessation of use of certain items of equipment.

43.1.3 The noise monitoring requirements including monitoring locations are given in the project SHE Manual.

43.2 Control Requirements

43.2.1 Construction material should be operated and transported in such a manner as not to create unnecessary noise as outlined below:

i) Perform Work within the procedures outlined herein and comply with applicable codes, regulations, and standards established by the Central and State Government and their agencies.
ii) Keep noise to the lowest reasonably practicable level. Appropriate measures will be taken to ensure that construction works will not cause any unnecessary or excessive noise, which may disturb the occupants of any nearby dwellings, schools, hospitals, or premises with similar sensitivity to noise. Use equipment with effective noise-suppression devices and employ other noise control measures as to protect the public.
iii) Schedule and conduct operations in a manner that will minimize, to the greatest extent feasible, the disturbance to the public in areas adjacent to the construction activities and to occupants of buildings in the vicinity of the construction activities.
iv) The Contractor shall submit to the Employer a Noise Monitoring and Control Plan (NMCP) under contract specific Site Environmental Plan. It shall include full and comprehensive details of all powered mechanical equipment, which he proposes to use during daytime and night time, and of his proposed working methods and noise level reduction measures. The NMCP shall include detailed noise calculations and vibration levels to demonstrate the anticipated noise generation and vibrations by the Contractor.
v) The NMCP prepared by the Contractor shall guide the implementation of construction activity. The NMCP will be reviewed on a regular basis and updated as necessary to assure that current construction activities are addressed. It may appear as a regular agenda item in project coordination meetings, if noise is an issue at any location in the contract.

43.3 Occupational Noise

i) Protection against the effects of occupational noise exposure should be provided when the sound levels exceeds the threshold values as provided in Project SHE Manual.
ii) When employees are subjected to sound levels exceeding those listed in the Table, feasible administrative or engineering controls should be utilized as given in this document and KMRC's Project SHE Manual.
iii) 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.
iv) 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 and sample computation as given in project SHE Manual.

43.4 Vibration Level

43.4.1 In locations where the alignment is close to historical / heritage structures, the contractor shall prepare a monitoring scheme prior to construction at such locations. This scheme for monitoring vibration level at such historical / heritage sites shall be submitted to Employer for his approval. This scheme shall include:

i) Monitoring requirements for vibrations at regular intervals throughout the construction period.
ii) Pre-construction structural integrity inspections of historic and sensitive structures in project activity.
iii) Information dissemination about the construction method, probable effects, quality control measures and precautions to be used.
v) The vibration level limits at work sites adjacent to the alignment shall conform to the permitted values of peak p velocity as given in article project SHE Manual.

44.0 Ventilation and illumination

44.1 Ventilation

44.1.1 The contractor shall ensure at a construction site of a building or other construction work that all working areas in a free tunnel are provided with ventilation system as approved by the DG/CIIBC and the fresh air supply in such tunnel is not less than 6m3/min for each building worker employed underground in such tunnel and the free air flow movement inside such tunnel is not less than 9m/min.

44.1.2 The oxygen level shall not be less than 19.5% in the working environment.

44.2 Illumination

44.2.1 The contractor shall take every effort to illuminate the work site as per the Employer's requirement illustrated in general instruction ***KMRC/SHE/GI/0011/ILL/281105***.

44.2.2 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.

45.0 Radiation

45.1 The use of radioactive substances and radiating apparatus shall comply with the Govt. regulatory requirements and all subsidiary legislation

45.2 Operations involving ionising radiation shall only be carried out after having been reviewed without objection by the Employer's representative and shall be carried out in accordance with a method statement.

45.3 each area containing irradiated apparatus shall have warning notices and barriers, as required by the Regulations, conspicuously posted at or near the area.

45.4 Radioactive substances will be stored, used or disposed shall be strictly in accordance with the Govt. Enactments.

45.5 The contractor shall ensure that all site personnel and members of the public are not exposed to radiation.

46.0 Welfare measures for workers

46.1 Latrine and Urinal Accommodation

46.1.1 The contractor shall provide one latrine seat for every 20 workers up to 100 workers and thereafter one for every additional 50 workers. In addition one urinal accommodation shall be provided for every 100 workers.

46.1.2 When women are employed, separate latrine and urinals accommodation shall be provided on the same scale as mentioned above.

46.1.3 Latrine and urinals shall be provided as per Section 33 of BOCWA and maintained as per Rule 243 of BOCWR and shall also comply with the requirements of public health authorities

46.1.4 Moving sites

46.1.4.1 In case of works like track laying, the zone of work is constantly moving at elevated level or at underground level. In such cases mobile toilets with proper facility to drain the sullage shall be provided at reasonably accessible distance.

46.1.5 In case if the contractor fail to provide required number of urinals and latrines or fail to maintain it as per the requirements of Public Health laws, the Employer shall have the right to provide/maintain through renowned external agencies like “Sulabh” at the cost of the contractor.

46.2 Canteen

46.2.1 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.

46.3 Serving of tea and snacks at the workplace

46.3.1 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.

46.4 Drinking water

46.4.1 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.

46.4.2 While locating these drinking water facility 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.

46.4.3 All such points shall be legible marked “Drinking Water” in a language understood by a majority of the workmen employed in such place and such point shall be situated within six metres of any washing places, urinals or latrines.

46.5 Labour Accommodation

46.5.1 The contractor shall provide free of charges as near as possible, temporary living accommodation to all workers conforming to provisions of Section 34 of BOCWA. These accommodations shall have cooking place, bathing, washing and lavatory facilities

46.6 Creches

46.6.1 In every workplace where in more than 50 female workers are ordinarily employed, there shall be provided and maintained a suitable room for use of children under age of 6 yrs, conforming to the provisions of Section 35 of BOCWA.

PART - IV: ENVIRONMENTAL MANAGEMENT

47.0 Air Quality

47.1 The Contractor shall take all necessary precautions to minimise fugitive dust emissions from operations involving excavation, grading, and clearing of land and disposal of waste. He shall not allow emissions of fugitive dust from any transport, handling, construction or storage activity to remain visible in atmosphere beyond the property line of emission source for any prolonged period of time without notification to the Employer.

47.2 The Contractor shall use construction equipment designed and equipped to minimise or control air pollution. He shall maintain evidence of such design and equipment and make these available for inspection by Employer.

47.3 If after commencement of construction activity, Employer believes that the Contractor's equipment or methods of working are causing unacceptable air pollution impacts then these shall be inspected and remedial proposals shall be drawn up by the Contractor, submitted for review to the Employer and implemented.

47.4 In developing these remedial measures, the Contractor shall inspect and review all dust sources that may be contributing to air pollution. Remedial measures include use of additional / alternative equipment by the Contractor or maintenance / modification of existing equipment of the Contractor. In the event that approved remedial measures are not being implemented and serious impacts persist, the Employer may direct the Contractor to suspend work until the measures are implemented, as required under the Contract.

47.5 Contractor's transport vehicles and other equipment shall conform to emission standards fixed by Statutory Agencies of Government of India or the State Government from time to time. The Contractor shall carry out periodical checks and undertake remedial measures including replacement, if required, so as to operate within permissible norms.

47.6 The Contractor shall establish and maintain records of routine maintenance program for internal combustion engine powered vehicles and equipment used on this project. He shall keep records available for inspection by Employer.

47.7 The Contractor shall cover loads of dust generating materials like debris and soil being transported from construction sites. All trucks carrying loose material should be covered and loaded with sufficient free- board to avoid spills through the tailboard or sideboards.

47.8 The Contractor shall promptly transport all excavation disposal materials of whatever kind so as not to delay work on the project. Stockpiling of materials will only be allowed at sites designated by the Employer. The Contractor shall place excavation materials in the dumping/disposal areas designated in the plans as given in the specifications.

47.9 The temporary dumping areas shall be maintained by the Contractor at all times until the excavate is re-utilised for backfilling or as directed by Employer. Dust control activities shall continue even during any work stoppage.

47.10 The Contractor shall place material in a manner that will minimize dust production. Material shall be minimized each day and wetted, to minimize dust production. During dry weather, dust control methods must be used daily especially on windy, dry days to prevent any dust from blowing across the site perimeter.

47.11 The Contractor shall water down construction sites as required to suppress dust, during handling of excavation soil or debris or during demolition. The Contractor will make water

sprinklers, water supply and water delivering equipment available at any time that it is required for dust control use. Dust screens will be used, as feasible when additional dust control measures are needed specially where the work is near sensitive receptors.

47.12 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.

47.13 The Contractor shall design and implement his blasting techniques so as to minimize dust, noise, vibration generation and prevention fly rock.

47.14 Blasting technique should be consistent not only with nature and quaintly of rock to be blasted but also the location of blasting.

47.15 The contractor shall give preference to explosives with better environmental characteristics.

47.16 The Contractor shall protect structures, utilities, pavements roads and other facilities from disfiguration and damage as a result of his activities. Where this is not possible, the contractor shall restore the structures, utilities, pavements, roads and other facilities to their original or better, failing which the rectification/restoration work shall be carried out at the risk and cost of the contractor.

47.17 The Contractor shall submit to the Employer an Air Monitoring and Control Plan (AMCP) under contract specific Site Environmental Plan to guide construction activity insofar as it relates to monitoring, controlling and mitigating air pollution.

48.0 Water Quality

48.1 The Contractor shall comply with the Indian Government legislation and other State regulations in existence insofar as they relate to water pollution control and monitoring. A drainage system should be constructed at the commencement of the Works, to drain off all surface water from the work site into suitable drain outlet.

48.2 The Contractor shall provide adequate precautions to ensure that no spoil or debris of any kind is pushed, washed, falls or deposited on land adjacent to the site perimeter including public roads or existing stream courses and drains within or adjacent to the site. In the event of any spoil or debris from construction works being deposited or any silt washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land and areas restored to their natural state by the Contractor to the satisfaction of the Employer.

48.3 Due to lowering of potable water supplies and subsequent contamination of ground water, the Contractor is not allowed to discharge water from the site without the approval of the Employer. The Contractor must comply with the requirements of the West Bengal Pollution Control Board for discharge of water arising from dewatering. Any water obtained from dewatering systems installed in the works must be either re-used for construction purposes and this water may subsequently be discharged to the drainage system or, if not re-used, recharged to the ground water at suitable aquifer levels. The Contractor must submit his proposals for approval of Employer, on his proposed locations of dewatering of excavation and collection of water for either construction re-use or recharge directly to aquifers. The Contractor's recharge proposals must be sufficient for recharging of the quantity of water remaining after deduction of water re-used for construction. During dewatering, the contractor shall monitor ground water levels from wells to ensure that draw down levels do not exceed allowable limits. The Contractor will not be permitted to directly discharge, to the drainage system, unused ground water obtaining from the excavation without obtaining approval of Employer or the Agency controlling the system.

48.4 The Contractor shall ensure that earth, bentonite, chemicals and concrete agitator washings etc. are not deposited in the watercourses but are suitably collected and residue disposed off in a manner approved by local authorities.

48.5 All water and waste products (surface runoff and wastewater) arising on the site shall be collected and removed from the site via a suitable and properly designed temporary drainage system and disposed off at a location and in a manner that will cause neither pollution nor nuisance.

48.6 Any mud slurry from drilling, tunnelling, diaphragm wall construction or grouting etc. shall not be discharged into the drainage system unless treatment is carried out that will remove silt, mud particles, bentonite etc. The Contractor shall provide treatment facilities as necessary to prevent the discharge of contaminated ground water.

48.7 The Contractor shall discharge wastewater arising out of site office, canteen or toilet facilities constructed by him into sewers after obtaining prior approval of agency controlling the system. A wastewater drainage system shall be provided to drain wastewater into the sewerage system.

48.8 The bentonite mixing, treatment and handling system shall be established by the contractor giving due regard to its environmental impacts. The disposal of redundant bentonite shall be carefully considered whether in bulk or liquid form. The disposal location will be advised and agreed with the relevant authorities.

48.9 The Contractor shall take measures to prevent discharge of oil and grease during spillage from reaching drainage system or any water body. Oil removal / interceptors shall be provided to treat oil waste from workshop areas etc.

48.10 The Contractor shall apply to the appropriate authority for installing bore wells for water supply at site.

49.0 Archaeological and Historical Preservation

49.1 The contractor shall seek to accommodate archaeological and historical preservation concerns that may arise due to the construction of the project especially in close vicinity of such areas where such monuments may be located.

49.2 The contractor shall consult the Archaeological Survey of India (ASI) and other parties, on the advise of the Employer, to identify and assess construction effects and seek ways to avoid, minimize or mitigate adverse effects on such monuments.

49.3 Adverse effects may include reasonably foreseeable effects caused by the construction that may occur later in time, be farther removed in distance or those that alter, howsoever temporarily, the significance of the structure.

50.0 Landscape and Greenery

50.1 As far as is reasonably practicable, the Contractor shall maintain ecological balance by preventing deforestation and defacing of natural landscape. In respect of ecological balance, the Contractor shall observe the following instructions.

50.2 The Contractor shall, so conduct his construction operations, as to prevent any avoidable destruction, scarring or defacing of natural surrounding in the vicinity of work.

50.3 Where destruction, scarring, damage or defacing may occur as a result of operations relating to Permanent or Temporary works, the same shall be repaired, replanted or otherwise corrected at Contractor's expense. All work areas shall be smoothened and graded in a manner to conform to natural appearance of the landscape as directed by the Employer.

50.4 A suggested list of trees / shrubs suitable for planting and landscaping is found in Employer's Project SHE Manual.

51.0 Felling of Trees

51.1 The contractor shall identify the number and type of trees that are require to be felled as a result of construction of works and facilities related to Kolkata Metro Project and inform the Employer.

51.2 All trees and shrubbery, which are not specifically require to be cleared or removed for construction purposes, shall be preserved and shall be protected from any damage that may be caused by Contractor's construction operations and equipment. The contractor shall not fell, remove or dispose of any tree or forest produce in any land handed over to him for the construction of works and facilities related to Kolkata Metro except with the previous permission obtained from the Ministry of Forest.

51.3 The Employer shall arrange permission from the forest department for trees to be felled or transplanted. The Employer will permit the removal of trees or shrubs only after prior approval.

51.4 Special care shall be exercised where trees or shrubs are exposed to injuries by construction equipment, blasting, excavating, dumping, chemical damage or other operation and the Contractor shall adequately protect such trees by used of protective barriers or other methods approved by the Employer. Trees shall not be used for anchorage.

52.0 Fly Ash

52.1 The Employer may require the contractor to use fly ash as a percentage substitution of cement, in concrete for certain structures and works.

52.2 In all such uses of Fly Ash, the contractor shall maintain a detailed record of usage of Fly Ash. The contractor shall also collect related details and provide to the Employer.

52.3 The reporting details on consumption of Fly Ash are found in Employer's SHE Manual.

53.0 Waste

53.1 The contractor is required to develop, institute and maintain a Waste Management Programme (WMP) during the construction of the project for his works, which may include: -

i) Identification of disposal sites.

ii) Identification of quantities to be excavated and disposed off.

iii) Identification of split between waste and inert material

iv) Identification of amounts intended to be stored temporarily on site location of such storage.

v) Identification of intended transport means and route.

vi) Obtaining permission, where required, for disposal.

53.2 Such a mechanism is intended to ensure that the designation of areas for the segregation and temporary storage of reusable and recyclable materials are incorporate into the WMP. The WMP should be prepared and submitted to the Engineer for approval.

53.3 The Contractor shall handle waste in a manner that ensures they are held securely without loss or leakage thus minimizing potential for pollution. The Contractor shall maintain and clean waste storage areas regularly.

53.4 The Contractor shall remove waste in a timely manner and disposed off at landfill sites after obtaining approval of KMRC for its disposal.

53.5 Burning of wastes is prohibited. The Contractor shall not burn debris or vegetation or construction waste on the site but remove it in accordance with ***50.1*** above.

53.6 The Contractor shall make arrangement to dispose of metal scrap and other saleable waste to authorized dealer and make available to the Employer on request, records of such sales.

54.0 Hazardous Waste Management

54.1 If encountered or generated as a result of Contractor's activity, then waste classified as hazardous under the "Hazardous Wastes (Management & Handling) Rules, 1989, amendments 2000, 2003" shall be disposed off in a manner in compliance with the procedure given in the rules under the aforesaid act.

54.2 Chemicals classified as hazardous chemicals under "Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 of Environment (Protection) Act, 1986 shall be disposed off in a manner in compliance with the procedure given in the rules under the aforesaid act.

54.3 The contractor shall identify the nature and quantity of hazardous waste generated as a result of his activities and shall follow regulations established by the West Bengal Pollution Control Board along with a map showing the location of storage area.

54.4 Outside the storage area, the contractor shall place a 'display board', which will display quantity and nature of hazardous waste, on date. Hazardous Waste needs to be stored in a secure place

54.5 It shall be the responsibility of the contractor to ensure that hazardous wastes are stored, based on the composition, in a manner suitable for handling, storage and transport. The labelling and packaging is required to be easily visible and be able to withstand physical conditions and climatic factors.

54.6 The contractor shall approach only Authorised Recyclers of Hazardous Waste for disposal of Hazardous Waste, under intimation to the Employer.

54.7 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 have demonstrated continual improvement in the implementation of Environmental management System. Failure to do so the employer shall impose appropriate penalty as indicated under penalty clause.

55.0 Energy Management

55.1 The contractor shall use and maintain equipment so as to conserve energy and shall be able to produce demonstrable evidence of the same upon Employer's request.

55.2 Measures to conserve energy include but not limited to the following:

i) Use of energy efficient motors and pumps

ii) Use of energy efficient lighting, which uses energy efficient luminaries

iii) Adequate and uniform illumination level at construction sites suitable for the task

iv) Proper size and length of cables and wires to match the rating of equipment

v) Use of energy efficient air conditioners

55.3 The contractor shall design site offices maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible.

PART - V: PENALTY AND AWARDS

56.0 Charges to be recovered from contractor for unsafe act or condition

56.1 KMRC has built an image of safety conscious organisation meticulously over a period of seven years. Any reportable accident (fatality / injury) results in loss of life and/or property damage. These accidents not only result in loss of life but also damage the reputation of KMRC. Most of the accidents are avoidable and caused preliminary due to contractors' negligence. Hence KMRC shall recover the cost of damages from the contractors for every reportable incident (fatality / injury).

56.2 In addition every KMRC work site is exposed to public scrutiny as the work is executed just on the right-of-way. Any unsafe act / unsafe condition observed by public further damages our reputation. Because of the non-voluntary compliance of contractors to the condition of contract on SHE and project SHE manual, KMRC has been forced to establish safety-enforcing organisation. The cost of established such organisation is to be recovered from contractors for all observed safety violations at sites.

56.3 The following table indicates the Safety, Health and Environment violation (unsafe act / unsafe condition) and charges to be recovered from contractors.

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
1.	SHE Policy & Plan	i) SHE Policy a) non-compliance of clause 4.1	Rs. 5,000 per single violation, compounded to a maximum of Rs. 25,000 at any single instance.
		ii) SHE Plan : a. Not as per Employers' content and coverage (clause 4.2, 4.7) b. Delay in submission (clause 4.2, 4.4) c. Not updated as per employer's instruction as per clause 4.4 d. Copies not provided to all required supervisors / engineers (clause 4.6)	Rs. 1,00,000 per single violation, compounded to a maximum of Rs. 2,00,000 at any single instance.

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
2.	SHE Organisation	i) Not complying to the minimum manpower requirements as mentioned in General Instruction KMRC/SHE/GI/001/ MPR/281105 (clause 6.1.1) ii) Not filling up the vacancies created due to SHE personnel leaving the contractor within 14 days. (clause 6.7) iii) SHE organization not provided with required Audio-visual and other equipments as per General Instruction DMRS/SHE/012/AVE/ 281105 (clause 6.9.2) iv) Employing through outsourcing agencies and SHE personal are not in the payroll of the main contractor (clause 6.5.1) v) Disobedience / Improper conduct of any SHE personnel. (clause 6.2) vi) Chief SHE Manager not reporting directly to CPM of contractor. (clause 6.6)	i) Rs. 1,00,000 per month for first month and Rs. 2,00,000 for subsequent months ii) Rs. 50,000 per month for first month and Rs. 1,00,000 for subsequent months For items iii), iv), v) and vi) Rs. 50,000 for first violation and Rs. 1,00,000 for subsequent violations
3.	SHE committee	i) Failed to formulate or conduct SHE Committee meeting for any month (clause 7.4) ii) Contractor and Sub-contractor representatives not attending SHE Committee meetings (clause 7.10) iii) Failed to conduct Site inspection before conducting SHE Committee meeting (clause 7.2.1 (viii)) iv) Failed to send SHE Committee Meeting minutes or Agenda to Employer in time (clause 7.8.1, 7.9.1) v) Non-adherence of clause 7.7.1 vi) Non-adherence of clause 7.9	i) Rs. 1,00,000 for the first violation and Rs. 5,00,000 for the subsequent violations ii) Rs. 5,000 to the contractor of the member who had not attended the meeting for first violation and Rs. 25,000 for subsequent violations. For item iii), iv), v) and vi) Rs. 25,000 for first violation and Rs. 50,000 for subsequent violations
4.	ID card	i) Non-adherence of clause 8.1, 8.2 and 8.3	Rs. 1,00,000 for first violation and Rs. 2,00,000 for subsequent violations

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
5.	SHE Training	i) Not complying to the requirements as mentioned in conditions of contract on SHE and project SHE manual with regard to : a) Induction training not given (clause 8.1) b) Supervisor/engineer/manager training not conducted as per clause 9.6 c) Refresher training as per clause 9.7 and 9.11 not conducted d) Tool-box talk not conducted as per clause 9.8 e) Skill development training not conducted as clause 9.9 f) Daily Safety Oath not conducted as per clause 9.10 g) Top management behavior based SHE training conducted (clause 9.4)	For item 1 a) to g) Rs. 50,000 for first violation on and Rs. 1,00,000 for subsequent violations
6.	SHE Inspection	i) Not complying to the requirements as mentioned in conditions of contract on SHE and project SHE manual as per clause 10.0 ii) Non compliance of clause 10.3.6	Rs. 50,000 for first violation and Rs. 1,00,000 for subsequent violations
7.	SHE audit	Internal Audit ; MARS i) Not conducted as per SHE Plan (clause 11.2.1) ii) Report not sent to Employer (clause 11.2.6) iii) Action not taken for any month (clause 11.2.4)	For item i) to iii) Rs. 50,000 for first violation and Rs. 1,00,000 for subsequent violations.
		External Audit iv) Not conducted as per SHE Plan (clause 11.4.3) v) Report not sent to employer (clause 11.4.7) vi) Action not taken for any quarter (clause 11.4.9)	For item iv) to vi) Rs. 1,00,000 for first violation and Rs. 2,00,000 for subsequent violations.
8.	SHE Communication	i) Non compliance of clause 13.1 ii) Non compliance of clause 13.2 iii) Non compliance of clause 13.3	For item i) Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations For item ii) and iii) Rs.1,00,000 for first violation and Rs.2,00,000 for subsequent violations

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
10.	Injury and Incidence reporting	i) Fatal accidents ii) Injury accident iii) Abnormal delay in reporting accidents or wilful suppression of information about any accidents / dangerous occurrence as per clause 14.1.4 iv) Non-compliance of the clause 14.4	i. Rs.5,00,000 for first fatality and Rs.10,00,000 for every subsequent fatality. ii. Rs.1,00,000 for first grievously injured person and Rs.2,00,000 for very subsequent grievously injured person (Grievous Injury as defined by Workmen Compensation Act) iii. Rs.1,00,000 for first violation and Rs.2,00,000 for subsequent violations For items iv) and v) Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations
11.	Emergency preparedness Plan	Non-compliance of the clause 15.1,15.2, 15.3, 15.4, 15.5 and 15.6	Rs.1,00,000 for non-compliance of any of the clauses

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
12.	Housekeeping	i) Housekeeping maintenance register not properly maintained up to date (clause 17.4) ii) Surrounding areas of drinking water tanks / taps not hygienically cleaned / maintained (clause 17.4) iii) Office, stores, toilet / urinals not properly cleaned and maintained. (clause 17.4) iv) Required dustbins at appropriate places not provided / not cleaned. (clause 17.6) v) Stairways, gangways, passageways blocked. (clause 17.9) vi) Lumber with protruding nails left as such (clause 17.10) vii) Openings unprotected (clause 17.7) viii) Excavated earth not removed within a reasonable time. (clause 17.15, 47.8) ix) Truck carrying excavated earth not covered / tyres not cleaned. (clause 17.11) x) Vehicles / equipments parked / placed on roads obstructing free flow of traffic (clause 17.13) xi) Unused surplus cables / steel scraps lying scattered (clause 17.17) xii) Wooden scraps, empty wooden cable drums lying scattered (clause 17.18) xiii) Water stagnation leading to mosquito breeding (clause 42.6.1)	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
13.	Working at Height / Ladders and Scaffolds	i) Not using or anchoring Safety Belt (clause 18.9) ii) Not using Safety Net (clause 18.18) iii) Absence of life line or anchorage point to anchor safety belt (clause 18.19) iv) Non-compliance of clause 18.17 v) Using Bamboo ladders (clause 18.20) vi) Painting of ladders vii) Improper usage (less than 1m extension above landing point, not maintaining 1:4 ratio) (clause 18.20) viii) Aluminium ladders without base rubber bush (clause 18.20) ix) Usage of broken / week ladders (clause 18.20) x) Usage of re-bar welded ladders (clause 18.20) xi) Improper guardrail, toe board, barriers and other means of collective protection (clause 18.16) xii) Improper working platform (clause 18.17) xiii) Working at unprotected fragile surface (clause 18.9) xiv) Working at unprotected edges (clause 20.0)	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
14.	Lifting appliances and gear	i) Non availability of fitness certificate as per clause 21.3 ii) Documents not displayed on the machine or not available with the operator as per clause 21.4 iii) Maximum Safe Working Load not written on the machine as per clause 21.5 iv) Non-compliance of 21.6 v) Non-compliance of 21.7 vi) Automatic safe load indicator not provided or not in working condition as per clause 21.8 vii) Age of the operator less than 21 years or without any licence and non-compliance of other item as per clause 21.9 viii) Non-compliance of 21.10 ix) Non-compliance of any of the items mentioned regarding rigging requirements as per clause 21.11 x) Failure to submit method statement in case of all critical lifting (clause 21.3) xi) Person riding on crane. (clause 23.4) xii) Creating more noise and smoke (clause 43.1.1) xiii) Absence of portable fire extinguisher in driver cabin (clause 31.5) xiv) Fail to guard hoist platform (clause 24.0) xv) No fencing of hoist rope movement area (clause 24.0) xvi) Hoist platform not in the horizontal position (clause 21.2)	Rs.50,000 per single violation Compounded to a maximum of Rs.5,00,000 at any single instance
15.	Launching operation	Non-adherence of any of the provisions mentioned in clause 22.2	Rs. 50,000 for first violation and Rs.1,00,000 for subsequent violations

