



**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**DESIGN, DEVELOPMENT, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF STANDARD GAUGE TRACKWORKS (BALLASTED AND BALLASTLESS) IN KASHELI DEPOT TRACKS FOR LINE 5 CORRIDOR OF MUMBAI METRO RAIL PROJECT OF MMRDA, MUMBAI**

**TENDER DOCUMENTS**

**CONTRACT NO: MMRDA/MPIU/ML5/CA-303**

**TENDER DOCUMENTS**

**VOLUME 3**

**EMPLOYER'S REQUIREMENTS**

- SECTION A: GENERAL
- SECTION B: FUNCTIONAL
- SECTION C: DESIGN
- SECTION D: CONSTRUCTION
- APPENDIX

**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**Metro PIU, 7th Floor, New Administrative Building,  
Bandra-Kurla Complex, Bandra (E), Mumbai –400 051, India**

## **TABLE OF CONTENTS**

### Contents

<b>SECTION A: EMPLOYER'S REQUIREMENTS – GENERAL</b>	<b>1</b>
1. INTRODUCTION	1
2. DEFINITIONS AND INTERPRETATIONS	1
3. RELEVANT DOCUMENTS	2
4. PHASES (DESIGN AND CONSTRUCTION)	3
5. SPECIFICATIONS	3
6. SPECIFICATIONS IN METRIC AND IMPERIAL UNITS	4
7. WORKS PROGRAMME	4
8. MONITORING OF PROGRESS	4
9. QUALITY ASSURANCE	5
10. SOFTWARE SUPPORT	5
11. CO-ORDINATION WITH DESIGNATED AND OTHER CONTRACTORS	6
12. SURVEY AND SITE INVESTIGATIONS	11
13. CLIMATIC CONDITIONS	11
14. PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)	12
15. CONTRACTOR'S PROJECT ORGANISATION	12
16. TECHNOLOGY TRANSFER	12
17. MAINTENANCE REPORT	12
<b>SECTION B: EMPLOYER'S REQUIREMENTS – FUNCTIONAL</b>	<b>16</b>
1. OBJECTIVE	16
2. GENERAL	16
3. SCOPE OF WORKS	16
4. ALIGNMENT FOR ENTIRE WORK	19
5. CLEARANCES	19
6. DESIGN LIFE	20
7. DURABILITY AND MAINTENANCE	20
8. OPERATIONAL REQUIREMENTS	20
9. ENVIRONMENTAL CONSIDERATIONS AND PROTECTION REQUIREMENTS	21
9.1. GENERAL	21
9.2. HOUSEKEEPING	22
9.3. AIR QUALITY	23
9.4. WATER QUALITY	26
9.5. NOISE	27
9.6. VIBRATION LEVEL LIMITS	30
9.7. WASTE	30

9.8. PREVENTION OF MOSQUITO BREEDING .....	31
9.9. TRAFFIC MANAGEMENT .....	31
9.10. SAFETY CERTIFICATION .....	31
9.11. STANDARDS.....	31
<b>SECTION C: EMPLOYER'S REQUIREMENTS - DESIGN .....</b>	<b>31</b>
1. INTRODUCTION .....	31
2. REQUIREMENTS DURING DESIGN PHASE.....	31
3. REQUIREMENTS DURING CONSTRUCTION PHASE.....	32
4. DESIGN INTERFACES WITH DESIGNATED CONTRACTOR .....	33
5. DESIGN SUBMISSIONS .....	33
5.1. PRELIMINARY DESIGN SUBMISSION .....	33
5.2. DEFINITIVE DESIGN SUBMISSION.....	34
6. DESIGN CRITERIA/TECHNICAL STANDARDS OF TRACK STRUCTURE .....	35
i) OPERATING ENVIRONMENT .....	35
ii) TRACK STRUCTURE .....	35
7. RAILS AND RAIL WELDING .....	36
7.1. RAILS .....	36
7.2. WELDING OF RAILS:.....	39
7.3. ULTRASONIC TESTING OF RAIL AND WELDS:.....	40
8. SLEEPER AND FASTENING FOR BALLASTED TRACK.....	40
8.1. SLEEPERS STANDARD GAUGE.....	40
8.2. FASTENING SYSTEM: .....	40
9. TRACK SLAB FOR BALLASTLESS TRACK, SCISSOR CROSSOVER AND TURNOUTS ETC.....	40
(IF REQUIRED).....	40
10. CHECK RAIL / RESTRAINING RAIL.....	41
11. SWITCH EXPANSION JOINT IN CWR TRACK .....	42
12. TURNOUTS, SCISSORS CROSSOVER .....	42
12.1. STANDARDS OF TURNOUT: .....	42
12.2. GENERAL.....	43
12.3. RAILS FOR TURNOUTS.....	44
12.4. SWITCH ASSEMBLY .....	44
12.5. INTERMEDIATE SECTION .....	45
12.6. CROSSING ASSEMBLY .....	45
12.7. ELASTIC FASTENINGS FOR TURNOUTS .....	45
12.8. TYPE AND GEOMETRY OF TURNOUT .....	45
12.9. OPERATING REQUIREMENT OF TURNOUT, SCISSOR CROSSOVER: .....	46
12.10. TECHNICAL SPECIFICATION OF TURNOUT, SCISSOR CROSSOVER.....	46
13. TRACK STRUCTURE AND ROAD SURFACE AT LEVEL CROSSINGS .....	48
14. CHECK RAILS (BALLASTLESS TRACK) .....	48

15. SLEEPER FOR PLAIN LINE, TURNOUTS AND DERAILING SWITCH .....	49
15.1. PSC SLEEPERS FOR TURNOUTS .....	50
15.2. PRESTRESSED CONCRETE SLEEPERS .....	50
16. LOCKING SYSTEM:.....	54
17. MONITORING SYSTEM:.....	54
18. SWITCH EXPANSION JOINT: (IF REQUIRED).....	54
19. FASTENING SYSTEM FOR:.....	55
20. BUFFER STOP.....	56
21. BALLAST SUPPLY AND LAYING .....	56
22. DOCUMENTS.....	57
23. DOCUMENTS REQUIREMENTS.....	61

<b>BLANK PAGE.....</b>	<b>64</b>
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#### **SECTION D: EMPLOYER'S REQUIREMENTS – CONSTRUCTION..... 66**

1. CONTRACTOR'S SUPERINTENDENCE .....	66
2. CHECKING OF THE CONTRACTOR'S TEMPORARY WORKS DESIGN .....	66
3. THE SITE.....	66
4. USE OF THE SITE .....	66
5. ACCESS TO THE SITE.....	66
6. ACCESS TO OUTSIDE THE SITE .....	67
7. SURVEY OF THE SITE .....	67
8. BARRICADES AND SIGNBOARDS.....	67
9. CLEARANCE OF THE SITE.....	68
10. SURVEY .....	68
11. SAFETY, HEALTH, AND ENVIRONMENTAL REQUIREMENTS .....	69
11.1. TRAINING OF CONTRACTOR'S EMPLOYEES/STAFF/WORKERS: -.....	69
11.2. USE OF "TRACTOR TRANSMISSION TYPE" PICK AND CARRY HYDRA CRANE: -.....	69
12. OTHER SAFETY MEASURES .....	69
13. DAMAGE AND INTERFERENCE.....	72
14. UTILITIES.....	73
15. STRUCTURES, ROADS AND OTHER PROPERTIES .....	73
16. WORK ON ROADS .....	74
17. SITE ESTABLISHMENT .....	78
18. SECURITY.....	79
19. TESTING .....	80
20. RECORDS.....	83
21. MATERIALS .....	84
22. PROVISION AND DISPOSAL OF EARTHWORKS MATERIAL .....	84
23. RESTORATION OF AREAS DISTURBED BY CONSTRUCTION .....	84
24. PACKAGING, STORAGE, SHIPPING AND DELIVERY .....	85