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
16.	Site Electrical safety	i) Non-compliance of clause 26.1.1 ii) Non-compliance of clause 26.2.3, 26.2.4 & 26.2.5 iii) Non-compliance of clause 26.3.1 iv) Non-compliance of clause 26.7, 26.8 and 26.9.1 v) Non-compliance of clause 26.10 and 26.13 vi) Non-compliance of clause 28.3.2 vii) Exposed electric lines fermentative damage) and circuits in the workplace. (clause 26.5.1) viii) Inserting of wires directly into the socket ix) Improper grounding for the electrical appliances (clause 26.7.1) x) Electrical cables running on the ground (clause 26.8.5 & 26.8.6) xi) Non-compliance clause 27.0	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
17.	Hand tools and Power tools	i) Non-compliance of clause 28.0	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
18.	Gas Cutting	ii) Wrong colour coding of cylinder. iii) Cylinders not stored in upright position. (clause 29.1) iv) Flash back arrester, non-return valve and regulator not present or not in working condition. (clause 29.3 & 29.4) v) Fail to put cylinders in a cylinder trolley. (clause 29.1) vi) Damaged hose and fail to use hose clamps (clause 29.2) vii) Using domestic LPG cylinders (clause 29.5) viii) Fail to store cylinder 6.6m away from fire prone materials (clause 29.8) ix) Fire extinguisher not placed in the vicinity during operation (clause 29.6)	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance
19.	Welding	i) Voltmeter and Ammeter not working (clause 29.9) ii) Non-availability of separate switch in the transformer (clause 29.9) iii) Improper grounding and return path. (clause 29.10) iv) Damaged and bare openings in the welding cable. (clause 29.10) v) Damaged holder (clause 29.10) vi) Fire extinguisher not placed in the vicinity during operation (clause 29.6)	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
20.	Fire precaution	i) Smoking and open flames in fire prone area (clause 31.6) ii) Using more than 24V portable electrical appliances in the fire prone area (clause 34.2.3) iii) Not proper ventilation in cylinder storage area. (clause 29.8) iv) Absence of fire extinguishers (clause 31.1) v) Fire extinguishers not refilled once in a year. (clause 31.2) vi) Fire extinguisher placed in a not easily accessible location	Rs.5,000 per single violation Compounded to a maximum of Rs.25,000 at any single instance.
21.	Excavation, Tunnelling and confined space	i) Non-compliance of clause 34.1.1 ii) Non-compliance of clause 34.2.3 iii) Non-compliance of clause 34.3	For any item from i) and ii) Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance. For item iii) Rs.10,000 per first violation and Rs.50,000 for subsequent violations
22.	Work permit system	i) Non-compliance of clause 35.2 ii) Non-compliance of clause 21.11.9	For item I) and ii) Rs.50,000 per first violation and Rs.1,00,000 for subsequent violations
23.	Traffic Management	i) Non-compliance of clause 36.4.1 ii) Non-compliance of clause 36.8.3 iii) Non-compliance of clause 36.9.2 iv) Non-compliance of clause 36.9.3 v) Non-compliance of clause 36.9.7 vi) Non-compliance of clause 36.9.8	Rs.1,00,000 per first violation and Rs.2,00,000 for subsequent violations
		a) Barricades (clause 36.9.4) i) Not Cleaned ii) Not in alignment iii) Not numbered iv) Not painted v) Red lights / reflectors not working vi) Damages not repaired vii) Not secured properly viii) Barricade inspector not employed ix) Protruding parts / portions repaired x) Barricades maintaining register not properly maintained up to date	Rs.25,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
		b) Contractor Vehicles (clause 36.9.5 & 36.9.6) i) Over loading of vehicles ii) Unfit drivers or operators iii) Unlicensed vehicles iv) Absence of traffic marshals v) Absence of reversing alarm vi) Absence of fog light (at winter) vii) Power / hand brakes not in working condition.	Rs.25,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance
		c) Splashing of Bentonite on roads / non-cleaning of tyres of dumpers and transit mixers (clause 17.11 & 17.14) i) Mishandling of bentonite like splashing of bentonite outside specified width of barricading ii) Non-cleaning of tyres of dumpers and transit mixers before leaving the site and thereby creating a traffic safety hazard to road users.	For item i) and ii) a) Rs.1,00,000 on first observation. b) Rs. 2,00,000 on second observation c) Rs. 3,00,000 on third and subsequent observations
24.	Batching plant / Casting yard	Non-adherence of any of the provisions mentioned in clause 38.0.	Rs. 10,000 for single violation compounded to a maximum of Rs.1,00,000 at any single instant.
25.	PPE	i) Not having (clause 39.1) ii) Not wearing (or) using and kept it elsewhere (clause 39.1) iii) Using damaged one (clause 39.2) iv) Using wrong type (clause 39.5) v) Using wrong colour helmet or helmet without logo (clause 39.4.1) vi) Using for other operation (e.g. Using safety helmet for storing materials or carrying water from one place to other) (clause 39.5) vii) Not conforming to BIS standard (clause 39.2) viii) Non-compliance of clause 39.6, 39.7 and 39.8	From item i) to vi). Rs.200 per single violation For item vii) Rs.10,000 for first violation and Rs.50,000 for subsequent violations For item viii) Rs.50,000 for first violation and Rs.1,00,000 for subsequent violations

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
26.	Occupational Health	i) Fail to conduct Medical examination to workers (clause 42.1) ii) Absence of ambulance van & room (clause 42.3) iii) Workers not having ID card (clause 8.2) iv) Absence of first-aid person in work site. (clause 42.4) v) Absence or inadequacy of first-aid box. (clause 42.4) vi) Misuse of first-aid box. (clause 42.4) vii) First-aid box not satisfy the minimum Indian standard. (clause 42.4) viii) Smoking inside the construction site (clause 42.7.2) ix) Drink and drive or work (clause 42.7.1) x) Fumigation / insecticides not sprayed to prevent Mosquito breeding (clause 42.6.3) xi) Non-compliance of clause 44.1 and 44.2	Rs.10,000 per single violation Compounded to a maximum of Rs.1,00,000 at any single instance

SL. NO.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTIBLE AMOUNT
27.	Labour Welfare measures	i) Inadequate number of toilets (clause 46.1.1) ii) Toilets not cleaned properly (clause 46.1.3) iii) Absence of water facilities for toilets and washing places (clause 46.1.3) iv) Toilet placed more than 500m from the work site (clause 46.1.3) v) Accommodation not provided as per BOCWA (clause 46.5.1) vi) Absence of drinking water (clause 46.4) vii) Excessive noise and vibration (clause 43.0) viii) Canteen not provided (clause 46.2) ix) Food stuff not served on no loss no profit basis (clause 46.3) x) Creche not provided (clause 46.6) xi) Non adherence of Labour welfare provisions of BOCWA (clause 3.3.1.2) xii) Fail to register establishment and display the registration certificate at workplace (clause 3.3.1.2) xiii) Absence of workers register and records (clause 3.3.1.2) xiv) Absence of muster roll and wages register (clause 3.3.1.2) xv) Fail to display an abstract of BOCWA and BOCWR (clause 3.3.1.2)	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance
28.	Environmental Management	i) Tyre wash facility not provided (clause 47.12) ii) Spillage from vehicles not arrest (clause 48.9) iii) Air monitoring not practiced (clause 47.17) iv) Noise monitoring not practiced (clause 43.2.1) v) The values of air monitoring and noise monitoring not within acceptable limits (clause 47.17, 43.2.1) vi) Dust control measures at sites not practiced (clause 47.13) vii) Improper disposal of debris / residues viii) Non compliance of clause 53.0 & 54.0	Rs.10,000 per single violation Compounded to a maximum of Rs.50,000 at any single instance

56.4 Without limiting to the unsafe acts and or conditions mentioned above in clause 56.3 the Employer shall have the right to deduct charges for any other unsafe act and or condition depending upon the gravity of the situation on a case-to-case basis. The charges shall be in comparison with that of the similar offence indicated in clause 56.3.

57.0 Stoppage of work

57.1 The Employer shall have the right to stop the work at his sole discretion, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident.

57.2 The contractor shall not proceed with the work until he has complied with each direction to the satisfaction of Employer

57.3 The Contractor shall not be entitled for any damages / compensation for stoppage of work, due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.

58.0 Awards

The following categories will be considered for awards as per the scheme in practice of Employer

i) For every safe million man hour working without any reportable incidents
ii) Zero fatality contracts
iii) 100% adherence to voluntary reporting of all accidents throughout the currency of contract
iv) Safest project team of the year.
v) Best SHE team of the year.
vi) Safest Contractor of the year.

KOLKATA METRO RAIL CORPORATION LTD.

APPENDIX NO.: 1

SAMPLE Memorandum of Understanding between KOLKATA Metro Rail Corporation (KMRC) and the Contractor for safe execution of contract work

This Memorandum of Understanding is made and executed by and between KOLKATA Metro Rail Corporation Ltd. (KMRC), a Company registered under the Companies Act 1956 and having its registered office at HRBC Building, 4th floor, Munshi Premchand Sarnni, P.S. Hastings, KOLKATA-700 021 or their authorized representative(s), hereinafter referred to as "EMPLOYER" (which expression shall wherever the context so requires or admits be deemed to mean and include its successors in business and assigns) of the one party

AND

M/s _____ having its registered office at _____ hereinafter referred to as the "CONTRACTOR" (which expression shall wherever the context so requires or admits be deemed to mean and include its successors in business and assigns) of the other party

WITNESSETH THAT

WHEREAS the EMPLOYER gives highest importance to the occupational safety, health and environment during execution of work, seeks cooperation from the CONTRACTOR in this endeavour.

Thus, this Memorandum of Understanding is for promoting the safety, health and environment aspects required to be followed at workplace/site and will be applicable to any site job to be done by the CONTRACTOR

AND

WHEREAS the CONTRACTOR has read all the terms and conditions of the EMPLOYER and whereas the CONTRACTOR has studied the following documents:

(a) Tender Documents, including Notice Inviting Tender, General Conditions, Special Conditions,

(b) Conditions of Contract on Safety, Health and Environment and Project Safety, Health and Environment Manual.

(c) Building and Other Construction Workers (Regulations of Employment and Conditions of Service) Act 1996, Central Rules 1998 and subsequent KOLKATA Government Rules 2002, Building and Other Construction Workers Welfare Cess Act 1996 and Rules 1998 and Building and Other Construction Workers' Welfare Board Rules and

(d) Indian Electricity Act 2003 and Rules 1956.

(e) Corresponding International / Bureau of Indian Standard Codes.

The amendments to any of the above rules and any other rules & regulations or procedures, circulars, notices & advices laid down by the EMPLOYER from time to time.

Now it is hereby AGREED AND DECLARED by and between the EMPLOYER and the CONTRACTOR as follows:

Clause – I The CONTRACTOR shall abide by the terms and conditions stipulated in Condition of Contract on Safety, Health & Environment and Project Safety, Health & Environment Manual.

Clause – II The CONTRACTOR shall undertake full responsibility for safe execution of job at work place/site and safety of his personnel and adjoining road users during work.

Clause – III Without giving any prior notice, the EMPLOYER shall from time to time be entitled to add/or amend any or all terms and conditions, or its Safety Health and Environmental Manual, with a view to improving safety and occupational health of personnel and safety of work, with immediate effect with no cost to the EMPLOYER, and the same shall be binding on the CONTRACTOR. The contractor agrees to implement all such amendments, which shall be laid down by the EMPLOYER.

Clause – IV Besides following the guidelines, safety rules and regulations, safety codes given in various safety procedures/documents mentioned above, the CONTRACTOR shall also prepare detailed method statement which includes job safety analysis wherever there are complicated and hazardous/high risk working involved and get it approved from Employer before execution of work.

Clause – V Any negligence or violation in implementing any of the provision of the conditions of contract on Safety, Health & Environment and KMRC project Safety, Health & Environment Manual shall be viewed seriously and the contractor is liable to compensate the employer for the loss of reputation. The cost of damage shall be fixed on case-to-case basis.

In witness thereof the Parties hereto by representatives duly authorised have executed this Memorandum of Understanding on _____ day of _____ 20____.

Signed on	Signed on
For and on behalf of KMRC	For and on behalf of (Contractor)
_____	_____
Signature:	Signature:
Name:	Name:
Title:	Title:

KOLKATA METRO RAIL CORPORATION LTD.

APPENDIX NO.: 2

Safety, Welfare and Occupational Health requirements as per BOCW Act 1996 and Rules 1998 and DBOCW Rules 2002.

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

S - Refers relevant **S**ections in BOCWA

R - Refers relevant **R**ules in BOCWR

C - Refers relevant **C**hapter No. in BOCWR

Sl. No.	Items	Relevant Section / Rules in BOCWA and BOCWR
1.	Registration of establishment	S – 7, R – 23 to 27
2.	Display of registration certification at workplace	R – 36 (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 – 238
9.	Register of persons employed as building workers	R – 240
10.	Muster roll and wages register	R – 241(1) (a) ; Form XVI and XVII
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.	Annual return	R – 242; Form XXV
18.	Drinking water	S – 32
19.	Latrines and Urinals	S – 33 R – 243
20.	Accommodation	S – 34

Sl. No.	Items	Relevant Section / Rules in BOCWA and BOCWR
21	Creches	S – 35
22	First-aid boxes	S – 36 R – 231 and Schedule III
23	Canteens	S – 37 R – 244
24	Food stuff and other items served in the canteens	R – 245
25.	Supply of tea and snacks in work place	R – 246
26.	Food charges on no loss no profit basis	R – 247
27.	BOCW welfare Board Rules	R – 250 to 296
28.	Safety committee	S – 38 R – 208
29.	Safety officer	S – 38 R – 209 and Schedule VII
30.	Reporting of accidents and dangerous occurrences	S – 39 R – 210
31.	Procedure for inquiry in to the causes of accidents	R – 211
32.	Responsibility of employer	S – 44 R – 5
33.	Responsibility of Architects, Project engineer and Designers	R – 6
34.	Responsibility of workmen	R – 8
35.	Responsibility for payment of wages and compensation	S – 45
36.	Penalties and Procedures	S – 47; S – 55
37.	Excessive noise, vibration etc	R – 34
38.	Fire Protection	R – 35
39.	Emergency action plan	R – 36
40.	Fencing of motors	R – 37
41.	Lifting of carrying of excessive weight	R – 38
42.	Health, Safety and Environmental Policy	R – 39
43.	Dangerous and Harmful Environment	R – 40
44.	Overhead protection	R – 41
45.	Slipping, Tripping, Cutting, Drowning and Falling Hazards	R – 42
46	Dust, Gases, Fumes, etc	R – 43
47	Corrosive substance	R – 49
48.	Eye Protection	R – 45
49.	Head Protection and other protection apparel	R – 46; R – 54
50.	Electrical Hazards	R – 47

Sl. No.	Items	Relevant Section / Rules in BOCWA and BOCWR
51.	Vehicular traffic	R – 48
52.	Stability of structure	R – 49
53.	Illumination	R – 50 ; R – 124
54.	Stacking of materials	R – 51
55.	Disposal of debris	R – 52
56.	Numbering and marking of floors	R – 53
57.	Lifting appliances and gears	C – VII; R – 55 to 81
58.	Runways and Ramps	C – VIII; R – 82 to 85
59.	Working on or adjacent to water	C – IX ; R – 86 & 87
60.	Transport and earthmoving equipments	C – X ; R – 88 to 95
61.	Concrete work	C – XI; R – 96 to 107
62.	Demolition	C – XII; R – 108 to 118
63.	Excavation and Tunnelling works	C – XIII; R – 119 to 168
64.	Ventilation	R – 153
65.	Construction, repair and maintenance of step roof	C – XIV; R – 169 to 171
66.	Ladders and Step ladders	C – XV; R – 172 to 174
67.	Catch platform and hoardings, chutes, safety belts and nets	C – XVI ; R – 175 to 180
68.	Structural frame and formworks	C – XVII ; R – 181 to 185
69.	Stacking and unstacking	C – XVIII ; R – 186 & 187
70.	Scaffold	C – XIX; R – 188 & 205
71.	Cofferdams and Caissons	C – XX ; R – 206 & 211
72.	Explosives	C – XXI ; R – 212 & 213
73.	Piling	C – XXII ; R – 214 & 222
74.	Medical Examination for building and other construction worker, Crane operation an Transport vehicle drivers	R – 81 ; R – 223(a)(iii) and Schedule XII
75.	Medical examination for occupational health hazards	R – 223(a)(iv)
76.	Charging of workers for medical Examination	R – 223(b)
77.	Occupational health centres and medical officers	R – 225 and Schedule X & XI
78.	Ambulance van & room	R – 226 & 227 and Schedule IV & V
79.	Stretchers	R -228
80.	Occupational health service for building workers	R - 229
81.	Medical examination for occupational health hazards	R – 223(a)(iv)
82.	Emergency care services and emergency treatment	R – 232
83.	Panel of experts and agencies	Central Rule 250
84.	Power of inspectors	Central rule 251

METRO RAIL CORPORATION LTD.

APPENDIX NO.: 3

SITE SHE PLAN

Contract No

Contractor Name

Project Name

1. Project Highlights
   - 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
   - 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
   - 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

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
viii) Work Permit Systems
ix) 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

KOLKATA METRO RAIL CORPORATION LTD.

APPENDIX NO.: 4

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

Kolkata Metro Rail Corporation (KMRC) 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, KMRC 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 West Bengal State Aids Prevention and Control Society (WBSACS).

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/001/MPR/200106

MINIMUM MANPOWER REQUIREMENTS OF SHE ORGANIZATION BASED ON CONTRACT VALUE

	1	2	3	4	5	6
Awarded Contract value (in Cr.)	**Chief SHE Manager**	**Senior SHE Manager**	**Junior SHE Manager**	**Safety Steward**	**Senior SHE (Electrical) Engineer**	**Junior SHE (Electrical) Engineer**
Upto 2	-	-	1	Refer Note 1	-	1
Upto 10	-	1	Refer Note 1		1	Refer Note 2
Upto 25	1	Refer Note 1			1	
Upto 100	1				1	
Upto 250	1				1	
More than 250	1				1	

	7	8	9	10	11	12	13
Awarded Contract value (in Cr.)	***Junior SHE (Fire) Manager / ** Senior SHE (Fire) Manager**	**Occupational Health officer** with Necessary Nursing Assistants (Refer Note 3)	**Environmental Manager**	**Senior SHE (Traffic) Engineer** (Refer Note 4)	**Barricade Maintenace Squad** (Refer Note 4)	**Junior SHE (Electrical) Engineer**	**Labour Welfare Officer**
Upto 2	-	-	-	-	Refer Note 5	Refer Note 6	-
Upto 10	-	1 (PT)	1	1			1
Upto 25	1*	1 (PT)	1	1			1
Upto 100	1*	1 (PT)	1	1			1
Upto 250	1**	2 (FT)	1	1			1 with support staff
More than 250	2**	2 (FT)	1 with support staff	1			1 with support staff

Note 1: Adequate, qualified and trained SHE Professionals with required support staff to be deployed at each worksite at each shift.

Note 2: Adequate, qualified and trained Electrical Engineers / supervisors to be deployed at each worksite at each shift.

Note 3: (PT) means Part-Time and (FT) means Full-time.

Note 4: Senior SHE (Traffic) Engineer Post and Barricade Manager (including the staff) Posts are applicable to contracts where the work has to be executed either below or over the right-of-way like Viaduct, Tunnel Contracts wherein erection and maintenance of barricades are paramount important.

Note 5: One Barricade Manager supported by required supervisors and workmen

Note 6: One Housekeeping Manager supported by required supervisors and workmen

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/002/QE/281105

MINIMUM QUALIFICATION AND EXPERIENCE FOR (SHE) SAFETY, ELECTRICAL, ENVIRONMENTAL, TRAFFIC ENGG. AND OCCUPATIONAL HEALTH PROFESSIONALS

Sl. No.	Designation	Qualification	Experience (in years)
1	Chief SHE Manager	The Chief SHE Manager shall have qualified in any of the following degree/diploma with demonstrated safety industry experience and competence: i) Post Graduate Diploma in Industrial Safety & Environmental Management (PGDISEM) from National Institute of Industrial Engineering, Mumbai ii) M.E. in Industrial Safety from NIT, Trichy, Tamil Nadu iii) M.E. in Industrial Safety from Mepco Schlenk Engineering College, Sivakasi, Tamil Nadu iv) B.E. in Fire and Safety Engg. From Cochin University of Science and Engg. Cochin, Kerala v) B.E. with advanced Safety Management Diploma from CLI / RLI Mumbai / Chennai / Kolkata and Kanpur. vi) B.E / B.Arch., with one year Full Time advanced Safety diploma from NICMAR, Hyderabad. vii) B.E / B.Tech with any other equivalent State and Central Govt. recognized full time Degree / Diploma in Safety. viii) International qualifications like CSP (Certified Safety Professional), NEBOSH, MIOSH, MSISO etc.	5 plus {for all category except (iv) and 7yrs for category (iv)}
2	Senior SHE Manager	As stated in Sl. No:1 and in addition the following categories: i) B.Sc.(Physics/Chemistry/Maths) with one year Full Time advanced Safety diploma from NICMAR, Hyderabad ii) B.Sc. / Diploma in Engg. with advanced Safety Management Diploma from CLI / RLI / Mumbai / Chennai / Kolkata and Kanpur. iii) B.Sc. (Physics/Chemistry/Maths) with One year Full Time diploma in Safety Engineering offered by West Bengal State Technical Education Departments and similar courses by other states. iv) Any Graduate or diploma holder with 7 years of work experience in full fledged SHE department of any Public	4 {for category (i), (ii) and (iii) only}

		Sector / Leading Private Sector / MNC / with prior approval of employer on a case to case basis	
3.	Junior SHE Manager	i) Degree in Science / Diploma in Engineering with Govt. recognized safety diplomas from Correspondence course of NICMAR, Annamalai University, National and State Productivity Councils, Other State Technical Education Boards etc. ii) Any Graduate or diploma holder with 5 years of work experience in full fledged SHE department of any Public Sector / Leading Private Sector / MNC / with prior approval of employer on a case to case basis	3 (for category (i) only)
4.	Safety Steward	Any basic qualification with any SHE related certificate courses.	3
5.	Senior SHE (Electrical) Manager	Degree in Electrical Engineering + Govt. recognized Electrical Licence holder	3
6.	Junior SHE (Electrical) Manager	Diploma in Electrical Engineering + Govt. recognized Electrical Licence holder	2
7.	Senior SHE (Fire) Manager	i) B.E. (Fire) from National Fire Service College, Nagpur ii) B.E (Fire & Safety) from Cochin University iii) Graduate with any Govt. recognized diploma in Fire Safety with 5 years of experience	2 (for category (i) and (ii) only)
8.	Junior SHE (Fire) Manager	Any Diploma holder with any Govt. recognized diploma in Industrial Fire Safety.	1
9.	Occupational Health Officer	MBBS with Govt. recognized degree/diploma in Industrial/ occupational health	2
10.	Environment Manager	Govt. recognized PG Degree / PG Diploma / Degree in Environmental Engineering / Science	2
11.	Senior SHE (Traffic) Engineer	Govt. recognized PG Degree / Degree / Diploma in Traffic/Transportation Engineering or Planning	1
12.	House Keeping Squad - Manager	Any Diploma in Engineering	1
13.	Barricade Manager	Any Diploma in Engineering	1
14.	Labour Welfare Officer	Any Degree with Govt. Recognized Degree / Diploma / P G Diploma in Labour Welfare related fields like Law, Personnel / Industrial Relations etc.	2

Note 1: In some extraordinary cases where the candidate had earlier worked in Delhi Metro Rail Corp or KMRC Projects they can be considered for the following posts:

i) Senior SHE Manager

ii) Junior SHE Manager

iii) Safety Steward

depending upon the qualification and no. of years of experience on a case-to-case basis even if they do not possess the prescribed qualification as listed above.

Note 2: In all other cases other than listed under **Note 1** irrespective their earlier experience with Delhi Metro Rail Corp and KMRC projects the candidates shall qualify as specified above.

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/003/AVE/281105

MINIMUM REQUIREMENTS OF SHE MONITORING AND AUDIO-VISUAL EQUIPMENTS

1. 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

2. 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 equipments are a must for conducting periodical in-house safety presentations in the training programmes.

3. In addition to the above portable hand held digital sound level meter (SLM) and portablehand held digital LUX meter are also to be provided.

Sl. No.	**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)	1	1	1	1
2.	Portable hand held Digital LUX Meter	1	1	1	1
3.	Laptop Computer with standard configuration including multi media facilities	1	1	1	1
4.	Colour Printer	1	1	1	1
5.	Computer projector with screen	-	1	1	1
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	1	1	1	2

	9 mega pixel and video facility				
9.	Digital still camera with flash of minimum 9 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	1
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				

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction: KMRC/SHE/GI/004/OT/281105

Topics for First day at work SHE orientation training of Workmen

1. Hazard Identification Procedure

   Hazards on site:

   - Falls
   - Earthing work
   - Electricity
   - Machinery
   - Handling materials
   - Transport
   - Site housekeeping
   - Fire

2. Personal Protective Equipment
   - What is available?
   - How to obtain it?
   - Correct use and care

3. Health
   - Site welfare facilities
   - Potential health hazards
   - First Aid/CPR

4. Duties of the contractor
   - Brief outline of the responsibilities of the Contractor by law
   - Details of Contractor's accident prevention policy
   - KMRC's SHE manual
   - Building and other Constructions Welfare Law

5. Employee's Duties
   - Brief outline of responsibilities of employee under law
   - Explanation of how new employees fit into the Contractor's plan for accident prevention. (Induction and orientation).