25. TEMPORARY WATER AND ELECTRICITY SUPPLY .....	86
26. WORK ON SITE .....	86
27. ELECTRICAL GENERAL .....	87
28. MATERIALS, APPLIANCES AND COMPONENTS .....	87
29. DESIGN CONSIDERATIONS.....	87
30. MAINS VOLTAGE .....	88
31. EARTHING .....	89
32. PLUGS, SOCKET OUTLETS AND COUPLERS .....	89
33. CABLES.....	89
34. LIGHTING INSTALLATION .....	90
35. ELECTRICAL MOTORS .....	90
36. INSPECTION AND TESTING.....	90
37. IDENTIFICATION .....	90
38. MAINTENANCE.....	90
39. MAINTENANCE RECORD .....	91
40. METERING.....	91
41. MOCK-UPS, PROTOTYPES AND SAMPLES .....	91
<b>APPENDICES.....</b>	<b>93</b>
APPENDIX 1- DRAWING LIST .....	93
APPENDIX 2A-WORKS AREAS.....	94
APPENDIX 2B- Detailed Program of Work .....	95
APPENDIX 3 - PROJECT CALENDAR.....	97
APPENDIX 4-PROGRAMME REQUIREMENTS.....	98
APPENDIX 5 -MONTHLY PROGRESS REPORTS .....	105
APPENDIX 6-QUALITY ASSURANCE .....	108
APPENDIX 7-DRAFTING AND CAD STANDARDS.....	110
APPENDIX 8-WORKS AREAS & TEMPORARY POWER SUPPLY.....	118
APPENDIX 9-RAILWAY ENVELOPE ACCESS AND TAKING OVER.....	125
APPENDIX 10- LIST OF APPROVED MANUFACTURERS/SUPPLIERS.....	127
APPENDIX 11-GAD : Depot Layout .....	130
APPENDIX 12- CONTRACTOR'S SITE LABORATORY .....	131
APPENDIX 13- Refer Volume 6 BOQ.....	137
ATTACHMENT A- PROVISION OF LABOUR CAMP .....	138



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## SECTION A: EMPLOYER'S REQUIREMENTS – GENERAL

### 1. INTRODUCTION

These Employer's Requirements are divided into four sections as follows:

- a) General: these apply throughout the Contract. This document should be read in conjunction with other parts of the tender.
- b) Functional: these include the specific core requirements for the design and performance of the Works.
- c) Design: these apply in respect of duties & requirements relating to the design of the Permanent Works.
- d) Construction: these apply in respect of duties and other requirements relating to the construction of the Works.

### 2. DEFINITIONS AND INTERPRETATIONS

In addition to the words and expressions defined in the General Conditions of Contract (GCC), the following words and expressions shall have the meaning assigned to them except where the context otherwise requires:

**"As-Built Drawings"**: means those drawings produced by the Contractor and endorsed by him as true records of construction of the Permanent Works and which have been agreed with the Engineer.

**"Combined Services Drawings" (CSD)**: means drawings showing the locations, layouts and sizes of all services including those of other contractors coordinated so as to eliminate all clashes.

**"Construction Phase"**: has the meaning identified in Clause 4 of the Employer's Requirements - General.

**"Construction Reference Drawings"**: means those drawings referred to in Section C, Clause 2(8) of the Employer's Requirements - Design in respect of which a Notice has been issued.

**"Construction Reference Drawings Submission"**: means the submission of Construction Reference Drawings representing elements of the Permanent Works and for which the Contractor seeks a Notice.

**"Construction Specification"**: means those parts of the Standard Outline Specification which relate to construction.

**"Definitive Design Submission"**: means the submission of documents which comprise the whole or parts of the proposed Definitive Design and for which the Contractor seeks a Notice.

**"Design Manual"**: means the manual to be prepared and submitted by The Contractor as part of the Definitive Design and as described in the Employer's Requirements - Design.

**"Design Package"**: has the meaning identified in Section C, Clause 2(5) of the Employer's Requirements - Design.

**"Design Phase"**: has the meaning identified in Clause 4 of the Employer's Requirements - General.

**"Design Criteria"**: means those parts of the Standard Outline Specification which relate to design.

**"Engineers"**: means General Consultants Expert appointed by the Employer as the Engineer Representative

**"Final Design"**: has the meaning identified in Clause 3(5) of Employer's Requirements – Design.

**"Notice"**: means a Notice of No Objection.

**"Particular Specification"**: means the combined specifications prepared by the Contractor in CSI format which combines the Employers Design Criteria, the Employer's Outline Construction Specifications and those parts of the Contractor's Technical Proposals which specify standards for design and construction which are developed during the Design Phase.

**"Preliminary Design"**: means the submission of documents which comprise the initial stage of the design phase.

**"Railway Envelope"**: means the zone or zones within the Works containing the track work and equipment necessary for the operation of the railway.

**"Services, Electrical, Mechanical (SEM) Drawings"**: means those drawings produced by the contractor executing the service works showing the locations, sizes and details for openings in structural elements for mechanical and electrical facilities and other related contracts.

**"Standard Outline Specification"**: means the Design Criteria and the Outline Construction Specifications that specify standards issued by the Employer for compliance by the Contractor in the design and construction of the Permanent Works.

**"Specification"**: has the meaning identified in Clause 5 of the Employer's Requirements - General.

**"Structure Gauge"**: means the profile related to the designed normal co-ordinated axis of the track into which no part of any structures or fixed equipment may penetrate.

**"Working Drawings"**: comprise the Construction Reference Drawings and such other drawings and documents, such as bar bending schedules and manufacturing drawings, as are necessary to amplify the Construction Reference Drawings for construction purposes and endorsed as required by the Engineer.

**"Track Components"**: All fittings, fastenings, fixtures, rail, turnouts and Buffer stop.

### 3. RELEVANT DOCUMENTS

The Design Criteria shall be read in conjunction with the General Conditions of Contract (GCC), the Special Conditions of Contract (SCC), the Employer's Requirements, the Drawings and any other document forming part of the Contract.

In the event of a conflict between the Employer's Requirements and any Design Criteria, the Design criteria shall prevail.

In the event of a conflict between any Design Criteria and any other standards or specifications quoted, the requirement of the Design Criteria shall prevail.

The order of precedence is:

- a) Technical Specifications
- b) Employer's Requirements
- c) Indian Railway Standards/ RDSO specifications/ or guidelines



- d) International Standards referenced herein
- e) Indian Standards
- f) Other National Standards
- g) Other International Standards

Notwithstanding the precedence specified above the Contractor shall always immediately seek advice from the Engineer in the event of conflicts between Specifications.

#### **4. PHASES (DESIGN AND CONSTRUCTION)**

- 4.1. The Contractor shall execute the Works in two phases, the Design Phase and the Construction Phase.
- 4.2. The Design Phase shall commence upon the date of issue of Letter of Acceptance. This phase shall include the preparation and submission of:

- a) The Preliminary Design.
- b) The Definitive Design.
- c) The Construction Reference Drawings

The Design Phase will be complete upon the issue of a Notice in respect of the comprehensive and complete Construction Reference Drawings Submission for the whole of the Permanent Works.

- 4.3. The requirements for the Preliminary Design, Definitive Design and Construction Reference drawings are stated in Clause 2 of the Employer's Requirements -Design.
- 4.4. The Construction Phase for the whole or a part of the Permanent Works shall commence immediately upon the issue of a Notice by the Engineer/Employer in respect of the relevant Construction Reference Drawings Submission. Such Notice may be issued by the Engineer in respect of a Construction Reference Drawing Submission covering a major and distinctive part of the Permanent Works. However, construction shall not be commenced until the original negatives of the appropriate Working Drawings have been endorsed:
  - (a) by the Contractor as "Good for Construction"; and
  - (b) by the Engineer that he has no objections to the drawing.

The Construction Phase shall include the completion and submission of the Final Design and the preparation and submission of the As Built Drawings and other records as specified.

- 4.5. Notwithstanding Clause 4(4) above, for those elements identified under Clause 2(6) of the Employer's Requirements – Design, the Construction Phase may commence immediately upon the issue of the Notice in respect of the Definitive Design Submission in respect of each such element subject to availability of the site in accordance with agreed programme.

#### **5. SPECIFICATIONS**

In accordance with the provisions of these Employer's Requirements, the Contract Specification contained in the Contract shall be developed during the design stage and submitted as part of the Definitive Design Submission. When the Specification has received a Notice of No Objection from the Engineer it shall become the Particular Specifications and shall take precedence over the other Specifications for construction purposes.

## **6. SPECIFICATIONS IN METRIC AND IMPERIAL UNITS**

- 6.1. The Contract shall utilize the SI system of units. Codes and Standards in imperial units shall not be used unless the Engineer has given his consent.
- 6.2. Conversion between metric units and imperial units shall be in accordance with the relevant Indian Standards.

## **7. WORKS PROGRAMME**

- 7.1. The Key Dates are defined in Appendix 2B to these Employer's Requirements.
- 7.2. The Contractor shall prepare and submit its Works Programme and three-month rolling programmes and the detailed requirements contained in Appendices 3 and 4 to these Employer's Requirements.
- 7.3. In compiling its Works Programme and in all subsequent updating and reporting, the Contractor shall make provision for the time required for co-ordinating and completing the design, testing, commissioning and integrated testing of the Works, including, inter alia, design co-ordination periods during which the Contractor shall co-ordinate design with those of Designated Contractors, the review procedures, determining and complying with the requirements of all Government Departments and all others whose consent, permissions, authority or licence is required prior to the execution of any work.
- 7.4. The Works Programme shall take full account of the Design Submission Programme.