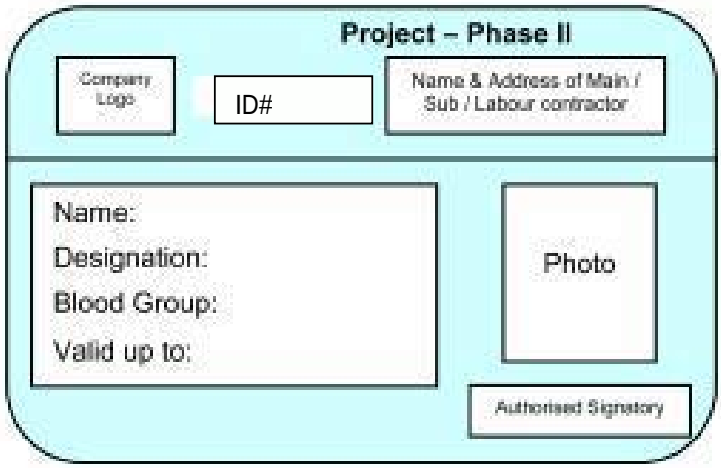
KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/005/IDC/281105

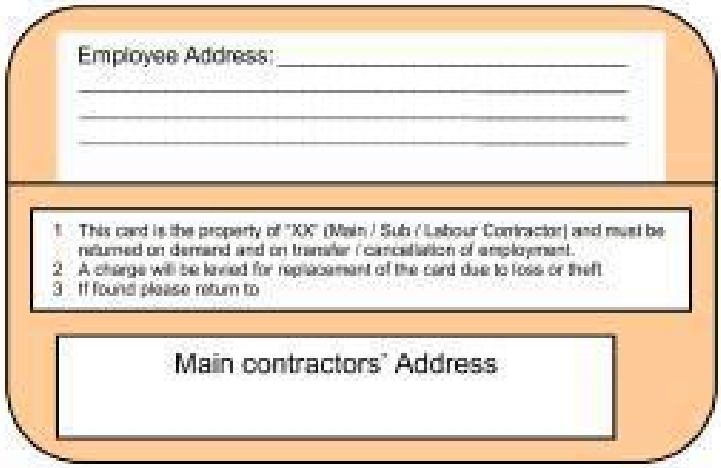
ID Card Format

(85 mm x 55mm)

Front side of ID Card:



Backside of ID Card:



KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/006/TMS/281105

SHE Training details for Managers and Supervisors

1. The Law and Safety	**2. Policy and Administration**
Statutory requirement Appropriate regulations Duties of employer and employee	Effect of incentive on accident prevention Human relations Consultation Safety Officer: duties, aims, objectives
3. Safety and the Supervisor	**4. Principles of Accident Prevention**
Safety and efficient production go together Accidents affect morale and public relations	Attitudes of management, supervision and operations Methods of achieving safe operations Accident and injury causes
5. Site Inspection	**6. Human Behavior**
The role of management Hazard Identification Procedure Records results Follow-up procedures Feedback	Motivating agencies Individual behavior Environmental effects Techniques of persuasion
7. Site housekeeping	8. Health
Site organization Relationship of site housekeeping to accident Hazard to health on site Site access Equipment storage Material stacking Materials handling	Medical examination occurrence Sanitation and welfare Protective clothing First Aid/CPR
9. Personal Protective Equipment	10. Electricity
Eye, face, hands, feet and legs Respiratory protective equipment Protection against ionizing radiation	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	12. Equipment
Cylinder storage and maintenance Condition and maintenance of valves, regulators, and gauges Condition and maintenance of valves, pressures	Accidents related to moving parts of machinery Appreciation of principles of guarding 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 Licensing, certification and training required Type of scaffold Overloading Work on roofs Fragile material Openings in walls and floors Use of safety belts and nets	Maintenance and inspection for operation of cranes Slinging methods Signaling 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

KOLKATA METRO RAIL CORPORATION LTD. General Instruction : KMRC/SHE/GI/007/TM/281105

SHE Training Matrix

	Management																				Supervisor											Specific												
Types of training	SHE Orientation	SHE Leadership	SHE Plan	SHE Improvement Plan	Management of Change	SHE Audit & Inspection	SHE Emergency Response & Preparedness	Incident / Accident Investigation & Reporting	SHE Communication	SHE Promotion & Incentives	Traffic Management	Hazard Identification & Risk Analysis	Permit to work system	Confined space entry	Scaffolding	Waste Management	Environment Monitoring	Labour welfare measures	Behavioural Based Safety Management (BBSM)	Job/Task Safety Analysis (JSA)	Safety Training Observation Programme (STOP)	Industrial First Aid & CPR	Incident / Accident Investigation & Reporting	Fire fighting	Confined Space Testing & Certification	Scafold Erection & Inspection	Rigging	Wire Rope Inspection	Crane Inspection	Electrical / Mechanical Isolation	Permit to Work System	Confined Space Working	Explosive Handling & Control	Heavy Lifting Operation	Radiography (X-Ray)	HAZMAT Handling & Control	Welding, Cutting & Bracing	Power Actuated Hand Tool	Electrical / Mechanical Isolation	Roofing Work	Steel erection work	Scaffold Erection / Dismantling	False-Work Erection / Dismantling	Painting in Confined Area
Project Manager	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•																						
Sr. Construction Managers	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•					•								•									
Quality Manager	•	•	•	•	•		•	•	•		•	•	•	•	•	•		•	•	•	•	•																						
Planning Engineers	•	•	•		•	•	•	•	•			•		•								•																						
Construction Managers	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•	•	•													
Construction Supervisors	•		•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Construction Foreman	•		•				•		•			•	•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Machinery Operators	•						•				•					•						•		•			•																	
Material Handlers	•						•					•	•		•							•	•	•			•																	
Station Building Workers	•						•						•		•	•						•		•							•			•		•		•		•		•	•	•
Steel Workers	•						•						•		•	•						•		•			•				•			•		•	•			•	•	•		
Mechanical Workers	•						•									•								•			•				•	•		•		•			•	•		•		•
Other Civil workers	•						•									•						•		•			•				•	•	•	•		•			•	•		•	•	•
Electrical Workers	•						•									•								•			•				•	•		•		•			•	•		•		•
Radiographers	•						•									•						•		•							•	•			•	•						•		
Transportation Drivers	•						•				•					•						•		•																				
Security officers	•						•	•			•	•	•		•	•						•	•	•																				
Clerical Staff	•						•									•						•		•																				
Medical Doctor	•	•	•				•	•							•	•		•				•																						
Sr. SHE Managers		•					•								•		•					•																						
Jr. SHE Managers	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
SHE Supervisors	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/008/DAY/281105

DAYS TO BE OBSERVED FOR CREATING SHE AWARENESS

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

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/009/PS/281105

Minimum Requirements of SHE Communication Posters / Signages / Video

1. 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
Up to 25 Cr	A
Up to 100 Cr	B
Up to 250 Cr	C
More than 250 Cr	D

2. 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 No. : 1 – Minimum No. of Posters

Sl. No.	SHE Poster Title	Minimum No. of concepts in each title	SHE Monitoring and Audio-Visual equipment required for			
			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 & Bengali	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 AREA etc.	2 types of sizes made up of **metal** sheet to be mounted at differed at different locations	Each 25	Each 50	Each 75	Each 200
b)	Helmet	5	Each 25	Each 50	Each 75	Each 200
c)	Shoe	5	Each 25	Each 50	Each 75	Each 200

Sl. No.	SHE Poster Title	Minimum No. of concepts in each title	SHE Monitoring and Audio-Visual equipment required for			
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	5	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 limit, safe crossing and working within barricaded area etc.)	5	Each 25	Each 50	Each 75	Each 200
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	-	-	-	-

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 No.: 2 – Size of Posters / Signages

Sl. No.	Item	Size
1.	Posters – Standard	17"x22" –135 GSM 4 Colour 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" x 12"
7.	Road Traffic Sign Boards	Strictly as per Indian Road Congress (IRC) specifications

Table No. : 3 – Safety Signage Colour (as per IS 9457)

Sl. No.	Type of Signage	Colour
1	Mandatory	Blue
2	Danger	Yellow
3.	Prohibit	Red
4.	Safe conditions	Green

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction: KMRC/SHE/GI/010/AE/281105

Experts / Agencies for SHE Services

(**Organizations are referenced from New Delhi, Mumbai and elsewhere)**

Sl. No.	Organisation	Services
1.	Bureau Veritas Industrial Services (India) Pvt. Ltd., 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	• External SHE Audit • SHE Management / Technical Training
2.	Central Labour Institute Post box no: 17851, N.S.Monkikar Marg Sion , Mumbai- 400 022 Tel.: 022- 4092203 Fax: 022 – 4071986 E-mail: cli@dgfasli.nic.in	• SHE Management /Technical Training
3	Construction Industry Development Council 801, 8th Floor, Hemkunt Chambers, 1 89, Nehru Place, New Delhi – 110 019 E-mail: cidc@vsnl.com	• SHE Management / Technical Training
4	Delhi Productivity Council 1E/10, Swami Ramtirath Nagar, New Delhi – 110 055 Tel.: 23522835	• SHE Management / Technical Training
5	Det Norske Veritas AS, 203, Savitri Sadan 1, 11 Preet Vihar Community Centre, New Delhi-110 092 Phone: 011-22531502/2253/1503, 22427688/22531278 Fax: 011-2253 0247 Website: www.dnv.com	• External SHE Audit • SHE Management / Technical Training
6	Dr. A. V. Baliga Memorial trust Link House, Bagadur Shah Zafar Marg Press Area New Delhi – 110 002 Phone: 011 – 23311119	• HIV / AIDS awareness

Sl. No.	Organisation	Services
7.	Dr. Cris Research Centre For Occupational Health & Safety 306, Guru Arjuna Dev Bhawan, Ranjit Nagar Complex, New Delhi – 110 008 Phone: 9810040406 Fax: 011 – 25702929 E-mail: team@drcris.com Website: www.drcris.com	• Ambulance Room & Van • Communication Materials • First-aid box • First-aid Training • HIV / AIDS awareness • ID Card • Medical Facilities • SHE Orientation Training
8.	DuPont Safety Resources, E.I. DuPont India Private Limited, Arihant Nitco Park 6th Floor, 90, Dr. Radhakrishnan Salai, Mylapore, Chennai-600 004 Phone: 044-2847 2800, 2847 3752 Fax: 044-2847 3800 Mobile: 9381201040 Website: in.dupont.com	• SHE Management Training
9.	EQMS INDIA PVT. LTD. 304 & 305, 3rd Floor, Rishabh Towers, Plot No. 16, Community Centre, Karkardooma, Delhi - 110092. Phone: 011 - 22374729 / 22374775 Fax: 011- 22374662 E-mail: eqms@eqmsindia.org Website: www.eqmsindia.com	• ISO Certification • SHE Management / Technical Training
10.	Green Cross Consultants 59, 7th Cross, 1st Floor, Jai Bharath Nagar, Banglore-560 033 Phone: 080-2549 6782 E-mail: etgrangan@yahoo.com	• SHE Management / Technical Training
11.	HSRTC, PENTASAFE, 201, 2nd Floor, Town Centre, Andheri Kurla Road, Marol, Andheri (East), Mumbai-400 059 Phone: 022-2850 2210/20/50 Fax: 022-2850 2260 E-mail: training@penta-safe.com	• SHE Practical Field Training for Height Safety

Sl. No.	Organisation	Services
12.	Institute of Driving Training & Research, Wazirabad Road, Adjoining Loni Road flyover. New Delhi – 110 094 Phone: 011 – 22813474, 22815833 Fax: 011 - 22811131	• SHE Technical Training for Vehicle Drivers.
13.	Institute for Research, Development & Training of Construction Trades & Management, An Educational Institute, Society and Trust, 1st Floor, UVCE Alumni Association Building, K.R. Circle, Banglore-560 001 Phone: 080-22294291/22243257 Fax: 080-22243257 E-mail: ubrco@vsnl.com Website: www.instructindia.org	• SHE Technical /Field Training
14.	International Engineering Company K – 10, South Extension, Part – 2, New Delhi – 110 049 Phone: 011 – 26254761, 26258130 Mobile: 9312260130 E-mail: ashok@intenco.net	• Crane and Lifting appliances and Gears Certification • SHE Practical Field Training for Crane Safety
15.	L & T Eutectic 32, Sivaji Marg, New Delhi – 110 015 Phone: 011 - 51419538, 51419539 Fax: 011 - 51419600 Website: www.lnteutecticwelding.com	• SHE Practical Field Training for Welding Safety
16.	Loss Prevention Association of India Ltd. Warden House, Sir P.M. Road, Mumbai – 400 001 Website: www.lpaindia.org	• SHE Management / Technical Training

Sl. No.	Organisation	Services
17.	MFA Crucial Moments Healthcare Pvt. Ltd., 42, Okhla Industrial Estate, Phase – II New Delhi – 110 020 Phone: 011 – 55624000 Fax: 011 – 55624010 E-mail: contact@crucialmoments.net	• First-aid Training
18.	Modicare Foundation New Delhi – 110 065 4 Community Centre, New Friends Colony, Phone: 011 – 5167235059 Fax: 011 – 26915469 E-mail: nivedita@modi.com nivedita@gmavil.com Website: www.modicarefoundation.org	• HIV / AIDS awareness
19.	National Safety Council HQ and Institute Building 98A, Sector 15, industrial Area C.B.D Belapur, Navi Mumbai – 400614 Phone: 27579924	• SHE Management / Technical Training
20.	NICMAR (National Institute of Construction Management and Research) 910,9th Floor, Hemkunt Chambers, 89, Nehru Place, New Delhi – 110 019 Phone: 011 – 51618415, 51618417, 51618418 Fax: 011 – 51618416	• SHE Management / Technical Training
21.	Quality Growth Services Pvt. Ltd. H-13, Kirti Nagar, New Delhi – 110 015 Fax: 011 – 25431737 / 25438598 / 25918332 E-mail: qgs@qgspl.com Website: www.qgspl.com	• ISO Certification

Sl. No.	Organisation	Services
22.	Safety Engineers Association / Safety Educational Trust – India 2/257, First Floor, Dr. Ambedkar Nagar, Manapakkam, Chennai – 600 116 Phone: 044 – 22523461 E-mail: safetrustindia@rediffmail.com	• SHE Management / Technical Training
23.	SHE Management Consultancy & Support Services, 145 A, Pocket-VI, (DDA Flats), Kondli Gharoli, Mayur Vihar-II, Delhi-110 096 Fax: 011-2262 5015 Mobile: 9811153873 E-mail: r_k_p@vsnl.net	• SHE Management / Technical Training
24.	Red Cross Road St. Johns' Ambulance New Delhi – 110 001	• First-aid Training
25.	208, A/4, Savitri Nagar, Vexil Business Process Services Pvt. Ltd. New Delhi – 110 017 Mobile: 9350232714, 98102832201, 9350232716 E-mail: info@vexilbps.com Website: www.vexilbps.com	• Emergency Preparedness Mock drill • SHE Management / Technical Training
26.	Welding Research Institute Bharat Heavy Electricals Ltd Trichirappalli, Tamil Nadu – 620 014 Phone: 0431 – 2577029, 2577283 Fax: 0431 – 2520770 E-mail: wri@bheltry.co.in	• SHE Practical Field Training for Welding Safety
27.	3M India Limited Occupational Health & Environmental Safety Division Kolkata 092305 79787	• SHE Practical Field Training for Fall protection, Road signs, PPE, and general and specialized safety training.
28.	Dr. John Antonopoulos, PhD, P.E. CSP American Society of Civil Engineering Certified Safety Professional hellasafety@aol.com 001-718-448-0541	• United States OSHA Safety Competent Person Training, • Virtual Safety Training • Safety and Quality Training
29.	M & M Media, LLC Cincinnati, Ohio 45247 USA Phone: 513 325-0967 Fax: 513 429-5079 Website: superrushenglish.com Email: carolina2782@yahoo.com	• Specialized on site or online, local and foreign language and safety training, support by a certified OSHA trainer and language specialists.

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/011/ILL/281105

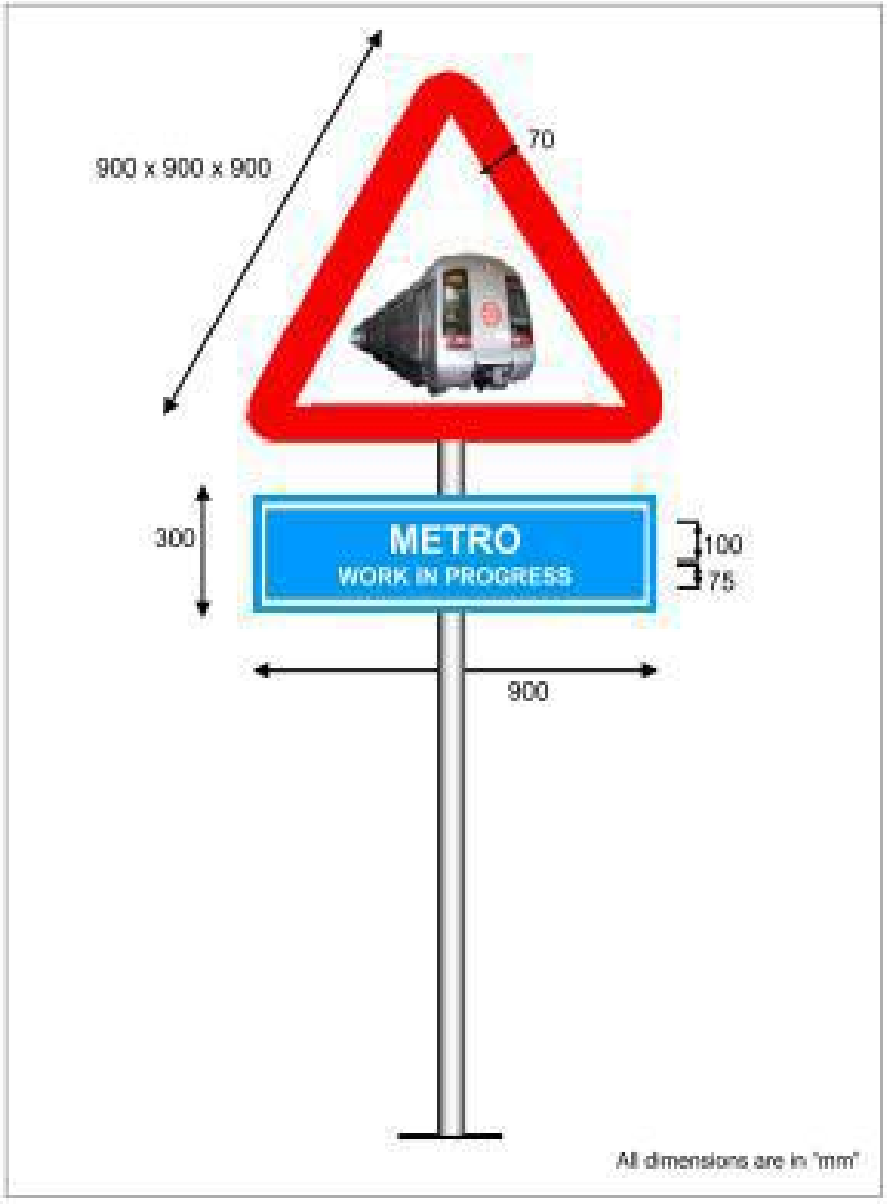
Minimum Lighting Requirements

Sl. No.	Facility or Function	Luminance – lx (lm/ft^2)
1.	Administrative areas (offices, drafting and meeting rooms, etc.)	540 (50)
2.	**Construction areas**	
	- general indoor	55 (5)
	- general outdoor	33 (3)
	- tunnel and general underground work areas (minimum 110 lux required at tunnel and shaft heading during drilling, mucking and scaling)	55 (5)
3	**Access ways**	
	- exit ways, walkways, ladders, stairs	110 (10)
4	**Maintenance / Operating areas / shops**	
	- vehicle maintenance shop	325 (30)
	- carpentry shop	110 (10)
	- outdoors field maintenance area	55 (5)
	- refueling area, outdoors	55 (5)
	- shops, fine details work	540 (50)
	- shops, medium detail work	325 (30)
	- welding shop	325 (30)
5	Mechanical/electrical equipment rooms	110 (10)
6	Hoists, Elevators, freight and passenger	215 (20)
7	**Warehouses and storage rooms/area**	
	- indoor stockroom, active/bulk storage	110 (10)
	- indoor rack storage	270 (25)
	- outdoor storage	33 (3)
8	Health Centers and First aid stations and infirmaries	325 (30)
9	Toilets, wash and dressing rooms	110 (10)
10	Work areas – general (not listed above)	325 (30)
11	Parking areas	33 (3)
12	Visitor areas	215 (20)
13	Laboratories	540 (50)

KOLKATA METRO RAIL CORPORATION LTD.

General Instruction : KMRC/SHE/GI/012/WTS/281105

Warning Traffic Sign



KOLKATA METRO RAIL CORPORATION LTD.

FORM No. : SF/001

FORMATION OF SITE SHE COMMITTEE

Contract No

Contractor Name

Contract Title

CIRCULAR

Committee

The following SHE Committee is constituted with immediate effect:

Chairman:

Members:

1)

2)

3)

4)

5)

Secretary:

Periodicity

The committee will meet at least once in a month on the day (specify date)

Agenda

Secretary will circulate agenda of the meeting at least two days in advance of the schedule date of the meeting.

Circulation

Discussions of the meeting will be minuted in the standard format and circulated to the following under the signature of the secretary.

1. Chairman
2. Members
3. KMRC Representatives
4. Others concerned

Date:

Signed By: ----------

CHAIRMAN

KOLKATA METRO RAIL CORPORATION LTD.

FORM No. : SF/002

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 : **P Manager** **(Signature & Name**

Kolkata Metro Rail Corporation Limited

EAST WEST CORRIDOR PROJECT
SAFETY HEALTH AND ENVIRONMENTAL MANUAL

PART - 1

Policy and Procedures

Part 1 – Safety and Health
Part 2 – Environmental and Health

(August 2009)

CONTENTS

1.0 STATEMENT OF INTENT

It is the intention of the Kolkata Metro Rail Corporation to build the East West Corridor for Kolkata 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 KMRC and the Contractors, to the workers on the sites.

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

The Kolkata Metro Rail Corporation 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 Kolkata Metro Rail Corporation 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

(Sumantra Choudhury)

Managing Director/KMRC

2.0 REFERENCES AND DISTRIBUTION OF THIS MANUAL

2.0 References

2.1.1 The procedures in this manual should be read in conjunction with;

(a) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996.

(b) The Factories Act, 1948

(c) Other Laws of India, Regulations, Rules and Codes of Practice on Safety Health and the Environment that may be applicable.

(d) The Conditions of Contract in respect of Health and Safety, that apply to the specific Contract under which the Contractor is employed.

(e) The important Indian Standards and British Standards as applicable to the work of this contract.

2.1 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 KMRC and all other persons who have need of it.

3.0 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.

(a) **Safety** means the freedom from unacceptable risks of personal harm, i.e. the avoidance of accidents and incidents.

(b) **Health** means the physical wellbeing of a person and the freedom from any illness caused working conditions.

(c) **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.

(d) **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.

(e) **Foreseeable** means that which is likely or possible.

(f) **Chief Safety Officer** means an officer nominated by KMRC as Chief Safety Officer

(g) **Site Safety Plan** means the contract specific safety plan that the Contractor has produced from his Outline Safety Plan.

(h) **Outline Safety Plan** means the contract specific outline safety plan that the Contractor will prepare as part of his tender submission.

(i) **Reportable Accident / Incident** means an Accident or Incident that is reportable to the Employer's Representative. 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.

(j) **Major Injury Accident** is defined as:

(1) 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.

(i) **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.

4.0 GENERAL

4.1 Introduction

4.1.1 It is the objective of the KMRC 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 KMRC.

4.1.3 It is the intention of KMRC to levy fines against contractors who do not comply with the requirements of this Manual. The fines levied will be donated to the KMRC 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 General 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 KMRC during the second phase of construction of the East West corridor of Kolkata. 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 Requirements

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, subcontractors' 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 section3.1.1.(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 KMRC 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 Electrical and Projects are responsible for ensuring that the contents of this Manual continue to meet the requirements of the KMRC and that they are implemented rigorously.

5.0 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:

(b) Site Agent/Manager:

(c) Engineers:

(d) Safety Officer:

(e) Supervisors:

(f) General Workers

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 West Bengal State.

5.3.2 The KMRC 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 Not Used.

5.3.4 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.

5.3.5 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 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 accidents

(c) Accidents involving members of the public

(d) Dangerous Occurrences

5.3.6 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 KMRC.

5.3.7 Contractors and sub-contractors are responsible for providing comprehensive safety and environment plans for the review by KMRC, and for subsequent implementation of the measures detailed in the safety and environment plans.

5.3.8 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 KMRC.

5.3.9 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 KMRC.

5.3.10 Contractors and sub-contractors are responsible for organising site safety committees which shall meet at least monthly.

5.3.11 Contractors and sub-contractors are responsible for reporting dangerous occurrences and accidents to the Employers Representative 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 KMRC 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 KMRC worksite.

6.0 SAFETY TRAINING AND SAFETY PROMOTION

6.1 Safety Training

6.1.1 Safety Training is an important factor in managing safety on construction sites. All contractors shall provide as a minimum the following types of training:

6.1.2 **Induction Training** shall be given to all persons prior to permitting them to go to the worksite. The workers ID 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

6.1.3 **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.

6.1.4 **Specific Training** shall be provided to persons with safety related tasks, such as Crane Operators, Banksmen, Slingers and Plant Operators etc.

6.1.5 **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.

6.1.6 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 Employer's Representative. 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)

6.1.7 The Contractor shall keep detailed records of all training undertaken, and shall keep such records available for inspection by the Employer's Representative.

6,2 Safety Promotion

6.2.1 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.

6.2.2 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

6.2.3 Other safety award and safety incentive schemes should be considered

6.2.4 Regular Safety and Industrial Health Poster Campaigns / Billboards / Banners / Glowsigns 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 other suitable language deemed appropriate. Posters / Billboards / Banners / Glowsigns should be changed at least once a month to maintain their impact.

7.0 SAFETY INSPECTIONS AND FOLLOW UP ACTION

7.1 Inspections by Contractor's Safety Supervisory Staff

7.1.1 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 Employer's Representative.

7.1.2 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.

7.1.3 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 8 of this Manual.

7.1.4 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.

7.1.5 The Employer's Representative Staff may carry out site safety inspections, which shall be attended by the Contractors' Site Manager and Safety Manager.

7.1.6 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.

7.2 Follow up actions

7.2.1 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.

7.2.2 In cases where the Employer's Representative 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.

7.2.3 If the Contractor's working method is deemed so unsafe as to represent a risk to life, the Employer's Representative 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 Employer's Representative may also invoke a fine on the Contractor in accordance with Section 4.1.3.

8.0 CONTACTOR'S SITE SAFETY COMMITTEES

8.1 General

8.1.1 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 Employer's Representative seven days prior to the meeting date, in order that they can decide if it is necessary for them to attend.

8.2 Composition and Functions of Contractor's Safety Committees

8.2.1 The Contractor should form a safety committee for each contract, however should the situation require more than one committee, or the Employer's Representative so requires, additional committees shall be created.

8.2.2 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.

8.2.3 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.

In attendance as and when they wish,

Representatives of the Employer and the Employer's Representative

8.2.3 Meetings should be held at least once every month

8.2.4 Minutes of the Site Safety Committee shall be sent to all members within two working days of the meeting. 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.

9.0 REPORTING OF ACCIDENTS AND DANGEROUS OCCURRENCES

9.1 Contractors Responsibility

9.1.1 All accidents and dangerous occurrences shall be recorded, regardless of whether or not personnel injury occurs.

9.1.2 The Employer and the Employer's Representative 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 3) :

(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

9.1.3 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 Employer's Representative within seven days of the incident.