## **8. MONITORING OF PROGRESS**

- 8.1. The Contractor shall submit to the Engineer three copies of a Monthly Progress Report (MPR), as described in Appendix 5 to these Employer's Requirements, describing the progress and current status of the Works. The MPR shall address the matters set out in the Works Programme.
- 8.2. The MPR shall be submitted by the end of each calendar month. It shall account for all works actually performed from "twenty sixth day" of the last month and up to "twenty fifth day" of the current month
- 8.3. The MPR shall be divided into two sections. The first section shall cover progress and current status relating to design and the second section shall cover progress and current status relating to Construction.
- 8.4. A monthly meeting to monitor & review the progress of the project shall be convened by the Engineer. Contractor's site Representative & Design Representative of Contractor and site agent of all interfacing contractors shall also attend the meeting. The Employer may also be present in the meeting. All partners holding a power of attorney must remain present at the quarterly review meeting in MMRDA, Mumbai.
- 8.5. The Engineer or Employer may also conduct progress review meetings at weekly /bi-weekly intervals depending upon the requirements or urgency of works. In these review meetings Engineer may request the Contractor to arrange for the attendance of the Contractor's Sub-Contractors, Designers, or key suppliers at such meetings. The Contractor shall facilitate such attendance

## **9. QUALITY ASSURANCE**

The Contractor shall establish and maintain a Quality Assurance System in accordance with Appendix 6 to these Employer's Requirements for Design Verification, Drawings and installation procedures and the interfaces between them. This Quality Assurance system shall be applied without prejudice to, or without in any way limiting, any Quality Assurance Systems that the Contractor already maintains.

## **10. SOFTWARE SUPPORT**

### **GENERAL**

Programming software used shall be AUTO CAD for all drawings & Civil 3D/ Open Rail Designer for alignment of track and STADD & MIDAS etc for design purpose (latest version). Scheduling software and relevant instruction manuals, licensed for use in connection with the contract, shall be provided by the Contractor according to the Employer's specifications. The Contractor shall supply the Employer's Representative two original licensed copy, including manuals and approved training of the software and any subsequent versions thereof at no extra cost.

This Document outlines the data input procedures between the Engineer and Contractors. The data input procedures must be coordinated, and the key parameters used to form Civil 3D & BENTLEY or AUTOCAD data files must be standardized. The production & exchange of electronic data and hard copies shall comply with the requirements furnished in this document.

- i) The Contractor shall provide full support to the Employer or Engineer for all computer programs provided by the Contractor under the Contract.
- ii) The Contractor shall submit a software support plan at least 90 days before commencement of software installation. This plan shall require the Contractor to provide all changes, bug fixes, updates, modifications, amendments, and new versions of the program as required by the Engineer.
- iii) The Contractor shall provide all tools, equipment, manuals and training necessary for the Employer / Engineer to maintain and re-configure all the software provided under the Contract.
- iv) The Contractor shall submit all new versions to the Engineer for review at least 2 weeks prior to their installation. New Versions of any program shall not result in any non-conformance with the Specification or degrade the operation of the System. The Contractor shall:
  - Ensure that all new versions are fully tested and validated on the simulation and system prior to installation.
  - Ensure that all new versions are fully tested and commissioned once installed on the Site.
  - Deliver to the Employer/Engineer any new version, together with the updated Operation and Maintenance Manuals.
- v) The Engineer shall not be obliged to use any new version and that shall not relieve the Contractor of any of its obligations. Any effect upon the performance or operation of the computer-controlled system that may be caused by a new version shall be brought to the Engineer attention including updating the files to suit new version.

## **SECURITY OBLIGATIONS**

Within 14 days of the installation of any software proposed to be used for the purpose of design & drawings of the Permanent Works by the Contractor, the Contractor shall submit to the Engineer for retention by the Employer/Engineer two backup copies of the software, which shall include, without limitation:

- All licenses in favour of Employer for their use.
- all source and executable code;
- all design documentation relating to the software; and
- Any specified tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers.

## **ERROR CORRECTION**

- i) When a fault is discovered within delivered software or documentation, the Contractor shall take necessary steps to rectify errors or faults at the earliest.
- ii) The Contractor shall provide written details as to the nature of the proposed correction to the Engineer.
- iii) The Contractor shall notify the Employer promptly of any fixes or patches that are available to correct or patch faults.
- iv) The Contractor shall detail any effect such fixes or patches are expected to have, upon the applications.

## **TRAINING**

The Contractor shall provide training for the Employer's staff to enable the Employer to make proper use of any software and its new versions.

## **11. CO-ORDINATION WITH DESIGNATED AND OTHER CONTRACTORS**

### **1. GENERAL**

- i) The Contractor is responsible for detailed co-ordination of his design and construction activities with those of the Designated Contractors, Civil Contractors, Utility Agencies, Statutory Authorities, Private Service Providers, Developers, Consultants and other Contractors whether or not specifically mentioned in the contract, that may be working on or adjacent to the site for the purpose of the Project. For the purpose of this Specification, all of the above parties shall be referred to as Interfacing Contractors. The Contractor shall note that there are other contractors, consultants, etc. which the Employer will engage from time to time with whom the Contractor shall have to similarly co-ordinate. Such co-ordination responsibilities of the Contractor shall include the following:
  - (a) To provide all information reasonably required by the Interfacing Contractors in a timely and professional manner to allow them to proceed with their design or construction activities, and specifically to meet their contractual obligations.
  - (b) To ensure that the Contractor's requirements are provided to all other Interfacing Contractors before the cut-off dates to be identified in the Interface Management Plan (IMP).

- (c) To obtain from the Interfacing Contractors information reasonably required to enable the Contractor to meet the design submission dates as identified in Appendix 2B.
  - (d) Where the execution of the work of the Interfacing Contractors depends upon the site management or information to be given by the Contractor, the Contractor shall provide to such Interfacing Contractors the services or correct, and accurate information required to enable them to meet their own programme or construct their work.
  - (e) To co-ordinate access and delivery routes, and to ensure that all provisions for access and delivery of Plant is co-ordinated with and reflected in the Interfacing Contractor's Delivery Route Drawings. The Interfacing Contractors shall ensure that all Plants are delivered at the time agreed to allow openings left in the structure for such delivery to be sealed in accordance with the Contractor's programme.
  - (f) To co-ordinate with the Interfacing Contractors.
  - (g) To attend regular co-ordination meetings convened by the Engineer with the Interfacing Contractors. The Contractor shall conduct separate meetings with the Interfacing Contractors as necessary to clarify particular aspects of the interfacing requirements of the Works. The party who convenes the meeting shall prepare minutes recording all matters discussed and agreed at the meeting.
  - (h) To ensure that copies of all correspondence, drawings, meeting minutes, programmes, etc. relating to the Contractor's co-ordination with the Interfacing Contractors are issued to all concerned parties and four (4) copies issued to the Engineer no later than two (2) calendar days from the date of such correspondence and meetings.
- ii) The Contractor, shall in carrying out his co-ordination responsibilities, raise in good time and provide sufficient information for the Engineer to decide on any disagreement between the Contractor and the Interfacing Contractors as to the extent of services or information required to pass between them. If such disagreement cannot be resolved by the Contractor despite having taken all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.
  - iii) Where an Interfacing Contract is yet to be awarded the Contractor shall proceed with the co-ordination activities with the Engineer until such time when the Interfacing Contractor is available. The Contractor shall provide the Interfacing Contractor with all information necessary to enable the Interfacing Contractor to follow-on and proceed with their co-ordination.
  - iv) The cut-off dates to be identified in the IMP (Interface Management Plan) are the latest dates. Any claim of additional costs by the Interfacing Contractors as a result of the Contractor's failure in adhering to these dates shall be borne by the Contractor. The Contractor shall note that the information exchange is an iterative process requiring the exchange and update of information at the earliest opportunity and shall be carried out on a regular and progressive basis so that the process is completed for each design stage by the cut-off dates.
  - v) The Contractor shall co-ordinate with the Engineer on all matters relating to works that may affect the Operation & Maintenance of the already operational Section corridor of the of Employer in general. Such work shall be subject to the rules and regulations imposed by the Employer.

## **2. DEDICATED CO-ORDINATION TEAM**

- i) The Contractor shall establish a dedicated co-ordination team, led by a Chief Co-ordinator in Mumbai reporting to the Contractor's Project In-charge. The primary function of the team is to provide a vital link between the Contractor's design and construction teams and the Interfacing Contractors.
- ii) The Chief Co-ordinator shall assess the progress of the co-ordination with Interfacing Contractors by establishing lines of communications as indicated in the co-ordination model shown in Figure 1 and promote regular exchange and updating of information so as to maintain the Contractor's programme.
- iii) The complexity of the Project and the importance of ensuring that work is executed within time limitations require detailed programming and monitoring of progress so that early programme adjustments can be made in order to minimize the effects of potential delays.
- iv) The Chief Co-ordinator in conjunction with the Interfacing Contractors shall identify necessary provisions in the Works for plant, equipment and facilities of the Interfacing Contractors. These provisions shall be allowed by the Contractor in his design of the Works.
- v) During the course of the contract, information will be obtained in a number of ways. These may include direct inspection, regular site meetings, the obtaining of progress reports and the use of turn round document to obtain design and programme data. Turn round document shall be issued to the Interfacing Contractors to be returned giving the current positions on their programme.