9.1.4 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.

9.2 Reportable Accidents

9.2.1 An accident shall also become reportable to the Employer's Representative 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 Employer's Representative within seven days of the incident.

9.2.2 The following information is required in reporting an accident to the Employer's Representative.

(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.

9.3 Dangerous Occurrences

9..3.1 The Employer's Representative 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.

9.3.2 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.

9.4 Reporting of Fires by Contractor

9.4.1 The Contractor shall report to the Employer's Representative all fires which occur on site including any fires that have been extinguished by the Contractor himself, and the Employer's Representative 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.

This action is in addition to reporting the incident to the Chief Fire Officer, and Police in accordance with local regulations.

9.5 Reporting to the Employer's Representative

9.5.1 The Contractor shall duly complete standard forms on dangerous occurrences and accidents as required by the Employer's Representative to enable the Employer's Representative to prepare a database on accident statistics. The Contractor shall deliver to the Employer's Representative a copy of any statutory reports he submits to the Relevant Authorities.

9.5.2 The Contractor shall send a monthly report to the Employer's Representative of all accidents and dangerous occurrences whether they are of a serious nature or not.

10.0 ACCIDENT INVESTIGATION

10.1 General

10.1.1 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.

10.1.2 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.)

10.1.3 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.

10.2 Recommended actions in incident investigation

10.2.1 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;

(a) take photographs and make sketches

(b) examine involved equipment, workpiece or material and the environmental conditions

(c) interview the injured, eye-witnesses and other involved parties

(d) consult expert opinion where necessary

(e) identify the specific Contractor or Sub-contractor involved.

10.2.2 Having gathered information, it is then necessary to make an Analysis of Incident

(a) establish the chain of events leading to the accident or incident

(b) find out at what stage the accident took place

(c) 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.

10.2.3 The next stage is to proceed with the Follow-up Action

(a) report on the findings and conclusions

(b) formulate preventive measures to avoid recurrence

(c) publicise the findings and the remedial actions taken

11.0 ACCIDENT STATISTICS

11.1 Introduction

11.1.1 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.

11.2 Collection of Accident Statistics

11.2.1 The procedures that apply for the reporting and collation of data in respect of accident statistics are set out below.

11.2.2 The Contractors' safety officers are required to send duly completed Report Forms (Refer to Schedule 3 – SAF 002 and SAF 003), to the Employer's Representative **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.

11.2.3 Man-hours' is defined as the man-hours worked by all persons employed on site. (including site supervisory staff, management staff and clerical staff).

11.2.4 'Man-days' is defined as the man-days worked by all persons employed on site. **(**including site supervisory staff, management staff and clerical staff).

11.3 Calculation of man-days lost - Construction Accident Statistics

11.3.1 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.

11.4 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 9.4.1, and reportable accidents as defined in 9.2.1

12.0 HAZARD IDENTIFICATION AND RISK ASSESSMENT

12.1 General

12.1.1 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.

12.1.2 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.

12.1.3 The worksheets should then show what measures the Contractor is going to take to reduce the level of risk to acceptable levels.

12.2 Method Statements

12.2.1 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.

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

12.2.3 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;

12.3 Permits to Work

12.3.1 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.

12.3.2 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

(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.

12.3.3 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;

12.3.4 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.

12.3.5 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) identity 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

12.3.6 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 2)

12.3.7 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.

12.3.8 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) 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.

13.0 EMERGENCY PREPAREDNESS PLANS

13.1 Emergency Situations

13.1.1 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 9.1.7)

(b) A Serious Fire That Threatens Life.

(c) A Flood 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
- major utility collapse
- unintended explosions
- subsidence causing damage to structures or services

13.1.2 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.

13.1.3 Copies of the emergency procedures and the Contractor's rescue organisation (reviewed without objection by the Employer's Representative) 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.

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

14.0 SAFETY SIGNAGE

14.1 Safety Signs

14.1.1 All safety signage that is displayed in and around the sites shall be in both Hindi 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

14.1.2 All safety signs shall comply with the Internationally recognised Safety Colours as indicated below:

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

14.2 References

Indian Standards

IS 9457 Standard for colours of Safety Signs

IS 12349 : 1988 Fire Protection - Safety Signs

15.0 INDUSTRIAL HEALTH AND WELFARE

15.1 Introduction

15.1.1 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.

15.1.2 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.

15.1.3 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.

15.2 Hazardous Substances

15.2.1 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 Employer's Representative who may require further MSDS's to be obtained.

15.2.2 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).

15.2.3 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.

15.3 Noise

15.3.1 Industrial deafness is caused by over exposure to high levels of noise from plant, machinery or construction processes. Once a part of a persons 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.

15.3.2 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).

15.3.3 If Peak noise levels exceed 120dB(A) then the wearing of suitable hearing protectors shall be Mandatory.

15.3.4 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.

15.3.5 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

15.3.6 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.

15.4 Ventilation in Shafts and Tunnels

15.4.1 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 Employer's Representative on demand.

15.4.2 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:

15.4.3 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 m^3 of fresh air per minute shall be furnished for each brake horsepower of diesel engine used in the tunnel.

15.4.4 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 4.25 m^3 of fresh air per minute per employee underground.

15.4.5 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.

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

15.4.7 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.

15.4.8 Motive power other than electric, shall not be used without prior authorisation from the employer's representative. No petrol engines shall be used underground. Diesel locomotives shall only be used with the prior consent of the Employer's Representative. 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.

15.5 Toilets

15.5.1 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.

15.5.2 The toilets shall have adequate water supply and be kept in a clean and tidy condition at all times.

15.6 Drinking Water

15.6.1 The Contractors shall ensure that effective arrangements are made to provide and maintain at suitable points a sufficient supply of wholesome drinking water.

15.6.2 All such points shall be legibly marked "Drinking Water" in Hindi and English and no such point shall be situated within six metres of any washing place, urinal or latrine.

15.7 Lifting and Carrying of Excessive Weights

15.7.1 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

15.8 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

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: 1993: Ear muffs
	352-2: 1993: Ear plugs
	352-3: 1997: Earmuffs attached to an industrial safety helmet.

16.0 WORKING AT HEIGHT

16.1 General

16.1.1 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.

16.1.2 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.

16.1.3 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.

16.2 Use of Scaffolds

16.2.1 All scaffolds should be erected and dismantled by workmen who are thoroughly experienced in the erection and dismantling of scaffolding.

16.2.2 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 Employer's Representative.

16.2.3 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.

16.2.4 All scaffolds shall be constructed of sound materials free from patent defect.

16.2.5 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;

16.3 Use of Ladders

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

16.3.2 Ladders should be checked weekly and defective ladders shall be promptly and properly repaired or replaced.

16.3.3 Ladders shall not be used as working platforms but may be used for work of short duration of up to thirty minutes.

16.3.4 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.

16.3.5 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;

16.4 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.

16.5 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapters: XV and XIX

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

17.0 EXCAVATIONS

17.1 General

17.1.1 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.

17.1.2 The contractor shall ensure that all excavations are supervised by workers with thorough knowledge and experience of excavation work.

17.1.3 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 Employer's Representative.

17.1.4 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.

17.2 Planning

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

(a) collapse of the sides;

(b) materials falling onto people working in the excavation;

(c) people and vehicles falling into the excavation;

(d) people being struck by plant;

(e) undermining nearby structures;

(f) contact with underground services;.

(g) fumes; and

(h) Make sure the necessary equipment needed such as trench sheets, props, etc, are available on site before work starts.

17.3 General Precautions

17.3.1 The following precautions should be observed;

(a) 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.

(b) Do not go into unsupported excavations.

(c) Never work ahead of the support.

(d) 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.

(e) Prevention of materials falling into excavations

(f) 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.

17.4 Undermining nearby structures

17.4.1 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.

17.5 Avoiding underground services

17.5.1 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.

17.6 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: XIII

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

18.0 LIFTING OPERATIONS

18.1 Lifting Appliances:

18.1.1 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 Employer's Representative a current Certificate of Inspection issued by a Competent Person approved by KMRC.

18.1.2 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.

18.1.3 All lifting appliances shall be maintained in accordance with the manufacturer's instructions and shall be subject to a regular preventative maintenance programme.

18.1.4 All lifting appliances shall be inspected every three months by a third party competent person approved by KMRC. Certificates of Inspection shall be available with the lifting appliance and a copy shall also be sent to the Employers Representative.

18.1.5 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 Employer's Representative.

18.1.6 The Contractor shall ensure that only thoroughly trained and experienced persons aged twenty-one years and over are allowed to operate lifting appliances.

18.2 Lifting Gear:

18.2.1 Lifting Gear includes chain slings, rope slings, or similar gear and a ring, link, hook, plate clamp, shackle, swivel or eye bolt.

18.2.2 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 Employer's Representative.

18.2.3 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.

18.2.4 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.

18.3 Lifting Operations:

18.3.1 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.

18.3 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: VII

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

19.0 WORK IN CONFINED SPACES

19.1 General

19,1.1 The term 'confined space' has two defining features. Firstly, it is a place which is substantially (though not always entirely) enclosed and, secondly, there will be a reasonably foreseeable risk of serious injury from hazardous substances or conditions within the space or nearby.

19.1.2 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.

19.2 The hazards

19.2.1 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.

19.2 Entry Procedures

19.2.1 Contractors will ensure that no work will be undertaken in Confined Spaces unless a Permit to Work, see Section 12.3, has been prepared and issued.

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

19.2.3 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

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

19.2.5 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 were 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.

19.3 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: XIII

Indian Standards

IS 11972 : 1987	Code of Practice for safety precautions to be taken when entering a sewerage system

20.0 SITE ELECTRICITY

20.1 General

20.1.1 The Contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Employer's Representative 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.

20.1.2 The name and contact telephone number of the representative having been reviewed without objection by the Employer's Representative shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.

20.1.3 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 Employer's Representative for review.

20.1.4 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.

20.1.5 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 (16^{th} 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.

20.2 Design Considerations

20.2.1 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.

20.2.2 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.

20.2.3 The installation on Site shall allow convenient access to authorised and competent operatives to work on the apparatus contained within.

20.3 Distribution of supply

20.3.1 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.

20.3.2 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.

20.3.3 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.

20.3.4 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.

20.3.5 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.

20.3.6 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.

20.4 Cables

20.4.1 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.

20.4.2 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.

20.5 Maintenance

20.5.1 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 Employer's Representative details of his maintenance schedule and maintenance works record.

20.5.2 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.

20.6 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: VI

(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.

21.0 WELDING AND CUTTING

21.1 General

21.1.1 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;

21.1.2 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 Employer's Representative.

21.1.3 Flexible hoses, cables and connections must be free from damage or risk of damage in service. Cables and hoses shall have adequate carrying capacity.

21.1.4 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.

21.1.5 Adequate ventilation and fume extraction must be provided and used as required by the risk assessment and especially in enclosed areas and pits.

21.1.6 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).

21.1.7 Naked flames or high temperature surfaces must not be allowed in the vicinity of volatile solvents.

21.1.8 All moveable flammable materials must be removed from the vicinity of work and fireproof covers placed over all flammable materials that cannot be removed.

21.1.9 During all welding the work piece and any access equipment must be safely secured.

21.2 Oxy-fuel Gas Processes

21.2.1 Handle cylinders carefully, keep outside enclosed areas and secure in an upright position. Keep oxygen cylinders away from fuel gas cylinders where possible.

21.2.2 Flash back arresters shall be fitted to both the fuel gas and oxygen cylinders;

21.2.3 Non return valves shall be fitted to the torch or cutting torch;

21.2.4 Ensure screwed fittings and hoses are correct and keep screwed and sealed surfaces free of contaminants, such as oil and grease.

21.2.5 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 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).

21.3 Arc Cutting, Gouging and Welding Processes

21.3.1 Connect the welding current return cable to the workpiece close to the arc point or to a well electrically conductive support structure in good contact with the workpiece. Also, connect the workpiece or the support structure to a separate earth terminal.

21.3.2 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.

21.3.3 Avoid being in contact with water or wet floors when welding. Use duckboards or rubber protection.

21.3.4 Provide screens to limit exposure of others to glare from arcs.

21.3.5 Use the correct eye and face protection with the correct filter glass.

21.3.6 Use a low voltage open circuit relay device if welding with alternating current in constricted or damp places.

21.4 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 : 1967 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

22.0 COMPRESSED GASES

22.1 Storage

22.1.1 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.

22.1.2 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.

22.1.3 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

22.1.4 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.

22.1.5 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.

22.1.6 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.

22.1.7 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.

22.1.8 Suitable portable first aid fire extinguishers shall be positioned in close proximity to the storage area for use in an emergency.

22.2 Handling Compressed Gas cylinders

22.2.1 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.

22.2.2 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.

22.2.3 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.

22.3 Regulators

22.3.1 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.

22.4 Hoses

22.4.1 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

22.5 Training and Instruction

22.5.1 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

22.6 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: VI

Indian Standards: IS 2190 : 1979 Code of Practice for the selection installation and maintenance of portable first aid fire extinguishers.

23.0 MACHINERY

23.1 Machinery Fencing

23.1.1 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.

23.1.2 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.

23.2 Maintenance

23.2.1 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.

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

23.2.3 Maintenance records shall be kept available for inspection by the Employer's Representative.

23.3 Air Receivers

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

23.3.2 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 Employer's Representative.

23.3.3 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.

23.4 Woodworking Machines

23.4.1 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;

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

23.5 Abrasive Wheels

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

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

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

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

23.6 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: X

Indian Standards

IS 7293 :. 1974 Safety Code for Working with Construction Machinery

24.0 HEAVY PLANT OPERATIONS

24.1 General

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

24.1.2 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.

24.1.3 No unauthorised person shall be permitted to ride on plant.

24.1.4 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 Employer's Representative.

24.1.5 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.

24.1.6 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.

24.1.7 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.

24.1.8 All drums of fuel oil shall be stored on drip trays or the fuel shall be kept in bunded bulk storage fuel tanks, with quantities stored being kept to a minimum.

24.1.9 The storage areas shall have dry powder fire extinguishers positioned in close proximity to their location for use in an emergency.

24.2 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: X

Indian Standards

IS 7293 : 1974 Safety Code for Working with Construction Machinery

IS 2190 : 1979 Code of Practice for the selection, installation and maintenance of portable first aid fire extinguishers.

25.0 TUNNELLING OPERATIONS

25.1 Procedures

25.1.1 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 Employer's Representative before the commencement of any tunnelling operations.

25.2 Sanitation and Drinking Water

25.2.1 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.

25.2.2 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.

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

25.3 Lighting

25.3.1 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.

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

25.4 Ventilation

25.4.1 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)

25.4 Protection Against Fire

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

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

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

25.6 Warning Signals

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

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

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

25.7 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: XIII

Indian Standards

IS 4756 : 1978 Safety Code for Tunnelling Work.

IS 2190 : 1979 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

26.0 BLASTING OPERATIONS

26.1 Authorisation for Blasting

26.1.1 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 Employer's Representative must also give his consent in writing before any blasting operations take place.

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

26.2 Risk Assessment and Method Statements

26.2.1 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.

26.3 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

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.

27.0 DEMOLITION

27.1 General

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

27.1.2 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.

27.1.3 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.

27.1.4 Before the demolition commences all relevant notifications will need to be given to the local authorities and media.

27.1.5 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.

27.1.6 All power supplies and services shall be disconnected before any demolition work commences.

27.2 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: XII

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

28.0 FALSEWORK / FORMWORK

28.1 General

28.1.1 The contractor shall ensure that all falsework / formwork has been properly designed and is suitable for the purpose.

28.1.2 All designed falsework / formwork shall be erected in strict accordance to the design.

28.1.3 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.

28.1.4 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.

28.1.5 The Contractor should use the following checklist to check that falsework / formwork is being used safely;

(a) have the design and the supports for shuttering and falsework / formwork been checked?

(b) is it being erected safely from steps or proper platforms?

(c) are the props plumb and properly set out?

(d) are the bases and ground conditions adequate for the loads?

(e) are the correct pins used in the props?

(f) are the timbers in good condition?

(g) is it inspected by a competent person against the agreed design before permission is given to pour concrete?

References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: XVII

29.0 PILING AND DIAPHRAGM WALLS

29.1 General

29.1.1 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.

29.1.2 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.

29.1.3 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.

29.1.4 All lifting operations shall be conducted in accordance with the requirements as detailed in Section 18 Lifting Operations.

29.1.5 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.

29.1.6 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.

29.1.7 A method statement shall be produced by the Contractor, which details the process for stop end recovery.

29.1.8 Wheel washing facilities shall be available on the sites for washing down the spoil removal trucks and the concrete delivery vehicles.

29.1.9 Bentonite and polymer storage tanks shall be bunded around to retain any unintentional and uncontrolled spillage.

29.1.10 The contractor shall submit to the Employer's Representative, for approval, proposals for the treatment of Bentonite slurry and its subsequent disposal.

29.1.11 No Bentonite spillage shall be allowed on any roads.

29.1.12 Regular site cleaning shall be carried out at all work-sites.

29.1.13 The Contractor as part of his Emergency Plans shall develop procedures for the collapse of piles and diaphragm walls.

29.2 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: XXIII and XI

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

30.0 WORK ADJACENT TO LIVE RAILWAYS

30.1 General

30.1.1 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

31.0 WORK ADJACENT TO LIVE ROADWAYS

31.1 General

31.1.1 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.

32.0 PERSONAL PROTECTIVE EQUIPMENT

32.1 General

32.1.1 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

32.1.2 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.

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

32.2 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter: VI

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 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: Safety footwear for professional use

BS EN 471 High visibility clothing

33.0 FIRST AID

33.1 First Aid Bases

33.1.1 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.

33.1.2 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.

33.1.3 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.

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

33.2 Medical Staff

33.2.1 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.

33.3 Ambulance

33.3.1 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.

33.4 First Aid Boxes

33.4.1 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.

33.4.2 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.

33.5 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter XXIV

34.0 FIRE PRECAUTIONS

34.1 General

34.1.1 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.

34.1.2 The Contractor shall ensure that specially trained personnel are available to deal with fires due to electrical causes, gas explosions etc.

34.1.3 A good standard of housekeeping shall be maintained at all times on the sites.

34.1.4 No accumulations of rubbish shall be allowed to gather.

34.1.5 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.

34.1.6 Signage shall be erected at prominent positions showing the correct use of portable first aid fire extinguishers.

34.1.7 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.

34.2 Fire Fighting Equipment

34.2.1 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.

34.2.2 Recharging of fire extinguishers and their proper maintenance should be ensured and as a minimum should meet Indian National Standards

34.2.3 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.

34.2.4 Sufficient number of fire hoses with branch pipes should be provided at site so that the fire can be controlled until the arrival the arrival of the Fire Brigade.

34.2.5 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

34.2.6 The Telephone Number of the local fire brigade should be prominently displayed near each telephone on site.

34.2.7 Supervisors and workmen at the site should be trained in the use of fire fighting equipment provided at the site.

34.3 Storage of Flammable Liquids

34.3.1 All flammable liquids shall be kept in a secure fire resistant store protected from electrical sparks welding sparks open flames and smoking.

34.3.2 Only such amounts of flammable liquids should be issued as are required for immediate use. Cans for carrying flammable liquids should be leakproof and properly stoppered and clearly marked “FLAMMABLE LIQUID”.

34.3.3 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.

34.3.4 All Diesel fuel storage tanks shall be bunded around in order to control any spillage or leakage that may occur.

34.3.5 "NO SMOKING" signs shall be prominently displayed at all areas where flammable materials are stored.

34.4 References

Building And Other Construction Workers (Regulation of Employment and Conditions of Service) **Rules 2002**

Chapter VI

Indian Standards

IS 13416 (Part 5) : 1994 Preventative measures against hazards at workplaces – Recommendations Part 5 Fire Protection

IS 1646 : 1982 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

35.0 SITE PERIMETER HOARDING

35.1 General

35.1.1 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.

35.1.2 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.

35.1.3 The Site Perimeter Fencing shall be constructed in accordance with the Specification attached as Appendix xx

35.1.4 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.

35.1.5 Wherever the fence runs adjacent to the highway with no buffer-zones then the fence shall have traffic warning lights duly affixed to it.

35.1.6 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.

35.1.7 Site perimeter fencing shall be washed at least once a month and repainted at least annually.

35.1.8 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.

35.2 References

Indian Standards

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

36.0 TRAFFIC MANAGEMENT

36.1 General

36.1.1 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.

36.1.2 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.

36.1.3 All traffic signs, barriers, cones and lighting shall be kept maintained and clean at all times.

36.1.4 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.

36.1.5 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 Employer's Representative.

36.2 Vehicle Control

36.2.1 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.

36.3 Spoil Removal

36.3.1 Only well maintained and licensed vehicles shall be allowed to be used for the removal of excavated spoil from the sites.

36.3.2 All drivers shall be medically fit and in possession of a valid and current driving licence.

36.3.3 No vehicles, which are overloaded, shall be allowed to leave the site.

36.3.4 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.

36.3.5 Vehicles exiting the site directly onto the live carriageway shall do so under the control of the clearly identified Traffic Controller.

36.3.6 Any vehicles that are required to reverse whilst on the site shall do so under the control of a trained banksman.

36.3.7 Any vehicles prior to leaving the site shall have their wheels washed and any loose material removed.

36.3.8 Any spoil that is removed from the work-sites shall be disposed of only at authorised dumping sites.

36.4 References

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

38.0 VISITORS TO SITE

38.1 General

38.1.1 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 SCHEDULES

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

Schedule 1 Sample Safety Forms:

Schedule 2 Example of Toolbox Talks

Schedule 3 Hierarchy of Safety and Industrial Health for KMRC Contracts

SCHEDULE 1

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 Employer's Representative. The Contractor is free to adapt the forms for his own use, however when the form is being used to transmit information to the Employer's Representative 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 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 List
SAF 031	Safety Training Attendance Record
SAF 032	Weekly Fire Fighting Equipment Check List
SAF 033	Scaffold Inspection Checklist
SAF 040	Contractor's Application for Approval of Safety Manager

KOLKATA METRO RAIL CORPORATION	**SAMPLE SAFETY FORM REFERENCE** :	**SAF - 001**
ACCIDENT/DANGEROUS OCCURRENCE REPORT FORM		**Accident No.**
Name of Contractor		**Contract No.**

Instructions :
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 Employer's Representative within 24 hours of the Accident.

Part A : Details of Injured Person

Name : _____ *Date of Birth* : _____ *Male* ☐ *Female* ☐

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 ☐ *Major Injury* ☐ *Minor Injury* ☐

Was the injured person sent to ; First Aid ☐ *Doctor* ☐ *Hospital* ☐ *Home* ☐

(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* _____

KOLKATA 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*** ☐ ***Female*** ☐

Address: _____ -

Job Title: _____ ***Name of Employer:*** _____

Accident: __ / __ / __ Time: _____ hrs. Location: _____

Cause of Accident

☐ ***01 Machinery*** ☐ ***05 Falling objects*** ☐ ***08 Hot or corrosive substances*** ☐ ***11 Handling goods or***
☐ ***02 Electricity*** ☐ ***06 Stepping on or Striking*** ☐ ***09 Gassing poisoning & other equipment***
☐ ***03 Hand Tool*** ***against objects*** ***toxic substances*** ☐ ***12 Transport***
☐ 04 Foreign Body in eye ☐ 07 Falls of person ☐ 10 Explosions or fires ☐ 13 Miscellaneous

Severity of Injury

☐ ***01 First Aid*** ☐ ***02 Medical Aid*** ☐ ***03 Three days or less*** ☐ ***04 Over or three days*** ☐ ***05 Discharged***
☐ 06 Detained ☐ 07 Fatal ☐ 08 Days Lost

Nature of Injury ENTER IN ORDER OF SERIOUSNESS

☐ ***01 Amputation*** ☐ ***05 Crush / Compression*** ☐ ***09 Foreign Body (eye*** ☐ ***13Sprain/Strain***
☐ ***02 Cut*** ☐ ***06 Contusion / Bruise*** ☐ ***10 Foreign Body (other)*** ☐ ***14 Inhalation / Ingestion***
☐ ***03 Location*** ☐ ***07 Fracture*** ☐ ***11 Puncture*** ☐ ***15 Concussion***
☐ 04 Abrasion ☐ 08 Dislocation ☐ 12 Scald / Burn ☐ 16 Others

Part of Body Injured ENTER IN ORDER OF SERIOUSNESS

HEAD AND SHOULDER	***TRUNK***	***UPPER EXTREMITIES***	***LOWER EXTREMITIES***
☐ ***01 Skull***	☐ ***11 Back***	☐ ***18 Shoulder***	☐ ***26 Hip / Buttock***
☐ ***02 Scalp & Forehead***	☐ ***12 Chest***	☐ ***19 Upper arm***	☐ ***27 Thigh***
☐ ***03 Eye***	☐ ***13 Abdomen***	☐ ***20 Elbow***	☐ ***28 Knee***
☐ ***04 Ear***	☐ ***14 Groin***	☐ ***21 Forearm***	☐ ***29 Shank***
☐ ***05 Nose***	☐ ***15 Respir-atory System***	☐ ***22 Wrist***	☐ ***30 Ankle***
☐ ***06 Mouth, teeth, jaw***	☐ ***16 Digestive System***	☐ ***23 Hand & Figures***	☐ ***31 Heel/sole/instep***
☐ ***07 Face & Cheek***	☐ ***17 Others***	☐ ***24 Thumb***	☐ ***32 Toes***
☐ ***08 Neck & Shoulder***		☐ ***25 Others***	☐ ***33 Others***
☐ 09 Brain	☐ 10 Others		

Unsafe Conditions

☐ ***01 Rough Slippery*** ☐ ***06 Improper dress*** ☐ ***11 Inadequate procedure*** ☐ ***14 Unsafe process or***
☐ ***02 Design effect*** ☐ ***07 Improper guard*** ☐ ***12 Inadequate aisle space job methods***
☐ ***03 Worn frayed*** ☐ ***08 Improper ventilation*** ***exists etc.,*** ☐ ***15 Overloading***
☐ ***04 No protective gear*** ☐ ***09Improper illumination*** ☐ ***13 Unsafe planning & / or layout.*** ☐ ***16 Poor House Keeping***
☐ 05 Defective protective gear ☐ 10 Improper procedure of job traffic or process operation etc. ☐ 17 No unsafe conditions

Personal Factor

☐ ***01 Attitude*** ☐ ***03 Physical Defects*** ☐ ***04Unsafe Act by another*** ☐ ***05 No unsafe personal factor***
☐ 02 Knowledge or skill person

Unsafe Act

☐ ***01 Operating without authority*** ☐ ***06 Taking unsafe position or*** ☐ ***09 Failure to use safe attire or***
☐ ***02 Failure to secure or warn/ hands instead of posture personal protective equipment***
☐ ***03 Making safety devices equipment / or equipment*** ☐ ***07 Operating or working at*** ☐ ***10Horseplay***
☐ ***04 Working on moving or unsafely*** ☐ ***08 Unsafe loading, placing,*** ☐ ***11No unsafe act dangerous Equipment mixing***
☐ ***05 Using unsafe equipment***

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: / /

KOLKATA METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE:	SAF- 003

CONTRACTORS MONTHLY ACCIDENT STATISTICS REPORT

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* $= \left\{ \frac{[(3) + (4)]}{(1)} \right\} \times 100{,}000 =$ *Accident Frequency Rate*		
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 Employer's Representative within 5 days after the end of each month.

KOLKATA METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE:	SAF - 004

CONTRACTORS MONTHLY SAFETY REPORT

NAME OF CONTRACTOR	CONTRACT NO.

This report which shall be submitted to the Employer's Representative within five days of the end of each month consists of two sections; Part A. and Part B.

PART A Accident Statistics

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.

PART B Safety Activities

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:
    - 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.

KOLKATA 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 _____

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.

THIS PERMIT ONLY VALID FOR THE PERIOD SPECIFIED, WHICH MUST NOT EXCEED 24 HOURS

Date: _____ Time of Issue: _____ Date: _____ Time of Expiry _____

Signed _____ _____ Being the Authorised Person (Confined Spaces)

PART 2. RECEIPT

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.

Signed _____ Time _____ Date _____

Being the Competent Person (Confined Spaces)

PART 3. CLEARANCE CERTIFICATE

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 deatiled above, and that all gear, tools and other equipment have been removed.

Signed _____Time _____ Date _____

Being the Competent Person (Confined Spaces)

PART 4. CANCELLATION

I acknowledge receipt of the clearance of the Permit

THIS PERMIT IS NOW CANCELLED

Signed _____

Being the Authorized Person (Confined Spaces)

Time _____ Date _____

KOLKATA METRO RAIL CORPORATION	**SAMPLE SAFETY FORM REFERENCE** :	**SAF – 011**
PERMIT TO WORK – ELECTRICAL		
Name of Contractor		**Contract No.**

*PERMIT NO. E:*_____ *Date* _____

Part 1 : Issue

Issue to _____

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 } _____

The apparatus is efficiently connected to earth
At the following points } _____

All other apparatus is dangerous

The following is the work to be carried out on the
Apparatus. } _____

Caution Notices are posted at _____

Special Keys required for access to enclosures

Special Precautions to be taken _____

This permit is valid only for the specified period which must not exceed 24 hours

Signed _____ being an Authorized Person

Possessing authority to issue a Permit for the work specified above.

Time of issue _____ Date _____ Time of Enquiry _____

Part 2 : Receipt

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 aparatus.

Signed _____ Time _____ Date _____

Part 3 : Clearance Certificate

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.

I acknowlede return of authorised Key Nos _____

Signature of person responsible for issue of permit _____

Time _____ Date _____

KOLKATA 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 precuations 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 _____

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

KOLKATA METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE:	SAF - 021

HAZARDOUS SUBSTANCES TO BE USED ON SITE

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

							SPECIFY:
1	☐	Cement	24	☐	Epoxy Cleaners	47	☐ _____
2	☐	Lime	25	☐	Butyl Mastic Sealants	48	☐ _____
3	☐	Plaster	26	☐	Acrylic Sealants	49	☐ _____
4	☐	Artex	27	☐	Mastic Primers	50	☐ _____
5	☐	Sand	28	☐	Mastic Solvents	51	☐ _____
6	☐	Aggregates	29	☐	Elastomeric Sealants	52	☐ _____
7	☐	Plasticisers	30	☐	Elastomeric Primers	53	☐ _____
8	☐	Retarders	31	☐	Elastomeric Solvents	54	☐ _____
9	☐	Rapid Hardeners	32	☐	Hot Mastic Sealants	55	☐ _____
10	☐	Colouring / Mortar	33	☐	Bitumastics	56	☐ _____
11	☐	Curing Agents	34	☐	Coated Road Stone	57	☐ _____
12	☐	Rapid	35	☐	Contact Adhesives	58	☐ _____
13	☐	Diesel / Gas Oil	36	☐	Contact Solvents	59	☐ _____
14	☐	Engine Oils	37	☐	Softwoods	60	☐ _____
15	☐	Hydraulic Oils	38	☐	Hardwoods		
16	☐	Shutter Oils	39	☐	Fibreboards		
17	☐	Greases	40	☐	Paints / Primers		
18	☐	Pipe Lubricants	41	☐	Paint Solvents		
19	☐	Epoxy Mortars	42	☐	Brush Cleaners		
20	☐	Epoxy Adhesives	43	☐	Bleaches		
21	☐	Epoxy Sealands	44	☐	Brick Cleaner		
22	☐	Epoxy Primers	45	☐	Concrete Cleaner		
23	☐	Epoxy Solvents	46	☐	Liquified Petroleum Gas		

Completed by: Sign: Name: Title: Date: / /

(☐ - TICK AS APPLICABLE)

KOLKATA METRO RAIL CORPORATION	**SAMPLE SAFETY FORM REFERENCE :**	**SAF - 030**

SITE SAFETY AND EMERGENCY STAND BY NAME LIST

Name of Contractor	**Contract No.**

The following persons have been appointed to be our representatives on site for all site safety emergencies.

Name of Representative	***Position***	***Office Tel. No.***	***Home Tel. No.***	***Mobile No.***

Project Manager Name

Signature Date

KOLKATA 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.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			

CONFIRMED AS CORRECT BY:

SIGNATURE:_____SAFETY MANAGER DATE / /

SIGNATURE:_____PROJECT MANAGER DATE / /

KOLKATA METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE:	SAF - 032

WEEKLY FIRE FIGHTING EQUIPMENT CHECK

NAME OF CONTRACTOR | **CONTRACT NO**

SITE / LOCATION | **DATE OF CHECK / /**

FIRE POINT NUMBER	EXTINGUISHERS IN GOOD ORDER		ACCESS TO EXTINGUISHERS		SIGNAGE	
	YES	NO	CLEAR	OBSTRUCTED	CORRECT	INCORRECT

COMMENTS:

CHECK CARRIED OUT BY:

NAME : ***SIGNATURE*** ***POSITION*** ***DATE: / /***

KOLKATA METRO RAIL CORPORATION	SAMPLE SAFETY FORM REFERENCE :	SAF - 033

SCAFFOLD INSPECTION CHECKLIST

NAME OF CONTRACTOR:	CONTRACT No.	DATE: / /

Work commencement – Date _____/_____/_____

Location and description of scaffold, etc. and other plant or equipment inspected 1	Date of Inspection 2	Result of inspection State whether in good order 3	Signature of person who made the inspection 4

SHORT CHECK LIST – ATTACH INSPECTION CHECK THAT YOUR SCAFFOLDING DOES NOT HAVE FAULTS

		Week 1	2	3	4
FOOTING	Uneven				
	No base				
	No sole boards				
	Undermined				
STANDARDS	Not plumb				
	Jointed at same Height				
	Wrong Spacing				
	Damaged				
	Not level				
	Joint in same bays				
	Loose				
	Damaged				

		Week 1	2	3	4
RACING	Some missing				
FAÇADE &	Loose				
LEDGER	Wrong Fittings				
PUTLOGS	Wrongly Spaced				
AND	Loose				
TRANSOMS	Wrongly Supported				
COUPLINGS	Wrong fitting				
	Loose				
	Damaged				
	No check couplers				
	Wrong Spacing				
	Wrong couplings				
	Weak Support				

		Week 1	2	3	4
TILES	Some missing				
	Loose				
BOARDING	Bad boards				
	Trap Boards				
	Incomplete				
	Insufficient				
	Supports				
GUARDS	Wrong Height				
RAILS &	Loose				
TOE BOARDS	Some Missing				
LADDERS	Damaged				
	Insufficient Length				
	Not tied				

SIGNATURE _____ NAME _____ DATE / /

KOLKATA METRO RAIL CORPORATION	**SAMPLE SAFETY FORM REFERENCE:**	**SAF - 040**
CONTRACTOR'S APPLICATION FOR SAFETY OFFICERTO WORK *FOR CONTRACT.....*		
NAME OF CONTRACTOR	**CONTRACT No.**	

GENERAL PARTICULARS

Name :_____

(In Block Capitals)

Date of Birth

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

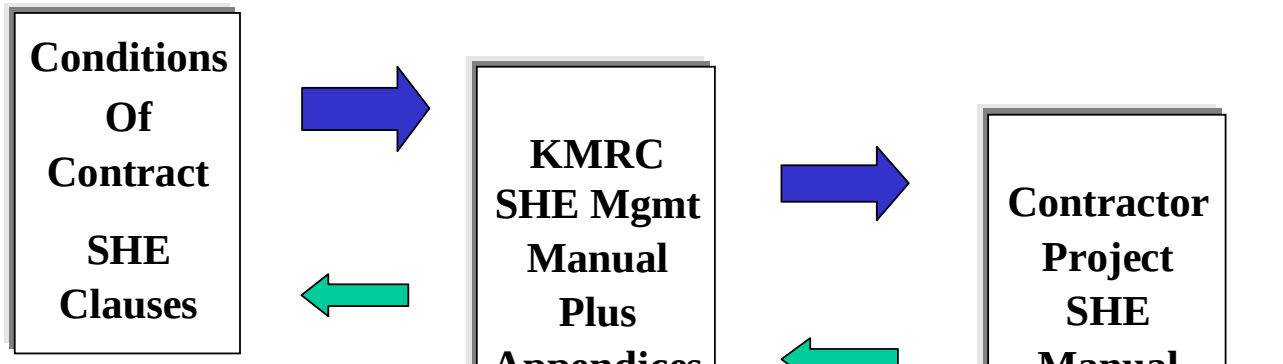
KOLKATA METRO RAIL CORPORATION	TOOL BOX TALK NO 1

PERSONAL POINTS

- Never take chances.
- Carry out the instructions you have been given.
- If you do not know or understand - Ask.
- If you see on 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 KMRC CONTRACTORS



Enforceable
With Financial Implications

Code of Practice
Enforceable through Conditions of Contract

Contractor Implementation Manual
For - Contractors and Employer's Rep.

KOLKATA METRO RAIL CORPORATION LIMITED

EAST WEST CORRIDOR PROJECT
SAFETY HEALTH AND ENVIRONMENTAL MANUAL

PART - 2

Policy and Procedures

Part 2 – Environmental and Health

(August 2009)

STATEMENT OF INTENT

The Kolkata Metro Rail Corporation 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 KMRC to demonstrate continual improvement in its environmental management system during construction of the underground phase of the East West Corridor.

This manual represents the minimum standards that the Kolkata Metro Rail Corporation 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 Kolkata 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.

(Sumantra Choudhury)
Managing Director/KMRC

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TABLE OF CONTENTS

ENVIRONMENTAL MANAGEMENT MANUAL
(Refer Employer's Requirements on Environment)

1.0 INTRODUCTION

1.1 This Environmental Management Manual (EMM) forms an essential part of the overall Environmental protection system employed by KMRC for the construction of Kolkata East West Corridor project.

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 Kolkata Metro Rail Corporation 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 KMRC 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 mach 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 employer may under take 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

2.0 PURPOSE & SCOPE

2.1 The purpose of this Environmental Management Manual (EMM) is to make the Contractors aware of the environmental concerns of KMRC, 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 KMRC '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

3.0 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 KMRC, which will enable it to manage the environmental challenges and resolve environmental issues posed during construction of East West Corridor Project, Kolkata.

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.

4.0 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 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 KMRC contract for East West Corridor Project, Kolkata.

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 $\mu g/m^3$(microgram per cubic meter)

4.34 **Suspended Particulate Matter** is abbreviated as SPM and measured in µg/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 **West Bengal Pollution Control Board** (WBPCB).

5.0 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 employer

5.3 Reporting to the Employer, 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 Employer for resolution of environmental issues.

6.0 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 Employer 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 subcontractors 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. (Refer clause 12 (a) of Employer's Requirement on Environment).

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 docuement, to control environmental pollution. Elements of the plan must address the management of pollution, the monitoring programme, and the reporting requirements.

7.0 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 Employer.

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.

8.0 ENVIRONMENTAL PERFORMANCE REVIEWS

8.1 Environmental Performance Reviews, through an Environmental Audit Programme, may be carried out quarterly by the employer 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 Employer 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 is 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 Employer 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 Employer will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures as defined in this manual. Environmental Performance Reviews, through an Environmental Audit Programme, may be carried out quarterly by the employer to assess the effectiveness of the Site Environmental Plan, and

that the required mitigation measures are routinely implemented and environmental standards are maintained.

8.8 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.

8.9 The reviews by Employer shall focus on the effectiveness of the implemented measures to achieve the purpose not simply the fact that a measure has been implemented.

8.10 The Employer will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures as defined in this manual. Environmental Performance Reviews, through an Environmental Audit Programme, may be carried out quarterly by the employer to assess the effectiveness of the Site Environmental Plan, and that the required mitigation measures are routinely implemented and environmental standards are maintained.

8.11 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.

8.12 The reviews by Employer shall focus on the effectiveness of the implemented measures to achieve the purpose not simply the fact that a measure has been implemented.

8.13 In such reviews, demonstrable evidence on the part of the environmental requirements will be sought.

8.14 The Contractor shall carry out daily, environment inspection of his works and submit a weekly report as per format for reporting is suggested as Appendix – II.

8.15 The Contractor shall ensure that his weekly/monthly environmental reports and mandating audits are linked to respective previous submission. The Employer 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.

8.16 The Employer will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures as defined in this manual.

9.0 ENVIRONMENTAL FRIENDLY CONSTRUCTION PRACTICES

9.1 Containment of Air Pollution

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 in the drawings.

(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 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. 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 $20m^3$ 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 Employer 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 Pollution

(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.

(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 (July 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 tunnels under construction should be discharged into strorm drains after the removal of silt in silt removal facilities.

(o) 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.

(p) 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.

(q) 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 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 Employer 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) It is estimated that construction activities used generate 2.5mm^3 of soil, majority of which will 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 the same to the Employer.

(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 English and Hindi as to the contents, quantity and safe method of disposal in accordance with instructions contained in 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.

(iv) Disposal of chemical waste should be via a licensed waste collector; duly authorized by MOEF or West Bengal State Pollution Control Board as the case may be. License of the waste collector shall be shown to the employer on demand.

(v) 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.

(vi) The Contractor should have a point of contract that will maintain the above information and conduct periodic inspections.

(vii) 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 & Handing) 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.

(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.

(iv) For disposal of waste requiring special attention and hazardous waste the contractor shall enter into agreement with authorised agencies dealing with the same.

(v) The environmentally hazardous waste shall be stored on an impermeable surface with containment bunding to retain leaks, spills and ruptures.

(vi) 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.

(vii) 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 Hindi 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.

(g) 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 Municipal Corporation of Kolkata 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 - I. 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

(vii) 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.

(viii) 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.

(ix) 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.

(h) Reuse and Recycle

(i) Some good quality reusable topsoil is expected from site clearance works across agricultural land over the banks of Yamuna River. This can be locally 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. The excavated material may have to be temporarily stockpiled on-site for subsequent re-use.

(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.

(k) 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 on request.

(l) 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 reposible for the separation of the waste and information regarding waste separation shall be posted at appropriate locations around the site.

10.0 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 House keeping 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 buts, 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, for which these are available to the Employer 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 of shall not be allowed to stagnate at work sites specially at construction depots and batching plant locations, by executing and 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 breading;
(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 Hindi and English which draw attention to the dangers of permitting mosquito breeding shall be displayed prominently on the site.

11.0 LANDSACPE 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 seen 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 tress. 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. Some such species are give in Table –2 for guidance.

Table – 2
Recommended species for Plantation and Landscaping

S.No.	Botanical Name	Common Name
A.	**TREES**	
1.	Bambosa goldiana	Golden Bamboo
2.	Bauhinia blackiana	Kachnar
3.	Cassia renigera	Pink Cassia
4.	Ficus regionald (Topiart)	RegionalD
5.	Ficus retusa	Retusa
B.	**PALMS**	
1.	Areca leutescens	Areca Palm
2.	Cycus Revoluta	Cycus
3.	Oreodoxa Regia	Royal Palm/Bottle Palm
4.	Phoenix palm	Date Palm
5.	Rhapihis palm	Rhaphis Palm
C.	**GROUND COVER**	
1.	Asparagu sprengeril	Asparagus
2.	Chlorophytum comosum	Chlorophythum
3.	Duranta goldeana	Golden Duranta
4.	Iresin herbestii	Lal Sag
5.	Lantana alba	White Lanta

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 Kolkata 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 hi 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 sucrose of power or provide a solution that is acceptable to the employer. This may include but not limited to providing appropriate cladding for the stack.

12.0 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.

13.0 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 metro rail.

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 Employer 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 2m 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.

14.0 ARCHAEOLOGICAL AND HISTORIC RESOURCES

14.1 During the construction period, archaeological or historic resources may potentially be affected by direct or indirect construction activity.

14.2 Prior to the initiation of construction KMRC intends to 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).

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 and KMRC shall determine how to proceed.

15.0 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 Employer.

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 site of not less than $1.1m^3$/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.

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 employer 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 employer, 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 Employer
Duration of Monitoring by Contractor	During Civil Construction	During Civil Construction	
Additional Monitoring	As directed by the Employer	As directed by the employer.	

16.0 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 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 Employer 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 Employer.

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 Employer 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 Employer additional measurements are required in view of deteriorating air quality;

Then, the Employer's Representative 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 Employer. 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 Employer determines that the recorded SPM level is significantly greater than the Limit levels, the Employer 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.

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

17.0 NOISE MONITORING

17.1 The activities which are expected to cause noise during the construction of East West Corridor Project, Kolkata include noise from construction equipment, construction activities such as portal construction, earthwork excavation, concreting, viaduct construction 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 Employer 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 (Leq) 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 L90 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.

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	Night Time
	75	65
		At all Times
Commercial		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.

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

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 additional measurements are required in view of deteriorating noise environment,

then, the Employer 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.

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

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

Distance (Feet)	Level to Estimate Sound Level at 50 Feet dB (A)
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

17.17 The Contractor shall inform the Employer 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 Employer determines that the recorded Noise level is significantly greater than the acceptable levels, the Employer 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. 6 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 provide 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.

$F_e = (T_1/L_1) + (T_2/T_2) + \ldots + (T_n/L_n)$ where:

F_e= The equivalent nose 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 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:

11db A 1/4 hour.
100 db A1/2 hour.
90 db A 1/2 hours.

Then,

Fe = (1/41/2) +(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 permit 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.

18.0 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 Employer 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 Employer 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 Employer shall also carry out Ad hoc site inspection which shall be attended by Contractor's Representative.

19.0 ENVIRONMENTAL AUDITS

19.1 As indicated earlier in this Manual, the Employer 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.

20.0 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.

21.0 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 is likely to be received by KMRC , 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 Employer.

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 Employer 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.

22.0 COMPLETION OF THE EMM PROGRAMME

22.1 The construction of Kolkata East West Project will be undertaken as a series of individual construction contracts with necessarily different construction programme and completion dates.

22.2 The Employer 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 KMRC '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)	
(v)	Procedure is available for Contractor's system of enforcing good environmental practices of its Sub-contractor.
(vi)	The Site Environmental Plan contains procedures for screening material used in the contract, for their environmental friendliness.
2	**ENVIRONMENTAL FRIENDLY CONSTRUCTION PRACTICES**
	The Site Environmental Plan must contain specific procedures for achieving environmental performance requirements as given in the Employer's requirement on Environment and KMRC Environmental Management Manual.
(i)	Procedures for carrying out Aspect/Impact analysis of contractor's proposed works and their affect on environment.
(ii)	Procedures for setting up Objectives and Targets commensurate with Employer's requirement on Environment and KMRC Environmental Management Manual and how these shall be met.
(iii)	Procedures for formulating Environmental Management Plans and Operational Control Procedures to meet contractual requirements.
(iv)	Procedures for offering environmental training and methods for promoting environmental awareness amongst his employees.
(v)	The SEP must contain details on Air Monitoring and Control Plan which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.
(vi)	The SEP must contain details on Noise Monitoring and Control Plan which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.
(vii)	The SEP must contain procedures on prevention and control of water pollution from sanitary surface runoff and process wastewater.
(viii)	The SEP must contain details on procedures for Storage, handling and disposal of waste including, municipal, construction, chemical and hazardous wastes.
(ix)	The SEP must contain procedures for reuse/recycle of waste, selling to authorised recyclers and records thereof.
(x)	The SEP must contain procedures for preservation of landscape disturbed due to construction, house keeping and traffic management as required under the contract.
(xi)	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 Employer.
(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 contain 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 KMRC required in the following:
(i)
(ii)
(iii)

5. Complaints received in the past week.

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

Auditor: Project Manager

Contract Number: Contractor:

Weekly Environmental Inspection

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

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

SL. NO.	ITEM	OBSERVATION	REMARKS	ACTION	
				By Date	By whom
2.1	**Site Drains**	❑ storage of refuse/ excavate muck not near the drains			
2.2	**Adjacent Drains**	❑ Not damaged ❑ No signs of pouring bentonite ❑ No signs of pouring Chemicals ❑ Signs of discharging Silt/ debris			
2.3	**Separator Tanks**	❑Tank not full of silt ❑ Tank regularly emptied ❑			
3.0	**NOISE POLLUTION**				
3.1	**Noise control measures**	❑ All powered mechanical equipments are sound reduced ❑ Acoustic / enclosures constructed in areas of excessive noise ❑ Equipment located and directed away from noise receptors ❑			
3.2	**Generators Provided with acoustic enclosures**	❑ Effective ❑ Not effective ❑ Not provided ❑			
3.3	**Noise Monitoring**	❑ Carried out as per contract ❑ Not exceeded baseline values ❑ Remedial measures in place ❑ Results evaluated statistically for inclusion in Monthly repot ❑			
4.0	**WASTE MANAGEMENT**				
4.1	**Waste Identified**	❑ Chemical Flammable Corrosive Construction related/ oil/ Filters/ Batteries ❑ Hazardous ❑ Other (Specify) ❑			
4.2	**Storage Containers & Bins**	❑ Adequate number and properly place ❑ Proper quality ❑ Emptied regularly ❑ Labeling proper ❑ No spillage on container surface noticed			

SL. NO.	ITEM	OBSERVATION	REMARKS	ACTION	
				By Date	By whom
4.2	**Storage Containers & Bins**	❑ Pollutants (e.g. waste chemical), not dumped in bins ❑ Recyclable (e.g. metal) not dumped in garbage bins ❑			
4.3	**Oil Waste**	❑ Drip pans available ❑ No oil stains on ground ❑ Spill absorption material available ❑ Waste oil poured in to designated waste drums ❑ Used oil filters not dumped in garbage bins ❑			
4.4	**Excavate/Muck**	❑ Storage satisfactory/ properly secured ❑ Dumping in authorized areas ❑ No interference with nearby drainage			
5.0	**STORAGE**				
5.1	**Diesel Storage**	❑ Extensive diesel spillage on ground not visible ❑ Drip pans used when pumping diesel ❑ Pipes / connectors/ pumps not leaking ❑ Not located close to storm water drains ❑ transfer arrangement satisfactory			
6.	**AESTHETICS & CLEANLINESS**				
6.1	**Housekeeping & Hygiene**	❑ Designated storage area for materials ❑ Scraps/brickbats/rubbish scattered at site ❑ Proper space for handling waste ❑ Area Clean and dry ❑ Stagnant water treated weekly ❑ Proper stacking of drums ❑ Barricades are clean, in line, firmly secured and proper earthling ❑ Water not allowed to accumulate in work area for any reason ❑			

SL. NO.	ITEM	OBSERVATION	REMARKS	ACTION	
				By Date	By whom
7.0	**ROADS**				
7.1	Access Roads	☐ Satisfactory Maintenance ☐ In urgent need of Maintenance			
7.2	Public Roads used by Contractor	☐ Satisfactory maintenance ☐ Repair not carried out			

WEEKLY ENVIRONMENTAL AUDIT

AUDIT No. : **WEEK ENDING :**

PROGRESS IN THE LAST WEEK:

PLANNING /GOALS FOR THE NEXT WEEK:

Environmental Manager	**Project Director**	**Document No.:**

APPENDIX - III - DETAILS ON FLY ASH

The Employer 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 Employer.

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 Employer, on a monthly basis)

F2.1 Process Emission from daily production records
- Quantity of calicareous 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

KMRC

KOLKATA METRO RAIL CORPORATION LIMITED

SCHEDULE OF DIMENSIONS

FOR

STANDARD GAUGE (1435 mm)

DRAFT February, 2015
(To be submitted to Ministry of Railways for approval)

KOLKATA METRO RAIL CORPORATION LIMITED
KMRC BHAWAN (2ND & 3RD FLOOR), HRBC COMPLEX,
MUNSHI PREMCHAND SARANI,
KOLKATA 700 021
INDIA

SCHEDULE OF DIMENSIONS (STANDARD GAUGE, 1435 mm)

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KOLKATA METRO EAST WEST LINE PROJECT

SCHEDULE OF DIMENSIONS – 1435 mm GAUGE

PREAMBLE

The Schedule of Dimensions for Standard Gauge with third rail traction system for Kolkata East West Metro line has been prepared based on the following:-

i. The dimensions given in this Schedule of Dimensions are to be observed in all works on 1435 mm gauge.

ii. The kinetic envelop have been developed for the 2880 mm wide and 3873 mm high rolling stock, based on the kinematic envelop calculations. The track and vehicle maintenance shall conform to the tolerances indicated therein during period of these stocks are in operation.

iii. The clearances are based on the assumption that windows are sealed and doors are closed during movement/ operation.

iv. Track shall be maintained to the tolerances taken for calculation of kinetic envelop.

v. The structure gauge indicated in the SOD shall not be violated under any circumstances except for platform coping, third rail arrangement and platform screen door.

vi. The kinematic envelop indicated in the SOD shall not be violated under any circumstances.

vii. The vehicle kinematic envelop of 50kmph shall be applied only within the confines of the stations. At all other locations, the full 80kmph envelop shall be used for determining the structure gauge and electrical clearances.

viii. Maximum operating speed at platform shall be 50kmph and kinematic envelop will not be infringed under any circumstances.

INTRODUCTION

1. This Schedule of Dimensions is applicable to Underground, Elevated and Surface (At-Grade) sections with 750 Volt D.C. Traction system and third rail for current collection adjacent to the track.

2. The Underground system may run within a Circular Tunnel or Rectangular Box or any other suitable shape while Elevated system may run on suitable Over Ground structures such as Viaducts. Both Underground and Elevated systems shall have suitably designed Ballastless (DFF) Track. The At-grade system may have Ballasted Track, or if necessary, Ballastless track.