## **3. DESIGN & CONSTRUCTION INTERFACE**

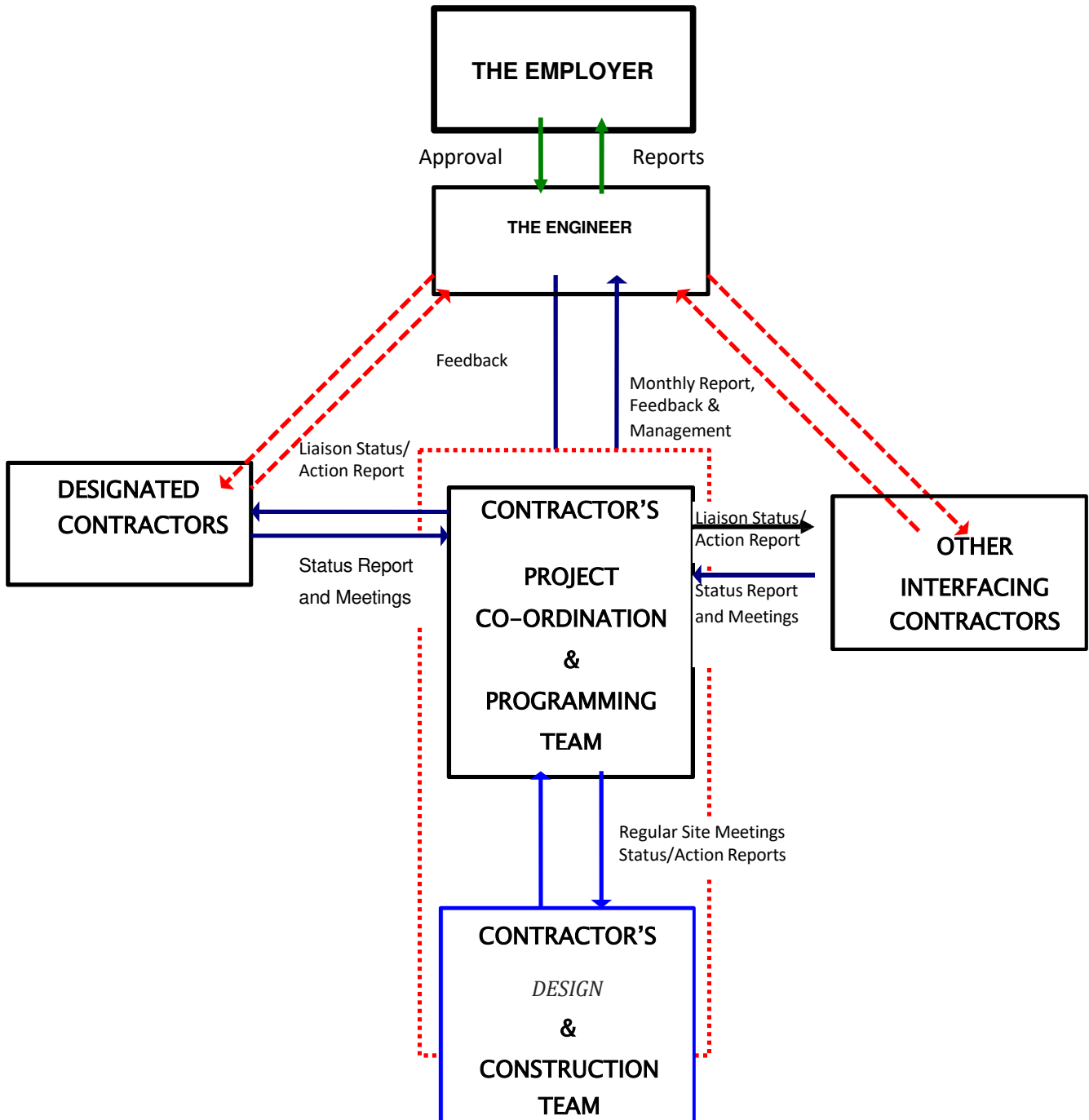
- i) The key dates shown in Employer's Requirements Appendix 2B are critical to the timely completion of the project. The Contractor shall commence design interface with the Interfacing Contractors as soon as he has been notified by the Engineer that such Interfacing Contract has been awarded. In the case of utility agencies and other statutory boards, interface shall commence as soon as it is practicable. Where no design interface date has been established whether because the Interfacing Contractor(s) have not been identified or for whatever reason, the Contractor shall liaise with such Interfacing Contractor/s as soon as they have been awarded.
- ii) The Contractor shall immediately upon award of the Contract gather all necessary information and develop his design to a level where meaningful interaction can take place as soon as the Interfacing Contracts are available. The Contractor shall submit together with each of his Design Submissions a joint statement from the Contractor and the relevant Interfacing Contractor confirming that design co-ordination has been completed and that they have jointly reviewed the appropriate document to ensure that a consistent design is being presented.
- iii) The design interface is an iterative process requiring regular exchange and update of interfacing information. The Contractor shall ensure that the information he requires from the Interfacing Contractors is made known at the outset of each design interface and vice versa so that the information can be provided in time for the Contractor and the Interfacing Contractors to complete their design to meet their various design submission stages.