3. No fixed structure should infringe the structure gauge except for designated railway operational structures. Designated railway operational structures include platform edges, platform screen doors, emergency walkways, Third rail arrangements.

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

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

CHAPTER-1 GENERAL

1.1 SPACING OF TRACKS

1.1.1 Minimum distance, between centre to centre of tracks on Tangent (Straight) alignment, without any structure located between the tracks, shall be:

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

Note: For minimum track centres on curves, refer to Appendix-1

1.2 CURVES

1.2.1 Minimum radius of curves (horizontal)

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

Note: For curves of radius less than 190 m in mainline, check rails to be provided.

1.2.2 Minimum radius of vertical curve 1500 m

Note: No vertical curve is permitted/ allowed in station area.

1.2.3	i)	Maximum permissible cant	125 mm
	ii)	Maximum permissible cant deficiency	100 mm

1.3 BUILDINGS AND STRUCTURES

1.3.1 Minimum horizontal distance from centre of track to any structure (except a passenger platform and Conductor Rail (Third Rail) for heights above rail level on tangent track on level/constant grade shall be as under:

a) Underground Sections (Circular Tunnel and Rectangular Box Tunnel)

	Height from rail level	Distance from C.L. of track
(i)	Up to 75 mm	1670 mm increasing to 1705 mm
(ii)	75 mm to 920 mm	1705 mm
(iii)	920 mm to 1765 mm	1705 mm increasing to 1770 mm
(iv)	1765 mm to 3150 mm	1770 mm increasing to 1805 mm
(v)	3150 mm to 3550 mm	1805 mm decreasing to 1450 mm
(vi)	3550 mm to 3975 mm	1450 mm decreasing to 610 mm
(vii)	3975 mm	610 mm decreasing to zero

Also refer to Figure No.2 (TNL)

b) Elevated Sections, At-Grade (Ballastless Track) Sections

	Height from rail level	Distance from C.L. of track
(i)	From R.L. to 360 mm	1755 mm
(ii)	At 360 mm	1755 mm decreasing to 1650 mm
(iii)	360 mm to 960 mm	1650 mm increasing to 1760 mm
(iv)	960 mm to 1760 mm	1760 mm increasing to 1820 mm
(v)	1760 mm to 3090 mm	1820 mm increasing to 1855 mm
(vi)	3090 mm to 3555 mm	1855 mm decreasing to 1560 mm
(vii)	3555 mm to 4025 mm	1560 mm decreasing to 610 mm
(viii)	At 4025 mm	610 mm decreasing to zero

Also refer to Figure No.2 (ELE/AG)

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

	Height from rail level	Distance from C.L. of track
(i)	From R.L to 88 mm	1765 mm
(ii)	At 88mm	1765 mm increasing to 1880 mm

(iii)	From 88 to 3085 mm	1880 mm
(iv)	3085 mm to 3515 mm	1880 mm decreasing to 1585 mm
(v)	3515 mm to 4035 mm	1585 mm decreasing to 505 mm
(vi)	At 4035 mm	505 mm decreasing to zero

Also refer to Figure No.2 (AG)

Notes for a), b) and c) of Para 1.3 above:

i) Extra allowance shall be provided for curves as laid down at para 1.6.

ii) The term 'structure' covers any item including light ones like ladders, isolated posts, cables etc. erected alongside the track.

1.4 KINEMATIC ENVELOPE

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

a) Figure No. 1(TNL/AG/ ELE) for Underground, At-Grade and Elevated Sections with Ballastless Track.

b) Figure No. 1(AG) for Surface (At-Grade) Sections with Ballasted Track.

1.5 STRUCTURE GAUGE

1.5.1 Underground sections

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

Refer to Figure No.2 (TNL) for Structure Gauge for underground sections (Outside station) with Ballastless Track for level constant grade tangent track.

Note: Extra allowance shall be provided for curves as laid down at para 1.6

1.5.2 Elevated Sections and Surface (At-Grade) section with Ballastless track.

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

Refer to Figure No.2 (ELE/AG) for Structure Gauge on Elevated Sections and At-Grade Sections (outside station) with Ballastless Track for level/constant grade tangent track.

Note: Extra allowance shall be provided for curves as laid down at para 1.6

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

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

Refer to Figure No.2 (AG) for Structure Gauge on At-Grade sections (outside stations) with Ballasted Track for level/constant grade tangent track.

Note: Extra allowance shall be provided for curves as laid down at para 1.6

1.6 EXTRA CLEARANCES ON CURVES

Following are the extra allowances considered for curves.

Abbreviations used in para 1.6:

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

1.6.1 Inside of curve

(A) Curvature effect

i) Mid throw at the center of the vehicle = V (in mm)

$= 125 \times C^2/R$

ii) Allowance due to gauge widening on curves

For values of curvature effect, refer to:

Appendix-2(TNL/ELE/AG) for Underground, Elevated/At Grade Ballastless Sections

Appendix-2(AG) for surface (At-Grade) Ballasted Sections

Note:

a) Underground , Elevated and At-Grade Ballastless Sections

A lateral shift of 34 mm due to nosing is included in the Kinematic Envelope for Underground, Elevated and At-Grade Sections with Ballastless Track for tangent track (and as a result, also included in Structure Gauge) which shall be subtracted

from the total extra allowance worked out as at para 1.6.1(A) above if the value of mid throw (V) is equal to or greater than 34 mm. However, if the value of mid throw (V) is less than 34 mm, the curvature effect shall be due to widening of the gauge only (Mid throw minus 34 mm shall be taken as zero).

b) At-Grade (Surface) Ballasted Sections

A lateral shift of 37 mm due to nosing is included in the Kinematic Envelope for Surface (At-Grade) Sections with Ballasted Track for tangent track (and as a result, also included in Structure Gauge) which shall be subtracted from the total extra allowance worked out as at para 1.6.1(A) above if the value of mid throw (V) is equal to or greater than 37 mm. However, if the value of mid throw (V) is less than 37 mm, the curvature effect shall be due to widening of the gauge only (Mid throw minus 37 mm shall be taken as zero).

(B) Allowance for Cant

a) Underground (Box structures) Elevated and At-Grade (Surface) sections

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

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

For values of Structure Gauge (E_1) for inside of a curve with only the cant effect, as shown in Figure 4, refer to:

(i) Appendix -3(TNL) for Box structures of Underground Sections

(ii) Appendix -3(ELE/AG) for Elevated and At Grade Ballastless Sections

(iii) Appendix -3(AG) for Surface (At-Grade) Ballasted Sections

b) Circular Tunnels

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

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

(C) Vertical Throw (allowance for vertical curve)

Values of Vertical Throw V_1 and V_2 (in mm) for vertical curves shall be calculated as under:

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

V_2 (with vehicle centre on summit or vehicle end in sag) = $\left[125\frac{C_1^{\ 2}}{R}\right]-\left[125\frac{C^2}{R}\right]$

Value of Vertical Throw, V_1 & V_2 due to vertical curves of different radii are shown in Figure 5.

1.6.2 OUTSIDE OF CURVE

(A) Curvature effect

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

= $[125xC_1^2/R]-[125xC^2/R]$

(ii) Allowance due to gauge widening on curves

(iii) Additional nosing due to gauge widening on curves

The values of items (i) to (iii) are shown in Appendix-2(TNL/ELE/AG) and 2(AG).

(B) Allowance for Cant

a) <u>Elevated, Surface and box sections of Underground</u>

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

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

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

<u>Note</u>:

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

For values of Structure Gauge (F_1) on outside of curve with cant effect only as shown in Figure-4, refer to:

(i) Appendix 3(TNL) for Underground sections(Rectangular Box)

(ii) Appendix 3(ELE/AG) for Elevated and At-Grade Ballastless sections.

(iii) Appendix 3(AG) for Surface (At-Grade) Ballasted sections

b) Circular Tunnels

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

For values of horizontal and vertical shifts of centre of Circular Tunnel for different values of cant, refer to Appendix-4 (TNL) and Figure-3.

(C) Allowance for Vertical Curve (Vertical Throw)

The provision at para 1.6.1 (c) above shall be applicable in this case also. Values of vertical throw V_1 and V_2 due to vertical curves of different radii are shown in Figure 5.

1.7 MINIMUM TRACK SPACING ON CURVES

Underground, Elevated and Surface Sections

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

1.7.1 Without any structure between tracks

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

(i) (E + F),

(ii) T_1 (Extra lateral allowance due to curvature on inside of curve)

(iii) T_2 (Extra lateral allowance due to curvature on outside of curve)

(iv) Minimum clearance between adjacent Kinematic Envelopes stipulated as under:

a) 200 mm for Underground Sections

b) 300 mm for Elevated Sections

c) 300 mm for Surface (At-Grade) Sections and

Where,

E is the distance from vertical axis of centre line of tangent track to canted Kinematic Envelope on inside of curve at a height 'h' (from rail level) for a given cant (Figure-4A) and

F is the distance from vertical axis of centre line of tangent track to canted Kinematic Envelope on outside of curve at a height 'h' (from rail level) for a given cant (Figure-4A).

Notes:

a) The value of 'F', calculated from the formula at Figure -4A includes full relief due to Cant.

b) The sum of 'E' and 'F' for same height (which are with cant effect only), shall be the maximum of values calculated for various heights from rail level.

1.7.1.1 For values of E, F, T_1 and T_2, refer to the Appendices as shown below:

	SECTIONS	For E & F	For T_1 &T_2
(i)	UG, Elevated, At-Grade BLT	3A(TNL/ELE/AG)	2(TNL/ELE/AG)
(ii)	Surface (At-Grade)Ballasted	3A(AG)	2(AG)

1.7.2 With a structure between adjacent tracks

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

(i) **(E_1 +T_1)** Minimum clearance to the structure from centre line of track on inside of curve (for outer track)

(ii) **(F_1 +T_2)** Minimum clearance to the structure from centre line of track on outside of curve (for inner track)

(iii) Width of structure between adjacent tracks (measured across the tracks).

Where,

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

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

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

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

Notes:

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

b) Minimum track spacing, so worked out with a structure between the adjacent tracks shall not be less than that calculated as per para 1.7.1 for tracks without any structure between adjacent tracks.

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

	SECTIONS	E_1 & F_1	T_1 & T_2
(i)	Underground	3(TNL)	2(TNL/ELE/AG)
(ii)	Elevated & At Grade BLT	3(ELE/AG)	2(TNL/ELE/AG)
(iii)	At Grade Ballasted	3(AG)	2(AG)

1.8 SPECIAL OPERATING CONDITIONS (COMMON FOR UNDERGROUND, ELEVATED AND AT-GRADE)

i. In case of At-grade and elevated section, the track is expected to be laid on the surface and passing through populated areas and there are chances of people passing through the track. To prevent the access to the track by general public, stray, cattle and other animals from adjacent areas, all at–grade/ elevated sections will be robustly fenced to prevent any untoward incident due to 750 volts DC traction system with third rail current collection and track rail return current.

ii. Schedule maintenance of permanent way will be performed outside service hours only.

iii. As the track is open to the climate, temperature variation will take place in the track which may require patrolling/ inspection of the section during extreme winter and summer. For this purpose, provision shall be made for visual inspection from the walkways on the outside of each track, permitting safe walking for patrolmen during service hours.

iv. In view of chances of collision of derailed train with the train coming from other direction, adequate measures shall be taken to restrict lateral movement of derailed vehicles on elevated/ at-grade structures. Proper communication facilities should also be available at the stations.

v. All the passenger coaches will be provided with sealed windows including the cab, to prevent limbs and heads of passengers projecting outside the train. The passenger coaches will be provided with automatic remote controlled double leaf doors with their control from drivers cab. Until all doors are proved closed, it will not be possible to start the train. Likewise until the train come to the stop, it will not be possible to energize the door opening circuits.

vi. The rail corridor when fully functional will not have way side signalling as train protection will be by ATP. However, in the initial period, till cab signalling system is fully commissioned, there will be way side signalling which should be so located near the masts that proper visibility is ensured considering the alignment.

vii. The speed of trains shall be restricted to 30kmph when wind speed is more than 80kmph but less than 90kmph. When wind speed exceeds 90kmph, the train movement shall be halted.

viii. The way side signalling wherever provided on temporary or permanent basis will be so located that proper visibility to the driver is ensured. No workmen/ equipment are allowed between vehicle and structure gauge during operation of train.

1.8.1 Scheduled maintenance of permanent wayside assets such as track, signalling, traction equipment etc shall be performed outside service hour only.

1.8.2 No workman/equipment/structure are allowed between vehicle and structure gauge during operation of trains.

1.8.3 At stations provided with Platform Screen Door the maximum operating speed for any train entering, leaving or passing through the station shall be limited to 50 kmph.

1.8.4 In view of chances of collision of derailed train with train coming from other direction, adequate measures shall be taken to restrict lateral movement of derailed vehicles on elevated/at-grade structures. Proper communication facilities should also be available at the station.

1.9 ADDITIONAL OPERATING CONDITION FOR ELEVATED AND AT GRADE SECTION.

1.9.1 In case of elevated corridor, the track is expected to be on the surface at some locations passing through populated areas and there are chances of people passing through the track.

Considering this fact to prevent the access to the track by general public, stray, cattle and other animals from the adjacent areas, all at-grade/elevated sections shall be robustly fenced.

1.9.2 As the track will be open to climate, temperature variation will take place in the track, which may require patrolling of the section during extreme winter and summer. For this purpose, provision shall be made for visual inspection from the walk way on the outside of each track permitting safe walking for patrolmen during service hours.

1.10 TECHNICAL STANDARDS FOR TRACK STRUCTURE FOR METRO RAILWAYS/MRTS SYSTEMS

Track Structure shall comply with "Technical Standards for Track Structure for Metro Railways/MRTS systems" issued by Railway Board, under their letter No.2010/Proj./Genl./3/3 dated 23.12.2011. Any deviations there from shall require Railway Board's approval.

1.11 WALKWAYS

Minimum Width of Walkway	550 mm
Minimum height of Walkway	1075 mm
Maximum height of Walkway	1120 mm

Note:

a) Extra allowance shall be provided for curves as per Para 1.6.

b) Walkway should be used by Metro inspection groups only in non-operation periods.

c) No structure other than signalling and minor signalling equipment post shall be permitted within the minimum width of walkway.

CHAPTER-2 STATIONS

2.1 MINIMUM SPACING OF TRACKS AT STATIONS

Minimum Spacing of tracks at station on straight and on curve of radius of 1000 M and flatter, without any structure between adjoining tracks for:

a) Underground Section 3650 mm

b) Elevated Section 3750 mm

c) At-Grade Section (ballastless track) 3750 mm

d) At-Grade Section (ballasted track) 3800 mm

2.2 PLATFORMS

2.2.1 Maximum horizontal distance from centre of track to face of passenger platform coping 1525 mm (A)

2.2.2 Minimum horizontal distance from centre of track to face of passenger platform coping 1515 mm (B)

Notes:

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

- 1590 ± 5 mm

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

			Ballastless Track	Ballasted Track
2.2.3	(a)	Maximum height above rail level for passenger platform	1085 mm	1095 mm
	(b)	Minimum height above rail level for passenger platform	1075 mm	1085 mm

Note:

The height of platform serving super elevated track should be in relation to the plane passing through the top of both the rails.

2.2.4	(i)	Minimum horizontal distance of any isolated structure on a passenger platform from the edge of coping	2500 mm

(ii) Minimum horizontal distance of any continuous structure on a passenger platform from the edge of coping 3000 mm

Note:

The structure on the platform is treated as isolated if the length along the platform length is 2000 mm or less. Any structure having a length exceeding 2000 mm is treated as continuous structure.

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

a) For Underground Stations Figure-6(TNL) &6A(TNL)

b) For Elevated Stations Figure No.6(ELE)

c) For Surface (At-Grade) Station Figure No.6(AG)

2.2.6 Design Criteria Values for Platform Screen Doors/Gates:

Sl. No.	Criteria	Design Criteria Value
1	Free Passage	2400 mm (except extremity modules which are 2100 mm in order not to obstruct the cab door).
2	Clear Height	2150 mm
3	Platform Screen Door (PSD) Height	2650 mm
4	Platform Screen Gate (PSG) Height	1700 mm (Half Height)
5	Stoppage Accuracy	All trains in ATO shall stop within ± 300 mm of the stopping position for 99.5% of the station stops and ± 500 mm for 99.98% of the station stops.

Note:

"Platform Screen Doors are under tendering stage and the above dimensions will be validated / modified upon award of Contract."

2.3 GRADIENTS

2.3.1 Station Yards

Gradient in station yards, unless special safety devices are adopted and / or special rules enforced to prevent accidents in accordance with approved special instructions, shall be as under:

a)	Maximum gradient	1 in 1000
b)	Desirable	Level

Note:

There shall be no change of grade / vertical curve within 30 metres of any points or crossings on Ballasted track. In the case of Ballastless track, there shall be no change of grade / vertical curve on the turnout.

2.3.2 Mid Section

Maximum gradient in Mid Section 1 in 25

The gradient will be compensated for curvature at the rate of 0.04% per degree of curve.

2.4 INTERLOCKING AND SIGNAL GEAR

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

a) In Underground Stations

- From CL of track to 1150 mm — 25 mm
- From 1150 mm to 1670 mm — 25 mm rising to 65 mm

b) In Elevated Stations

- From C.L. of track to 1150 mm — 25 mm
- From 1150 mm to 1605 mm — 25 mm increasing to 65 mm
- From 1605 mm to 1755 mm — 65 mm increasing to 200 mm

c) In Surface Stations

- From C.L. of track to 1160 mm — 25 mm
- From 1160 mm to 1615 mm — 25 mm increasing to 65 mm
- From 1615 mm to 1880 mm — 65 mm increasing to 200 m

Note:

Except for check rails of ordinary and diamond crossings, or wing rails and point rails of crossings leading to snag dead ends, or such parts of signalling gear as are required to be

actuated by the wheels, no gear or track fittings shall project above rail level for a distance of 229 mm outside and 140 mm inside the gauge face of the rails.

2.5 POINTS & CROSSING

2.5.1	Maximum clearance of check rail opposite nose of crossing	44 mm
2.5.2	Minimum clearance of check rail opposite nose of crossing	41 mm
2.5.3	Maximum clearance of wing rail at nose of crossing	44 mm
2.5.4	Minimum clearance of wing rail at nose of crossing	41 mm
2.5.5	Nominal clearance between toe of open switch and stock rail	160 mm
2.5.6	Minimum radius of curvature for slip points, turnouts of crossover roads.	
	a) For passenger running lines	190 metres
	b) For Depot lines and other non-passenger running lines	140 metres
2.5.7	Minimum angle of crossing (ordinary) for passenger running lines	1 in 7
2.5.8	Diamond crossings not to be flatter than	1 in 3.52

Notes:

a) The above restrictions shall not apply to moveable diamond crossings

b) There must be no change of super-elevation (of outer over inner rail) between points 18 m outside toe of switch rail and nose of crossings respectively, except in the case of special crossing leading to snag dead-ends or under circumstances as provided for in item 2.6 below.

2.5.9	Minimum length of tongue rail	10134 mm

2.6 SUPER ELEVATION AND SPEED AT STATIONS ON CURVES WITH TURNOUTS OF CONTRARY AND SIMILAR FLEXURE.

2.6.1 Main Line:

Subject to the permissible run through speed based on the standard of interlocking, the equilibrium super-elevation, calculated for the speed of the fastest train may be reduced by a maximum amount of 100 mm without reducing speed on the main line.

2.6.2 Turnouts:

i) Curves of contrary flexure

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

Where, c= Rail head width, R = radius of turnout in m and V is speed on turnout in kmph. The permissible negative super elevation on the turnout (which is also the actual super elevation of the main line) may then be = (100 – **s**) mm.

ii) Curves of Similar flexure

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

2.7 ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES

The additional clearance for platforms on curves is to be provided as under:

2.7.1 On inside of curve: Mid throw

2.7.2 On outside of curve: End throw

The additional clearance for platforms on curves is shown at Appendix-5

Note:

1. As the minimum radius of Curve for stations is 1000 m, there will be no gauge widening at stations.
2. No super elevation will be provided in passenger platform lines.

CHAPTER-3 ROLLING STOCK

3.1 PASSENGER ELECTRIC MULTIPLE UNITS

1)	Coach width		2880 mm
2)	Length of the coach body (maximum) (*The length of the Driving Motor Car may be increased up to 21050 mm, without exceeding the Kinematic Envelope given in this Schedule of Dimensions)		20800* mm
3)	Distance between bogie centers		14700 ± 250 mm
4)	Kinematic Envelope for level tangent track		
	(i)	For Underground and Elevated Sections	Figure No. 1(TNL/AG/ELE)
	(ii)	For Surface (At-Grade) Sections	Figure No. 1(AG)
5)	Minimum clearance above Rail level under dynamic condition of fully loaded vehicle under worst condition * for bogie mounted equipment		65 mm
6)	Minimum clearance above Rail level under dynamic condition of fully loaded vehicle under worst condition * for body mounted equipment		102 mm

The “worst condition” means that it is with the deflection of primary springs with maximum tread wear.

7)	Wheel		
	(a)	Maximum wheel gauge back to back distance	1360 mm
	(b)	Minimum wheel gauge back to back distance	1358 mm
8)	a)	Maximum diameter on the tread measured at 70 mm from the wheel gauge face	860 mm
	b)	Minimum diameter on the tread measured at 70 mm from the wheel gauge face	780 mm

9)	a)	Minimum projection for flange of new wheel measured from tread at 70 mm from the wheel gauge face	28 mm
	b)	Maximum projection for flange of worn wheel measured from tread at 70 mm from the wheel gauge face	36 mm
10)	a)	Maximum thickness of flange of wheel measured from wheel gauge face at 18 mm from outer edge of flange.	32.5 mm
	b)	Minimum thickness of flange of wheel measured from wheel gauge face at 18 mm from outer edge of flange.	22 mm
11)	Minimum width of wheel		134 mm
12)	Incline of tread		1 in 20
13)	Floor Height		
	(a)	Maximum height above rail level for floor of any unloaded vehicle	1130 mm
	(b)	Minimum height above rail level for floor of any loaded vehicle under operating conditions	1100 mm
14)	a)	Maximum height of centre couplers above rail level for unloaded vehicle	815 mm
	b)	Minimum height of centre couplers above rail level for unloaded vehicle	740 mm
15)	Length over buffers/couplers		21900 mm
16)	Adjacent axles (maximum)		12750 mm
17)	Length of rigid wheel base for single bogie		2200 to 2400 mm

3.2 LOCOMOTIVES AND ENGINEERING SERVICE VEHICLES

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

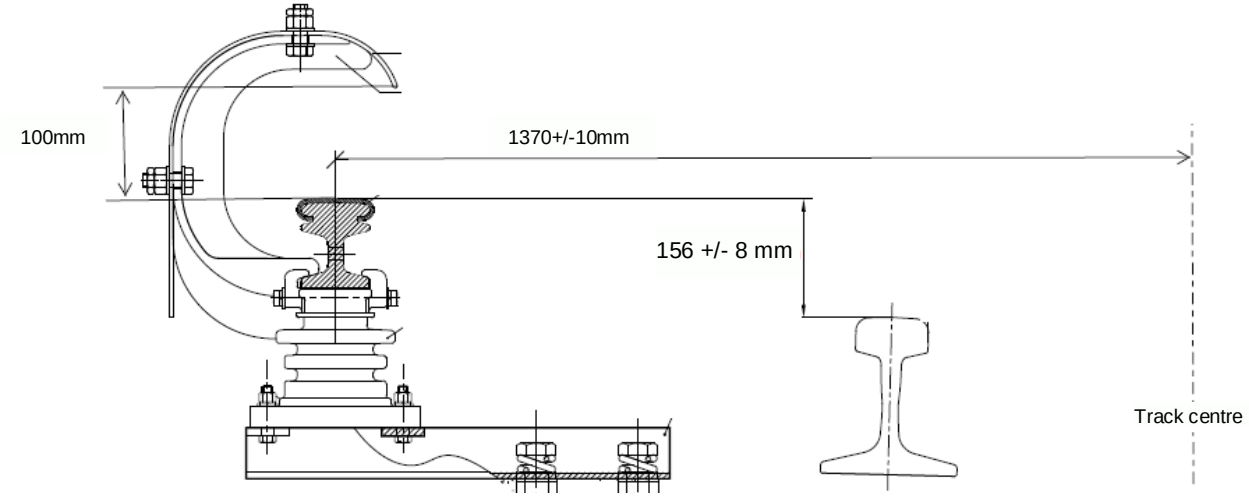
1(TNL/AG/ELE) for Underground, Elevated and At-Grade ballastless sections and Figure-1(AG) for Surface (At-Grade) ballasted Sections.

CHAPTER-4 ELECTRIC TRACTION

4.1 ELECTRIC TRACTION 750 V DC (THIRD RAIL WITH TOP CURRENT COLLECTION)

4.1.1 (a) Maximum height from top of rail level to current collecting surface of the conductor rail 164 mm

(b) Minimum height from top of rail level to current collecting surface of the conductor rail 148 mm



4.1.2 (a) Maximum distance of centre line of the conductor rail from the track centre 1380 mm

(b) Minimum distance of centre line of the conductor rail from the track centre 1360 mm

4.1.3 Minimum distance between the bottom of the shroud and the top of the conductor rail 100 mm

4.1.4 Minimum distance between the centre line of the conductor rail and the shroud structure 110 mm

4.1.5 (a) Conductor rail electrical clearances

i) The static distance between any exposed conductor rail, including all metalwork connected thereto, and any other fixed metalwork shall be at least 75mm

ii) The 75mm referred to in i) may be infringed where insulation is located between such metal parts and the conductor rail.

iii) The minimum vertical clearance between the lowest part of any collector shoe and the running rail shall be 25mm.

iv) The exception to iii) is fourth rail systems where the potential of a set of collector shoes does not, except under fault conditions, exceed 250v and therefore the minimum vertical clearance may be reduced to 10mm for those shoes.

v) Under all circumstances the distance between any conductor rail and another conductor rail, whether or not it is connected to the same power source, shall not be less than 200mm.

Appendix-1

PERMISSIBLE SPEED, CANT AND MINIMUM TRACK SPACING ON CURVES

UNDER GROUND (TUNNELS), ELEVATED AND SURFACE (AT-GRADE) SECTIONS

(REFERENCE: PARA 1.1)

RADIUS OF CURVE	CANT	MAXIMUM PERMISSIBLE SPEED	MINIMUM DISTANCE BETWEEN ADJACENT TRACKS See note (a)		
			UNDER GROUND	ELEVATED & AT-GRADE BALLASTLESS	AT-GRADE BALLASTED
m	mm	kmph	Mm	mm	mm
3000	15	80	3650	3750	3800
2800	15	80	3650	3750	3800
2400	20	80	3650	3750	3800
2000	20	80	3650	3750	3800
1600	25	80	3650	3750	3800
1500	30	80	3650	3750	3800
1200	35	80	3650	3750	3800
1000	40	80	3650	3750	3800
800	55	80	3650	3750	3850
600	70	80	3700	3800	3850
500	85	80	3700	3800	3850
450	95	80	3750	3850	3900
400	105	80	3750	3850	3900
350	125	80	3800	3900	3950
300	125	75	3800	3900	3950
200	125	60	3900	4000	4050
175	125	55	NA	4050	4100
150	125	50	NA	4100	4150
120	125	45	NA	4200	4250

Notes:

a) The track spacing shown in the table above is without any column/structure between two tracks

and is with equal cant for both outer and inner tracks.

b) Track spacing shown in Table above is not applicable to stations which should be calculated depending on specific requirement.

c) Figures for any intermediate radius of curvature may be obtained by adopting the value of sharper curve.

APPENDIX-2(TNL/ELE/AG)
HORIZONTAL SHIFT ON CURVES – (CURVATURE EFFECT)

FOR UNDERGROUND, ELEVATED/AT GRADE BALLASTLESS SECTIONS

INSIDE OF CURVE **REFERENCE: PARA 1.6**

RADIUS (m) R	MID-THROW (27940/R) (mm) (V)	NOSING INCLUDED IN KE/STRUCTURE GAUGE FOR TANGENT TRACK (mm) (N)	EXTRA GAUGE TOLERANCE ON CURVES (mm)	EXTRA HORIZONTAL SHIFT ON CURVE (mm) (T1)	REMARKS
120	232.8	34.0	9.0	208	GAUGE WIDENING ON CURVES = 9 mm FOR CURVES SHARPER THAN 500 M RADIUS AND 3mm FOR CURVES WITH RADIUS OF 500 M TO LESS THAN 1000 M T1=V-N+G for V EQUAL TO OR GREATER THAN (N) AND T1= G for V < (N)
150	186.3	34.0	9.0	161	
175	159.7	34.0	9.0	135	
200	139.7	34.0	9.0	115	
250	111.8	34.0	9.0	87	
300	93.1	34.0	9.0	68	
350	79.8	34.0	9.0	55	
400	69.9	34.0	9.0	45	
450	62.1	34.0	9.0	37	
500	55.9	34.0	3.0	25	
600	46.6	34.0	3.0	16	
700	39.9	34.0	3.0	9	
800	34.9	34.0	3.0	4	
900	31.0	34.0	3.0	3	
1000	27.9	34.0	0.0	0.0	
1200	23.3	34.0	0.0	0.0	
1500	18.6	34.0	0.0	0.0	
1600	17.5	34.0	0.0	0.0	
2000	14.0	34.0	0.0	0.0	
2400	11.6	34,0	0.0	0.0	
2800	10.0	34.0	0.0	0.0	

3000	9.3	34.0	0.0	0.0

Mid throw (in mm) $V = (125 \times C^2) /R = 27940/R$
Where 'C' is the distance between bogie centres = 14.700+0.250=14.950m OR 14.700 - 0.250=14,450 m
The worst case will be with C=14.950 m
R is the radius of curve in metres

OUTSIDE OF CURVE

RADIUS (METERS) R	END-THROW (30610/R) (mm) (V0)	EXTRA GAUGE TOLERANCE ON CURVES (mm) (G)	EXTRA NOSING DUE TO EXTRA GAUGE TOLERANCE (mm) (EN)=Gx0,219723183	EXTRA HORIZONTAL SHIFT ON CURVE (mm) T2=Vo+G+EN	REMARKS
120	255.1	9.0	2.0	266	
150	204.1	9.0	2.0	215	
175	174.9	9.0	2.0	186	GAUGE WIDENING ON
200	153.1	9.0	2.0	164	CURVES = 9 mm FOR CURVES
250	122.4	9.0	2.0	133	SHARPER THAN 500 M RADIUS
300	102.0	9.0	2.0	113	AND 3mm FOR CURVES WITH
350	87.5	9.0	2.0	98	RADIUS OF 500 M TO LESS THAN 1000 M
400	76.5	9.0	2.0	88	
450	68.0	9.0	2.0	79	
500	61.2	3.0	0.7	65	
600	51.0	3.0	0.7	55	
700	43.7	3.0	0.7	47	
800	38.3	3.0	0.7	42	
900	34.0	3.0	0.7	38	
1000	30.6	0.0	0.7	31	
1200	25.5	0.0	0.7	26	
1500	20.4	0.0	0.7	21	
1600	19.1	0.0	0.7	20	
2000	15.3	0.0	0.7	16	
2400	12.8	0.0	0.7	13	
2800	10.9	0.0	0.7	12	
3000	10.2	0.0	0.7	11	

End Throw (in mm) $Vo = (125 \times C_1^2) / R - (125 \times C^2) / R = 30610/R$

Where 'C' is the distance between bogie centres = 14.700+0,250=14.950m OR 14.700-0.250=14.450m

Worst case will be with C=14.450 m

'C_1' is length of coach in meters = 21.30 m and 'R' is radius 0f curve in meters

COACH LENGTH=	20800	
FOR DMC IT CAN INCREASE TO	21050	

DIFFERENCE IN LENGTH	250	THIS INCREASE WILL BE ON ONE SIDE FOR DRIVING CAB
HALF LENGTH FROM CENTRE OF 2 BOGIES	10650	((20800)/2)+250)
LENGTH FOR CALCULATIONS OF END THROW	21300	

APPENDIX-2(AG)

HORIZONTAL SHIFT ON CURVES - (CURVATURE EFFECT) - SURFACE (AT-GRADE) BALLASTED SECTIONS

INSIDE OF CURVE

REFERENCE PARA 1.6

RADIUS (METERS) R	MID-THROW (27940/R) (mm) (V)	NOSING INCLUDED IN K.E/STRUCTURE GAUGE FOR TANGENT TRACK (mm) (N)	EXTRA GAUGE TOLERANCE ON CURVES (mm) (G)	EXTRA HORIZONTAL SHIFT ON CURVE (mm) (T1)	REMARKS
120	232.8	37	9.0	205	
150	186.3	37	9.0	158	
175	159.7	37	9.0	132	
200	139.7	37	9.0	112	GAUGE WIDENING ON
250	111.8	37	9.0	65	CURVES = 9 mm FOR CURVES
300	93.1	37	9.0	52	SHARPER THAN 500 M RADIUS
350	79.8	37	9.0	42	AND 3mm FOR CURVES WITH
400	69.9	37	9.0	34	RADIUS OF 500 M TO LESS THAN 1000 M
450	62.1	37	9.0	28	
500	55.9	37	3.0	13	
600	46.6	37	3.0	6	T1=V-N+G for V EQUAL TO OR
700	39.9	37	3.0	1	GREATER THAN (N) AND
800	34.9	37	3.0	3	T1= G for V < (N)
900	31.0	37	3.0	3	
1000	27.9	37	0.0	0.0	
1200	23.3	37	0.0	0.0	
1500	18.6	37	0.0	0.0	
1600	17.5	37	0.0	0.0	
2000	14.0	37	0.0	0.0	
2400	11.6	37	0.0	0.0	
2800	10.0	37	0.0	0.0	
3000	9.3	37	0.0	0.0	

Mid throw (in mm) $V = (125 \times C^2) /R= 27940/R$
Where 'C' is the distance between bogie centres = 14.700+0.250=14.950m OR 14.700 - 0.250=14.450 m
The worst case will be with C=14.950 m
R is the radius of curve in metres

OUTSIDE OF CURVE

RADIUS (METERS) R	END-THROW (30610/R) (mm) (V0)	EXTRA GAUGE TOLERANCE ON CURVES (mm) (G)	EXTRA NOSING DUE TO EXTRA GAUGE TOLERANCE (mm) (EN)=G x 0.219723183	EXTRA HORIZONTAL SHIFT ON CURVE (mm) T2=Vo+G+EN	REMARKS
120	255.1	9.0	2.0	266	
150	204.1	9.0	2.0	215	
175	174.9	9.0	2.0	186	
200	153.1	9.0	2.0	164	GAUGE WIDENING ON
250	122.4	9.0	2.0	133	CURVES = 9 mm FOR CURVES
300	102.0	9.0	2.0	113	SHARPER THAN 500 M RADIUS
350	87.5	9.0	2.0	98	AND 3mm FOR CURVES WITH
400	76.5	9.0	2.0	88	RADIUS OF 500 M TO LESS THAN 1000 M
450	68.0	9.0	2.0	79	
500	61.2	3.0	0.7	65	
600	51.0	3.0	0.7	55	
700	43.7	3.0	0.7	47	
800	38.3	3.0	0.7	42	
900	34.0	3.0	0.7	38	
1000	30.6	0.0	0.7	31	
1200	25.5	0.0	0.7	26	
1500	20.4	0.0	0.7	21	
1600	19.1	0.0	0.7	20	
2000	15.3	0.0	0.7	16	
2400	12.8	0.0	0.7	13	
2800	10.9	0.0	0.7	12	
3000	10.2	0.0	0.7	11	

End Throw (in mm) Vo= $(125 \times C_1^2) /R - (125xC^2)/R = 30610/R$
Where 'C' is the distance between bogie centres = 14.700+0,250=14.950m OR 14.700-0.250=14.450m .
Worst case will be with C=14.450 m
'C1' is length of coach in meters = 21.30 m and 'R' is radius of curve in meters.

COACH LENGTH=	20800	
FOR DMC IT CAN INCREASE TO	21050	
DIFFERENCE IN LENGTH	250	THIS INCREASE WILL BE ON ONE SIDE FOR DRIVING CAB
HALF LENGTH FROM CENTRE OF 2 BOGIES	10650	((20800)/2)+250)
LENGTH FOR CALCULATIONS OF END THROW	21300	

APPENDIX-3(TNL)

CANT EFFECT ON STRUCTURE GAUGE-HORIZONTAL
UNDER GROUND SECTIONS (RECTANGULAR BOX TUNNELS)

Height above rail level measured perpendicular to plane of track Distance from centre line of track to Structure Gauge for tangent track.					h= 0 ab= 1670				h= 75 ab = 1705				h= 920 ab = 1705				h= 1765 ab = 1770				h= 3150 ab = 1805				h= 3550 ab = 1450				h= 3975 ab = 610				h= 3975 ab = 0			
Cant	**Angle α**	**Sin α**	**Cos α**	**Tan α**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**
125	4.764	0.083	0.997	0.08334	1664	1664	201	-76	1705	1693	279	-4	1776	1623	1121	838	1910	1617	1968	1674	2060	1537	3352	3336	1740	1150	3721	3480	938	278	4074	3973	330	-330	4024	4024
120	4.573	0.080	0.997	0.07999	1665	1665	193	-73	1706	1694	271	-1	1773	1626	1113	841	1905	1624	1961	1678	2050	1548	3344	3056	1728	1162	3714	3483	925	291	4071	3974	317	-317	4022	4022
115	4.382	0.076	0.997	0.07664	1665	1665	185	-70	1706	1694	263	2	1770	1630	1105	845	1900	1630	1953	1682	2040	1559	3336	3060	1717	1174	3708	3486	912	304	4067	3974	304	-304	4021	4021
110	4.191	0.073	0.997	0.07329	1666	1666	177	-67	1706	1695	254	5	1768	1633	1097	848	1894	1636	1945	1686	2030	1570	3329	3065	1706	1187	3701	3490	899	318	4064	3975	291	-291	4019	4019
105	4.001	0.070	0.998	0.06994	1666	1666	169	-64	1706	1696	246	8	1765	1637	1089	851	1889	1643	1937	1690	2020	1581	3321	3069	1694	1199	3695	3493	886	331	4060	3975	277	-277	4018	4018
100	3.810	0.066	0.998	0.06659	1666	1666	161	-61	1706	1696	238	12	1762	1640	1081	855	1883	1649	1929	1693	2010	1592	3313	3073	1683	1211	3689	3496	873	345	4057	3976	264	-264	4016	4016
95	3.619	0.063	0.998	0.06325	1667	1667	153	-58	1706	1697	230	15	1760	1644	1073	858	1878	1655	1921	1697	2000	1603	3305	3077	1671	1223	3682	3499	860	358	4053	3976	251	-251	4015	4015
90	3.428	0.060	0.998	0.05991	1667	1667	145	-55	1706	1697	222	18	1757	1647	1065	861	1872	1661	1913	1701	1990	1613	3297	3081	1660	1235	3675	3502	847	371	4049	3976	238	-238	4013	4013
85	3.238	0.056	0.998	0.05657	1667	1667	137	-52	1707	1698	214	21	1754	1650	1057	865	1867	1667	1905	1705	1980	1624	3289	3086	1648	1247	3669	3505	834	385	4046	3977	225	-225	4011	4011
80	3.047	0.053	0.999	0.05323	1668	1668	129	-49	1707	1699	206	24	1751	1654	1049	868	1861	1674	1897	1708	1970	1635	3281	3090	1637	1259	3662	3508	820	398	4042	3977	211	-211	4009	4009
75	2.856	0.050	0.999	0.04990	1668	1668	121	-46	1707	1699	197	27	1749	1657	1041	871	1856	1680	1889	1712	1960	1646	3274	3094	1625	1271	3655	3511	807	411	4038	3977	198	-198	4008	4008
70	2.666	0.047	0.999	0.04656	1668	1668	113	-43	1707	1700	189	31	1746	1660	1033	875	1850	1686	1880	1716	1950	1657	3266	3098	1614	1283	3649	3514	794	424	4034	3977	185	-185	4006	4006
65	2.475	0.043	0.999	0.04323	1668	1668	105	-40	1707	1700	181	34	1743	1664	1025	878	1845	1692	1872	1719	1939	1667	3258	3102	1602	1295	3642	3517	781	438	4030	3977	172	-172	4004	4004
60	2.285	0.040	0.999	0.03990	1669	1669	97	-37	1707	1701	173	37	1740	1667	1017	881	1839	1698	1864	1723	1929	1678	3249	3106	1590	1307	3635	3519	768	451	4026	3978	158	-158	4002	4002
55	2.094	0.037	0.999	0.03657	1669	1669	89	-34	1707	1701	165	40	1737	1670	1009	885	1833	1704	1856	1727	1919	1689	3241	3109	1579	1319	3628	3522	755	464	4022	3978	145	-145	4000	4000
50	1.904	0.033	0.999	0.03324	1669	1669	80	-30	1707	1702	157	43	1735	1673	1001	888	1828	1710	1848	1730	1909	1699	3233	3113	1567	1331	3621	3525	742	478	4018	3978	132	-132	3998	3998
45	1.713	0.030	1.000	0.02991	1669	1669	72	-27	1706	1702	148	46	1732	1677	993	891	1822	1716	1840	1734	1898	1710	3225	3117	1555	1343	3614	3528	729	491	4014	3977	119	-119	3996	3996
40	1.523	0.027	1.000	0.02659	1669	1669	64	-24	1706	1702	140	50	1729	1680	985	894	1816	1722	1831	1737	1888	1721	3217	3121	1544	1355	3607	3530	715	504	4010	3977	106	-106	3994	3994
35	1.333	0.023	1.000	0.02326	1670	1670	56	-21	1706	1703	132	53	1726	1683	977	898	1811	1728	1823	1741	1878	1731	3209	3125	1532	1367	3600	3533	702	517	4006	3977	92	-92	3991	3991
30	1.142	0.020	1.000	0.01994	1670	1670	48	-18	1706	1703	124	56	1723	1686	969	901	1805	1734	1815	1744	1867	1742	3200	3128	1520	1379	3593	3535	689	531	4001	3977	79	-79	3989	3989
25	0.952	0.017	1.000	0.01661	1670	1670	40	-15	1706	1704	116	59	1720	1689	961	904	1799	1740	1807	1748	1857	1752	3192	3132	1509	1391	3586	3538	676	544	3997	3977	66	-66	3987	3987
20	0.761	0.013	1.000	0.01329	1670	1670	32	-12	1706	1704	108	62	1717	1693	953	907	1793	1746	1798	1751	1847	1763	3184	3136	1497	1403	3579	3540	663	557	3993	3977	53	-53	3985	3985
15	0.571	0.010	1.000	0.00997	1670	1670	24	-9	1706	1704	99	66	1714	1696	944	910	1788	1752	1790	1755	1836	1774	3175	3139	1485	1415	3572	3543	650	570	3988	3976	40	-40	3982	3982
10	0.381	0.007	1.000	0.00664	1670	1670	16	-6	1705	1704	91	69	1711	1699	936	914	1782	1758	1782	1758	1826	1784	3167	3143	1474	1426	3565	3545	636	584	3984	3976	26	-26	3980	3980
5	0.190	0.003	1.000	0.00332	1670	1670	8	-3	1705	1705	83	72	1708	1702	928	917	1776	1764	1773	1762	1815	1795	3158	3146	1462	1438	3557	3548	623	597	3980	3975	13	-13	3977	3977
0	0.000	0.000	1.000	0.00000	1670	1670	0	0	1705	1705	75	75	1705	1705	920	920	1770	1770	1765	1765	1805	1805	3150	3150	1450	1450	3550	3550	610	610	3975	3975	0	0	3975	3975

REFER TO FIGURE-4

E1=[ab+(h x tan α)] x cos α

F1=[Ab- (h x tan α)] x cos α

H1=(Ca/2)+(h/ cos α)+(Ab-h x tan α) x sin α

H2=(Ca/2)+(h/ cos α)-(ab+h x tan α) x sin α

ab=Ab=Distance from center line of vehicle to Structure gauge for Tangent track at height 'h' from rail level

ac=Distance from center line of Tangent tack to Structure Gauge for Canted track at height 'h' from rail level

bc=h x tan α=Lateral increment due to cant (measured along the line parallel to line joining top of rails)

APPENDIX-3(ELE/AG)

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

Height above rail level measured perpendicular to plane of track Distance from center line of track to Structure Gauge for tangent track.					h= 0 ab = 1755				h= 360 ab = 1755				h= 360 ab = 1650				h= 960 ab = 1760				h= 1760 ab = 1820				h= 3090 ab = 1855				h= 3555 ab = 1560				h= 4025 ab = 610				h= 4025 ab = 0			
Cant	**Angle α**	**Sin α**	**Cos α**	**Tan α**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**	**E1**	**F1**	**H1**	**H2**
125	4.764	0.083	0.997	0.0833	1749	1749	208	-83	1779	1719	567	275	1674	1614	558	284	1834	1674	1165	873	1960	1668	1968	1951	2105	1592	3296	2988	1850	1259	3735	3476	942	274	4124	4023	334	-334	4074	4074
120	4.573	0.080	0.997	0.0800	1749	1749	200	-80	1778	1721	559	279	1673	1618	550	287	1831	1678	1157	877	1955	1674	1960	1669	2095	1603	3288	2992	1838	1272	3728	3478	929	287	4121	4024	321	-321	4072	4072
115	4.382	0.076	0.997	0.0766	1750	1750	192	-77	1777	1722	551	282	1673	1618	543	290	1828	1683	1149	880	1949	1680	1951	1673	2086	1613	3280	2997	1827	1284	3721	3483	916	301	4117	4024	308	-308	4071	4071
110	4.191	0.073	0.997	0.0733	1750	1750	183	-73	1777	1724	542	286	1672	1619	535	293	1825	1688	1141	884	1944	1686	1943	1677	2076	1624	3272	3001	1816	1296	3715	3486	903	314	4114	4025	294	-294	4069	4069
105	4.001	0.070	0.998	0.0699	1751	1751	175	-70	1776	1726	534	289	1671	1621	527	297	1823	1685	1133	887	1938	1693	1935	1681	2066	1635	3264	3006	1804	1308	3708	3490	889	328	4110	4026	281	-281	4068	4068
100	3.810	0.066	0.998	0.0666	1751	1751	167	-67	1775	1727	526	293	1670	1623	519	300	1820	1692	1125	891	1933	1699	1927	1685	2056	1648	3256	3010	1793	1320	3701	3493	876	341	4107	4026	267	-267	4066	4066
95	3.619	0.063	0.998	0.0632	1752	1752	158	-63	1774	1729	518	296	1669	1624	511	303	1817	1696	1117	894	1927	1705	1919	1689	2046	1656	3248	3014	1781	1332	3694	3497	863	355	4103	4026	254	-254	4064	4064
90	3.428	0.060	0.998	0.0599	1752	1752	150	-60	1773	1730	509	299	1669	1626	503	306	1814	1699	1109	898	1922	1711	1911	1693	2036	1667	3240	3019	1770	1345	3687	3500	850	368	4099	4026	241	-241	4063	4063
85	3.238	0.056	0.998	0.0566	1752	1752	142	-57	1773	1732	501	303	1668	1627	495	309	1811	1702	1100	902	1916	1718	1902	1697	2027	1678	3232	3023	1758	1357	3680	3504	836	382	4096	4027	227	-227	4061	4061
80	3.047	0.053	0.999	0.0532	1753	1753	133	-53	1772	1733	493	306	1667	1629	487	312	1809	1706	1092	905	1911	1724	1894	1701	2017	1688	3224	3027	1747	1369	3673	3507	823	395	4092	4027	214	-214	4059	4059
75	2.856	0.050	0.999	0.0499	1753	1753	125	-50	1771	1735	485	310	1666	1630	479	315	1806	1710	1084	909	1905	1730	1886	1705	2007	1699	3216	3031	1735	1381	3666	3510	810	409	4088	4027	201	-201	4057	4057
70	2.666	0.047	0.999	0.0466	1753	1753	117	-47	1770	1738	476	313	1665	1631	471	318	1803	1713	1076	912	1900	1736	1878	1708	1997	1709	3208	3035	1724	1393	3659	3514	797	422	4084	4027	187	-187	4056	4056
65	2.475	0.043	0.999	0.0432	1753	1753	108	-43	1769	1738	468	316	1664	1633	463	321	1800	1717	1068	916	1894	1742	1869	1712	1987	1720	3200	3040	1712	1405	3652	3517	783	436	4080	4027	174	-174	4054	4054
60	2.285	0.040	0.999	0.0399	1754	1754	100	-40	1768	1739	460	320	1663	1634	455	324	1797	1720	1059	919	1889	1748	1861	1716	1977	1730	3191	3044	1700	1417	3644	3520	770	449	4076	4027	160	-160	4052	4052
55	2.094	0.037	0.999	0.0366	1754	1754	92	-37	1767	1741	451	323	1662	1636	448	327	1794	1724	1051	923	1883	1754	1853	1720	1967	1741	3183	3048	1689	1429	3637	3523	757	462	4072	4028	147	-147	4050	4050
50	1.904	0.033	0.999	0.0332	1754	1754	83	-33	1766	1742	443	326	1661	1637	440	330	1791	1727	1043	926	1877	1761	1844	1724	1957	1751	3175	3052	1677	1441	3630	3526	743	476	4068	4028	134	-134	4048	4048
45	1.713	0.030	1.000	0.0299	1754	1754	75	-30	1765	1743	435	330	1660	1638	432	333	1788	1731	1035	929	1872	1767	1836	1727	1947	1762	3167	3056	1666	1453	3623	3529	730	489	4064	4027	120	-120	4046	4046
40	1.523	0.027	1.000	0.0266	1754	1754	67	-27	1764	1745	427	333	1659	1640	424	336	1785	1734	1026	933	1866	1773	1828	1731	1936	1772	3158	3060	1654	1465	3615	3532	717	503	4060	4027	107	-107	4044	4044
35	1.333	0.023	1.000	0.0233	1755	1755	58	-23	1763	1746	418	337	1658	1641	416	339	1782	1737	1018	936	1860	1779	1819	1735	1926	1783	3150	3064	1642	1477	3608	3535	703	516	4056	4027	94	-94	4041	4041
30	1.142	0.020	1.000	0.0199	1755	1755	50	-20	1762	1747	410	340	1657	1642	408	342	1779	1741	1010	940	1855	1785	1811	1738	1916	1793	3141	3067	1631	1489	3600	3538	690	530	4051	4027	80	-80	4039	4039
25	0.952	0.017	1.000	0.0166	1755	1755	42	-17	1761	1748	402	343	1656	1644	400	345	1776	1744	1002	943	1849	1791	1802	1742	1906	1803	3133	3071	1619	1501	3593	3541	677	543	4047	4027	67	-67	4037	4037
20	0.761	0.013	1.000	0.0132	1756	1756	33	-13	1760	1750	393	347	1655	1645	392	348	1773	1747	993	947	1843	1798	1794	1746	1896	1814	3124	3075	1607	1513	3585	3544	663	556	4043	4027	53	-53	4035	4035
15	0.571	0.010	1.000	0.0100	1756	1756	25	-10	1759	1751	385	350	1654	1646	384	351	1769	1750	985	950	1837	1802	1786	1749	1886	1824	3116	3079	1595	1524	3578	3547	650	570	4038	4026	40	-40	4032	4032
10	0.381	0.007	1.000	0.0066	1756	1756	17	-7	1757	1753	377	353	1652	1648	376	354	1766	1754	977	953	1832	1808	1777	1753	1875	1834	3107	3083	1584	1536	3570	3550	637	583	4034	4026	27	-27	4030	4030
5	0.190	0.003	1.000	0.0033	1756	1756	8	-3	1756	1754	368	357	1651	1649	368	357	1763	1757	968	957	1826	1814	1769	1756	1865	1845	3099	3086	1572	1548	3563	3552	623	597	4030	4025	13	-13	4027	4027
0	0.000	0.000	1.000	0.0000	1756	1756	0	0	1755	1755	360	360	1650	1650	360	360	1760	1760	960	960	1820	1820	1760	1760	1855	1855	3090	3090	1560	1560	3555	3555	610	610	4025	4025	0	0	4025	4025

REFER TO FIGURE-4

E1=[ab+(h x tan α)] x cos α

F1=[Ab- (h x tan α)] x cos α

H1=(Ca/2)+(h/ cos α)+(Ab-h x tan α) x sin α

H2=(Ca/2)+(h/ cos α)-(ab+h x tan α)xsin α

ab=Ab=Distance from center line of vehicle to Structure gauge for Tangent track at height 'h' from rail level

ac=Distance from center line of tangent tack to Structure Gauge for Canted track at height 'h' from rail level

bc=h x tan α=Lateral increment due to cant (measured along the line parallel to line joining top of rails)

APPENDIX-3(AG)

CANT EFFECT ON STRUCTURE GAUGE-HORIZONTAL
AT-GRADE SECTIONS (BALLASTED TRACK)

ALL FIGURES ARE IN mm

Height above rail level measured						h=	0			h=	88			h=	88			h=	228			h=	3085			h=	3515			h=	4035			h=	4035		
Distance from center line of track to Structure Gauge for						ab =	1765			ab =	1765			ab =	1880			ab =	1880			ab =	1880			ab =	1585			ab =	505			ab =	0		
Cant	Angle α Degrees	Sin α	Angle α Radians	Cos α	Tan α	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2	E_1	F_1	H_1	H_2
125	4.764	0.083	0.083	0.997	0.083	1759	1759	209	-84	1766	1752	297	4	1881	1866	306	-6	1892	1855	446	134	2130	1617	3293	2981	1871	1288	3697	3434	838	168	4126	4042	335	-335	4084	4081
120	4.573	0.080	0.080	0.997	0.080	1759	1759	201	-81	1766	1752	288	7	1881	1867	298	-2	1892	1856	437	137	2120	1628	3285	2985	1860	1300	3690	3437	825	182	4122	4042	322	-322	4082	4082
115	4.382	0.076	0.076	0.997	0.077	1760	1760	192	-77	1767	1753	280	10	1881	1868	289	2	1892	1857	428	141	2110	1639	3277	2990	1849	1312	3683	3441	812	195	4118	4042	308	-308	4081	4081
110	4.191	0.073	0.073	0.997	0.073	1760	1760	184	-74	1767	1754	272	14	1881	1869	280	5	1892	1858	420	145	2100	1649	3269	2994	1838	1324	3676	3445	799	209	4116	4042	295	-295	4079	4079
105	4.001	0.070	0.070	0.998	0.070	1761	1761	176	-71	1767	1755	263	17	1882	1869	271	9	1891	1860	411	149	2091	1660	3261	2999	1826	1336	3670	3448	785	222	4113	4042	282	-282	4078	4078
100	3.810	0.066	0.066	0.998	0.067	1761	1761	167	-67	1767	1755	255	21	1882	1870	263	13	1891	1861	402	153	2081	1671	3253	3003	1815	1348	3663	3452	772	236	4110	4043	268	-268	4076	4076
95	3.619	0.063	0.063	0.998	0.063	1761	1761	159	-64	1767	1756	247	24	1882	1871	254	17	1891	1862	394	156	2071	1682	3245	3008	1804	1360	3656	3455	759	249	4106	4043	255	-255	4074	4074
90	3.429	0.060	0.060	0.998	0.060	1762	1762	151	-61	1767	1757	238	27	1882	1871	246	20	1890	1863	385	160	2061	1692	3237	3012	1792	1372	3648	3459	745	263	4103	4043	241	-241	4073	4073
85	3.238	0.056	0.057	0.998	0.057	1762	1762	142	-57	1767	1757	230	31	1882	1872	237	24	1890	1864	376	164	2051	1703	3229	3016	1781	1384	3641	3462	732	276	4100	4043	228	-228	4071	4071
80	3.047	0.053	0.053	0.999	0.053	1763	1763	134	-54	1767	1758	222	34	1882	1873	228	28	1889	1865	368	168	2041	1713	3221	3021	1770	1396	3634	3466	719	290	4096	4042	214	-214	4069	4069
75	2.856	0.050	0.050	0.999	0.050	1763	1763	125	-50	1767	1758	213	37	1882	1873	219	32	1889	1866	359	172	2031	1724	3212	3025	1758	1408	3627	3469	705	303	4093	4042	201	-201	4067	4067
70	2.666	0.047	0.047	0.999	0.047	1763	1763	117	-47	1767	1759	205	41	1882	1874	210	35	1889	1867	350	175	2021	1734	3204	3029	1747	1420	3620	3472	692	317	4089	4042	188	-188	4066	4066
65	2.475	0.043	0.043	0.999	0.043	1763	1763	109	-44	1767	1760	197	44	1882	1874	202	39	1888	1868	341	179	2011	1745	3196	3033	1735	1432	3613	3476	679	330	4086	4042	174	-174	4064	4064
60	2.285	0.040	0.040	0.999	0.040	1764	1764	100	-40	1767	1760	188	48	1882	1875	193	43	1888	1868	333	183	2001	1756	3187	3038	1724	1444	3605	3479	665	344	4082	4042	161	-161	4062	4062
55	2.094	0.037	0.037	0.999	0.037	1764	1764	92	-37	1767	1761	180	51	1882	1876	184	47	1887	1870	324	187	1991	1766	3179	3042	1712	1455	3598	3482	652	357	4078	4041	147	-147	4060	4060
50	1.904	0.033	0.033	0.999	0.033	1764	1764	84	-34	1767	1761	172	54	1882	1876	175	50	1887	1871	315	190	1981	1776	3171	3046	1701	1467	3591	3485	639	371	4075	4041	134	-134	4058	4058
45	1.713	0.030	0.030	1.000	0.030	1764	1764	75	-30	1767	1762	163	58	1882	1877	167	54	1886	1872	307	194	1971	1787	3162	3050	1689	1479	3583	3488	625	384	4071	4041	121	-121	4056	4056
40	1.523	0.027	0.027	1.000	0.027	1764	1764	67	-27	1767	1762	155	61	1882	1877	158	58	1886	1873	298	198	1961	1797	3154	3054	1678	1491	3576	3492	612	398	4067	4040	107	-107	4054	4054
35	1.333	0.023	0.023	1.000	0.023	1765	1765	59	-24	1767	1762	147	64	1882	1877	149	62	1885	1874	289	202	1951	1808	3145	3058	1666	1503	3568	3495	599	411	4063	4040	94	-94	4051	4051
30	1.142	0.020	0.020	1.000	0.020	1765	1765	50	-20	1766	1763	138	68	1881	1878	140	66	1884	1875	280	205	1941	1818	3137	3062	1655	1515	3561	3498	585	424	4059	4039	80	-80	4049	4049
25	0.952	0.017	0.017	1.000	0.017	1765	1765	42	-17	1766	1763	130	71	1881	1878	132	69	1884	1876	272	209	1931	1828	3128	3066	1643	1526	3553	3501	572	438	4055	4039	67	-67	4047	4047
20	0.761	0.013	0.013	1.000	0.013	1765	1765	33	-13	1766	1764	121	75	1881	1879	123	73	1883	1877	263	213	1921	1839	3120	3070	1632	1538	3546	3504	559	451	4051	4038	54	-54	4045	4045
15	0.571	0.010	0.010	1.000	0.010	1765	1765	25	-10	1766	1764	113	78	1881	1879	114	77	1882	1878	254	217	1911	1849	3111	3074	1620	1550	3538	3507	545	465	4047	4037	40	-40	4042	4042
10	0.381	0.007	0.007	1.000	0.007	1765	1765	17	-7	1766	1764	105	81	1881	1879	105	81	1881	1878	245	221	1900	1859	3102	3077	1608	1562	3530	3509	532	478	4043	4037	27	-27	4040	4040
5	0.190	0.003	0.003	1.000	0.003	1765	1765	8	-3	1765	1765	96	85	1880	1880	97	84	1881	1879	237	224	1890	1870	3094	3081	1597	1573	3523	3512	518	492	4039	4038	13	-13	4037	4037
0	0.000	0.000	0.000	1.000	0.000	1765	1765	0	0	1765	1765	88	88	1880	1880	88	88	1880	1880	228	228	1880	1880	3085	3085	1585	1585	3515	3515	505	505	4035	4035	0	0	4035	4035

REFER TO FIGURE-4 $E1=[ab+(h \times \tan\alpha)] \times \cos$

$F1=[Ab-(h \times \tan\alpha)] \times \cos\alpha$

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

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

ab=Ab=Distance from center line of vehicle to Structure gauge for Tangent track at height 'h' from rail level

ac=Distance from center line of Tangent track to Structure Gauge for Canted track at height 'h' from rail level

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

APPENDIX- 3A(TNL/ELE/AG)

CANT EFFECT ON KINEMATIC ENVELOPE-HORIZONTAL

ELEVATED, UNDERGROUND AND AT GRADE BALLASTLESS SECTIONS

Height above rail level measured perpendicular to plane of track						h=	996				h=	1769			h=	3051			h=	3266			h=	3430			h=	3486			h=	3681			h=	3873		
Distance from center line of track to K.E for tangent track.						ab =	1610				ab =	1667			ab =	1701			ab =	1565			ab =	1351			ab =	1351			ab =	965			ab =	574		
Cant	Anale Degree α	Sin α	Angle α Radian	cos α	tan α	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2
125	4.764	0.083	0.083	0.997	0.083	1687	1522	1189	921	1808	1514	1964	1687	1949	1442	3244	2962	1831	1288	3447	3187	1631	1061	3593	3581	1636	1057	3649	3424	1267	656	3811	3651	894	250	3970	3874
120	4.573	0.080	0.080	0.997	0.080	1684	1525	1181	924	1803	1521	1956	1690	1939	1452	3237	2966	1820	1300	3440	3191	1620	1073	3587	3371	1625	1069	3643	3427	1255	668	3806	3652	881	263	3966	3875
115	4.382	0.076	0.076	0.997	0.077	1681	1529	1174	928	1797	1527	1949	1694	1929	1463	3230	2970	1810	1311	3434	3194	1609	1085	3581	3374	1613	1081	3637	3430	1243	681	3801	3654	868	276	3963	3875
110	4.191	0.073	0.073	0.997	0.073	1678	1533	1166	931	1792	1533	1941	1697	1919	1473	3222	2974	1800	1322	3427	3198	1598	1097	3575	3377	1602	1093	3630	3433	1231	693	3797	3656	856	289	3960	3876
105	4.001	0.070	0.070	0.998	0.070	1676	1537	1158	934	1786	1540	1933	1701	1910	1484	3215	2977	1789	1333	3420	3201	1587	1108	3568	3380	1591	1104	3624	3436	1219	706	3792	3657	843	302	3956	3876
100	3.810	0.066	0.066	0.998	0.067	1673	1540	1151	937	1781	1546	1926	1704	1900	1495	3207	2981	1779	1345	3413	3205	1576	1120	3562	3383	1580	1116	3618	3439	1207	718	3787	3659	830	315	3953	3876
95	3.619	0.063	0.063	0.998	0.063	1670	1544	1143	940	1775	1552	1918	1708	1890	1505	3200	2985	1768	1356	3406	3208	1565	1132	3556	3385	1568	1128	3612	3441	1195	731	3782	3660	817	328	3949	3877
90	3.428	0.060	0.060	0.998	0.060	1667	1548	1135	943	1770	1558	1911	1711	1880	1516	3192	2989	1758	1367	3399	3212	1554	1143	3550	3388	1557	1140	3606	3444	1183	743	3777	3662	805	341	3945	3877
85	3.238	0.056	0.057	0.998	0.057	1664	1551	1128	946	1764	1564	1903	1715	1871	1526	3185	2993	1747	1378	3392	3215	1543	1155	3543	3391	1546	1152	3599	3447	1171	756	3772	3663	792	354	3942	3877
80	3.047	0.053	0.053	0.999	0.053	1661	1555	1120	949	1759	1571	1895	1718	1861	1536	3177	2996	1736	1389	3385	3218	1531	1167	3537	3393	1534	1164	3593	3449	1159	768	3767	3665	779	367	3938	3877
75	2.856	0.050	0.050	0.999	0.050	1658	1558	1112	952	1753	1577	1887	1721	1851	1547	3169	3000	1726	1400	3377	3221	1520	1178	3531	3396	1523	1176	3586	3452	1147	780	3762	3666	766	380	3934	3877
70	2.666	0.047	0.047	0.999	0.047	1655	1562	1105	955	1747	1583	1880	1725	1841	1557	3162	3004	1715	1411	3370	3225	1509	1190	3524	3398	1512	1187	3580	3454	1135	793	3757	3667	754	393	3931	3877
65	2.475	0.043	0.043	0.999	0.043	1652	1565	1097	958	1742	1589	1872	1728	1831	1568	3154	3007	1705	1422	3363	3228	1498	1202	3518	3401	1500	1199	3574	3457	1123	805	3752	3668	741	406	3927	3877
60	2.285	0.040	0.040	0.999	0.040	1648	1569	1089	961	1736	1595	1864	1731	1821	1578	3146	3011	1694	1434	3356	3231	1487	1213	3511	3403	1489	1211	3567	3459	1111	817	3747	3670	728	419	3923	3877
55	2.094	0.037	0.037	0.999	0.037	1645	1573	1082	964	1731	1601	1856	1734	1811	1588	3139	3014	1683	1445	3349	3234	1475	1225	3505	3406	1477	1223	3561	3462	1099	830	3741	3671	715	432	3919	3877
50	1.904	0.033	0.033	0.999	0.033	1642	1576	1074	967	1725	1607	1848	1738	1801	1599	3131	3018	1673	1456	3341	3237	1464	1236	3498	3408	1466	1234	3554	3464	1087	842	3736	3672	702	445	3915	3877
45	1.713	0.030	0.030	1.000	0.030	1639	1579	1066	970	1719	1613	1841	1741	1791	1609	3123	3021	1662	1467	3334	3240	1453	1248	3491	3411	1455	1246	3547	3467	1075	855	3731	3673	690	458	3911	3877
40	1.523	0.027	0.027	1.000	0.027	1636	1583	1058	973	1713	1619	1833	1744	1781	1619	3115	3025	1651	1478	3326	3243	1442	1259	3485	3413	1443	1258	3541	3469	1062	867	3725	3674	677	471	3907	3876
35	1.333	0.023	0.023	1.000	0.023	1633	1586	1051	976	1708	1625	1825	1747	1771	1630	3107	3028	1641	1489	3319	3246	1430	1271	3478	3415	1432	1270	3534	3471	1050	879	3720	3675	664	484	3903	3876
30	1.142	0.020	0.020	1.000	0.020	1630	1590	1043	979	1702	1631	1817	1750	1761	1640	3099	3031	1630	1500	3312	3249	1419	1282	3471	3417	1420	1281	3527	3473	1038	891	3715	3676	651	497	3899	3876
25	0.952	0.017	0.017	1.000	0.017	1626	1593	1035	982	1696	1637	1809	1754	1751	1650	3091	3035	1619	1511	3304	3252	1408	1294	3464	3420	1409	1293	3520	3476	1026	904	3708	3677	638	510	3895	3875
20	0.761	0.013	0.013	1.000	0.013	1623	1597	1027	985	1690	1643	1801	1757	1741	1660	3083	3038	1608	1521	3297	3255	1396	1305	3458	3422	1397	1305	3514	3478	1014	916	3703	3678	625	522	3890	3875
15	0.571	0.010	0.010	1.000	0.010	1620	1600	1019	987	1685	1649	1793	1760	1731	1671	3075	3041	1597	1532	3289	3258	1385	1317	3451	3424	1386	1316	3507	3480	1002	928	3698	3679	613	535	3886	3875
10	0.381	0.007	0.007	1.000	0.007	1617	1603	1012	990	1679	1655	1785	1763	1721	1681	3067	3045	1587	1543	3281	3261	1374	1328	3444	3426	1374	1328	3500	3482	989	941	3692	3680	600	548	3882	3874
5	0.190	0.003	0.003	1.000	0.003	1613	1607	1004	993	1673	1661	1777	1766	1711	1691	3059	3048	1576	1554	3274	3263	1362	1340	3437	3428	1363	1339	3493	3484	977	953	3687	3680	587	561	3877	3874
0	0.000	0.000	0.000	1.000	0.000	1610	1610	996	996	1667	1667	1769	1769	1701	1701	3051	3051	1565	1565	3266	3266	1351	1351	3430	3430	1351	1351	3486	3486	965	965	3681	3681	574	574	3873	3873

REFER TO FIGURE-4A

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

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

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

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

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

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

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

APPENDIX-3A(AG)

CANT EFFECT ON KINEMATIC ENVELOPE-HORIZONTAL SURFACE (AT-GRADE) SECTIONS- BALLASTED TRACK

Height above rail level measured perpendicular to plane of track						h=	987			h=	1760			h=	3040			h=	3241			h=	3295			h=	3390			h=	3446			h=	3885		
Distance from center line of track to K.E for tangent track.						ab =	1625			ab =	1686			ab =	1730			ab =	1591			ab =	1530			ab =	1380			ab =	1380			ab =	470		
Cant	Angle Degree α	Sin α	Angle Radian α	cos α	tan α	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2	E	F	H1	H2
125	4.764	0.083	0.083	0.997	0.083	1701	1537	1181	911	1826	1534	1956	1676	1977	1472	3236	2948	1855	1316	3424	3160	1798	1251	3473	3460	1657	1094	3555	3326	1661	1089	3611	3382	791	146	3973	3895
120	4.573	0.080	0.080	0.997	0.080	1699	1541	1173	914	1821	1540	1949	1680	1967	1482	3228	2952	1844	1328	3418	3164	1788	1262	3467	3223	1646	1105	3549	3329	1650	1101	3605	3385	778	159	3970	3895
115	4.382	0.076	0.076	0.997	0.077	1696	1545	1166	917	1816	1547	1941	1684	1957	1493	3221	2956	1834	1339	3411	3167	1777	1274	3460	3226	1635	1117	3543	3332	1639	1113	3599	3388	765	172	3967	3895
110	4.191	0.073	0.073	0.997	0.073	1693	1549	1158	921	1810	1553	1934	1687	1948	1503	3213	2960	1824	1350	3404	3171	1767	1285	3453	3229	1624	1129	3537	3335	1628	1124	3593	3391	753	185	3964	3895
105	4.001	0.070	0.070	0.998	0.070	1690	1552	1150	924	1805	1559	1926	1691	1938	1514	3206	2964	1813	1361	3397	3175	1756	1296	3446	3233	1613	1140	3531	3338	1617	1136	3586	3394	740	198	3961	3895
100	3.810	0.066	0.066	0.998	0.067	1687	1556	1143	927	1799	1565	1918	1694	1928	1524	3198	2968	1803	1372	3390	3178	1746	1308	3439	3236	1602	1152	3524	3341	1606	1148	3580	3397	727	211	3958	3895
95	3.619	0.063	0.063	0.998	0.063	1684	1559	1135	930	1794	1572	1910	1698	1918	1535	3191	2972	1792	1383	3382	3182	1735	1319	3433	3239	1591	1163	3518	3344	1595	1160	3574	3400	714	224	3954	3895
90	3.428	0.060	0.060	0.998	0.060	1681	1563	1127	933	1788	1578	1903	1701	1909	1545	3183	2976	1782	1394	3375	3185	1724	1330	3426	3243	1580	1175	3511	3346	1584	1171	3567	3402	701	237	3951	3895
85	3.238	0.056	0.057	0.998	0.057	1678	1567	1120	936	1783	1584	1895	1704	1899	1556	3175	2980	1772	1405	3368	3188	1714	1341	3419	3246	1569	1186	3505	3349	1572	1183	3561	3405	689	250	3948	3895
80	3.047	0.053	0.053	0.999	0.053	1675	1570	1112	939	1777	1590	1887	1708	1889	1566	3168	2984	1761	1416	3361	3192	1703	1353	3412	3249	1558	1198	3499	3352	1561	1195	3554	3408	676	263	3944	3895
75	2.856	0.050	0.050	0.999	0.050	1672	1574	1104	942	1772	1596	1879	1711	1879	1576	3160	2988	1751	1428	3354	3195	1692	1364	3405	3252	1547	1209	3492	3355	1550	1207	3548	3410	663	276	3941	3894
70	2.666	0.047	0.047	0.999	0.047	1669	1577	1097	945	1766	1602	1872	1715	1870	1587	3152	2991	1740	1439	3346	3198	1682	1375	3398	3255	1536	1221	3486	3357	1539	1218	3541	3413	650	289	3938	3894
65	2.475	0.043	0.043	0.999	0.043	1666	1581	1089	948	1760	1608	1864	1718	1860	1597	3144	2995	1729	1450	3339	3202	1671	1386	3391	3258	1525	1232	3479	3360	1528	1230	3535	3416	637	302	3934	3894
60	2.285	0.040	0.040	0.999	0.040	1663	1584	1081	951	1755	1614	1856	1721	1850	1607	3137	2999	1719	1461	3332	3205	1660	1397	3383	3261	1514	1244	3472	3362	1516	1242	3528	3418	625	315	3931	3893
55	2.094	0.037	0.037	0.999	0.037	1660	1588	1073	954	1749	1621	1848	1725	1840	1618	3129	3002	1708	1471	3324	3208	1649	1409	3376	3264	1503	1255	3466	3365	1505	1253	3522	3421	612	328	3927	3893
50	1.904	0.033	0.033	0.999	0.033	1657	1591	1065	957	1744	1627	1840	1728	1830	1628	3121	3006	1698	1482	3317	3211	1639	1420	3369	3267	1492	1267	3459	3367	1494	1265	3515	3423	599	341	3923	3892
45	1.713	0.030	0.030	1.000	0.030	1654	1595	1058	960	1738	1633	1832	1731	1820	1638	3113	3009	1687	1493	3310	3214	1628	1431	3362	3270	1481	1278	3452	3370	1482	1276	3508	3426	586	354	3920	3892
40	1.523	0.027	0.027	1.000	0.027	1651	1598	1050	963	1732	1639	1824	1735	1810	1649	3105	3013	1677	1504	3302	3218	1617	1442	3355	3273	1470	1289	3445	3372	1471	1288	3501	3428	573	367	3916	3891
35	1.333	0.023	0.023	1.000	0.023	1648	1602	1042	966	1726	1645	1816	1738	1800	1659	3097	3016	1666	1515	3295	3221	1606	1453	3347	3276	1458	1301	3439	3374	1460	1299	3495	3430	560	380	3912	3891
30	1.142	0.020	0.020	1.000	0.020	1644	1605	1034	969	1721	1651	1808	1741	1790	1669	3089	3020	1655	1526	3287	3224	1595	1464	3340	3279	1447	1312	3432	3377	1448	1311	3488	3433	547	392	3909	3890
25	0.952	0.017	0.017	1.000	0.017	1641	1608	1026	972	1715	1657	1800	1744	1780	1679	3081	3023	1645	1537	3279	3227	1585	1475	3332	3282	1436	1323	3425	3379	1437	1323	3481	3435	534	405	3905	3889
20	0.761	0.013	0.013	1.000	0.013	1638	1612	1019	975	1709	1662	1792	1747	1770	1689	3073	3027	1634	1548	3272	3230	1574	1486	3325	3284	1425	1335	3418	3381	1426	1334	3474	3437	522	418	3901	3888
15	0.571	0.010	0.010	1.000	0.010	1635	1615	1011	978	1703	1668	1784	1751	1760	1700	3065	3030	1623	1559	3264	3232	1563	1497	3318	3287	1414	1346	3411	3384	1414	1346	3467	3440	509	431	3897	3888
10	0.381	0.007	0.007	1.000	0.007	1632	1618	1003	981	1698	1674	1776	1754	1750	1710	3056	3033	1612	1569	3256	3235	1552	1508	3310	3290	1402	1357	3404	3386	1403	1357	3460	3442	496	444	3893	3887
5	0.190	0.003	0.003	1.000	0.003	1628	1622	995	984	1692	1680	1768	1757	1740	1720	3048	3037	1602	1580	3249	3238	1541	1519	3303	3292	1391	1369	3397	3388	1391	1369	3453	3444	483	457	3889	3886
0	0.000	0.000	0.000	1.000	0.000	1625	1625	987	987	1686	1686	1760	1760	1730	1730	3040	3040	1591	1591	3241	3241	1530	1530	3295	3295	1380	1380	3390	3390	1380	1380	3446	3446	470	470	3885	3885

REFER TO FIGURE-4A

E=[ab+(h x tan α)] x cos α

F=[Ab- (h x tan α)] x cos α

H1=(Ca/2)+(h/ cos α)+(Ab-h x tan α) x sin α

H2=(Ca/2)+(h/ cos α)-(ab+h x tan α) x sin α

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

ac=Distance from center line of Tangent tack to K.E for Canted track at height 'h' from rail level

bc=h x tan α=Lateral increment due to cant (measured along the line parallel to line joining top of rails)

APPENDIX-4 (TNL)

LATERAL AND VERTICAL SHIFT OF CENTRE OF CICULAR TUNNEL FOR DIFFERENT CANT VALUES (WITH D1=760 mm) REFER TO FIGURE-3 AND PARAs 1.6.1 (B)-b AND 1.6.2 (B)-b

All figures are in mm

CANT (mm)	Angle in degrees	Lateral shift of tunnel centre=X	Vertical shift of tunnel centre=Y	REMARKS
125	4.764	155	56	
120	4.573	149	54	(a) THE CANT IS PROVIDED BY ROTATING THE TUNNEL ABOUT THE MID POINT OF TOP OF INNER RAIL
115	4.382	143	52	THIS WILL RESULT IN LATERAL AND VERTICAL SHIFT OF THE CENTRE OF THE CIRCULAR TUNNEL.
110	4.191	136	50	
105	4.001	130	48	(b) LATERAL SHIFT OF THE CENTRE OF TUNNEL (TOWARDS INSIDE OF CURVE)
100	3.81	124	46	X= [{2 x (r-D1)/sin } x { sin /2}] x cos (90- - /2)
95	3.619	118	44	(c) VERTICAL SHIFT OF THE CENTRE OF TUNNEL (UPWARDS)
90	3.428	111	42	Y=[{2 X (r-D1)/sin } x { sin /2}] x sin (90- - /2)
85	3.238	105	40	Where 'r' is internal radius of the circular tunnel=2600 mm
80	3.047	99	37	D1 = depth from rail level to invert of circular tunnel=760 mm
75	2.856	93	35	= angle of rotation=sin-1 (Cant/g) and
70	2.666	86	33	= angle subtended by line joining top of two rails and the line joining mid point of top of inner rail and the centre of circular Tunnel
65	2.475	80	31	
60	2.285	74	29	= tan-1[(r-D1) / (g/2)] in degrees=
55	2.094	68	26	67.75703907
50	1.904	62	24	g= Centre to centre of rails = 1505 mm
45	1.713	55	22	
40	1.523	49	19	
35	1.333	43	17	
30	1.142	37	15	
25	0.952	31	12	
20	0.761	25	10	
15	0.571	18	7	
10	0.381	12	5	
5	0.19	6	2	
0	0	0	0	

APPENDIX-5

UNDER GROUND, ELEVATED AND SURFACE STATIONS

ADDITIONAL CLEARANCE FOR PLATFORMS ON CURVES

REFERENCE: PARA 2.7

RADIUS (meters)	CANT Ca (mm)	EXTRA ALLOWANCE (mm)		REMARKS
		INSIDE OF CURVE	OUTSIDE OF CURVE	
3000	0	9	10	Extra allowance for curves:
2400	0	12	13	(a) Inside of curve := Midthrow
2000	0	14	15	= (27940/R)
1800	0	16	17	b) Outside of curve: = End throw
1600	0	17	19	=(30610/R)
1500	0	19	20	Additional sway has not been taken to reduce the extra clearance on curved
1200	0	23	26	platforms for the safety of the passengers.
1000	0	28	31	Distance between bogie centres=C.C=14700+/- 250 mm.
				For worst condition:
				C for midthrow is taken as 14.95 M & for end throw as 14.45 M
				C1= Length of vehicle = 21.3 M
				No Cant or Gauge widening is to be provided