## **4. CONSTRUCTION INTERFACE**

- a) Construction interface will be necessary throughout the duration of the Works commencing from the time the Contractor mobilizes to the Site to the completion of the Works. Construction interface will overlap design interface, involving cast-in and buried items such

as pipes for electrical and mechanical services, supports, brackets, plinths, ducts, service buildings, openings, cableways, trenches etc. that are to be incorporated at the early stage of the construction up to provision of attendance during the testing and commissioning stage.

- b) The Contractor shall install track based on depot layout drawing. Verify geometry and clearances and advise if any modifications necessarily required in adjoining structures or roads to complete the work as per the given layout.
- c) The Contractor shall jointly establish the common reference co-ordinates and common survey benchmark in consultation with other contractors of depot.
- d) The Track Contractor shall supply to Depot contractor drawings for various types of tracks in Depot including structural interface arrangements such as shear connectors etc.
- e) The Contractor shall co-ordinate with Depot contractor to ensure proper track drainage both outdoor and indoor structures as per approved drawings.
- f) For Ballasted Track - The Contractor shall install the track structure based on employer requirement tender drawing and shall supply the required finished formation levels to Depot contractor. Track contractor shall build the track above formation.
- g) For Track on Column - The Contractor shall supply and install Structural steel columns, track on column including supply and welding of special base plate including all fittings and fixtures for track installation to ensure 1 in 20 cant in rail.
- h) For Embedded Track inside Depot buildings - The Contractor shall Design and install track including - pour concrete/ GP 2 or similar filling material of approved mix as per drawing.
- i) Track contractor will consider feasibility and will design the level crossing based on level specification provided, the formation done by the civil contractor as per the approved drawings.
- j) Track contractor will construct the level crossing including 5m length approach from track center and the civil contractor shall construct road structure beyond the level crossing constructed by the Track contractor.
- k) The Contractor shall ensure that there is no interference with the Works of the Interfacing Contractors and shall maintain close co-ordination with them to ensure that his work progresses in a smooth and orderly manner. The Contractor shall carry out and complete the Works, or any part thereof, in such order as may be agreed by the Engineer or in such revised order as may be requested by the Engineer from time to time. The Contractor shall, unless otherwise provided, be liable for and shall indemnify the Employer against all costs, charges, expenses, and the like resulting from failure of the Contractor to co-ordinate the Works as specified.
- l) Computers with Auto CAD Operator: -
- m) The contractor shall provide workstation Computers (2nos), Laptop (01nos), with the device configuration supporting software provided by contractor one A3 colour printer with scanner and one experienced Auto CAD operator exclusively for the Office of the Engineer till six months beyond the date of completion of project at project office.
- n) The contractor shall provide good fully furnished office accommodation measuring 250sqm for Engineer and employer staff on duty at depot with all services like internet, safe drinking water, pantry, sanitization, Toilet etc separate for ladies and Gents during the entire period of Execution including extension period.



CONTRACTOR'S ORGANISATION

Figure 1



## 12. SURVEY AND SITE INVESTIGATIONS

- i) The datum used for the Contract shall be Mean Sea Level Datum
- ii) The Contractor shall carry out all further site investigations necessary for the design of the Trackwork and to enable the determination of the methods of installation and the nature, extent and design of the Temporary works on the basis of above.

## 13. CLIMATIC CONDITIONS

### GENERAL

- i) Mumbai City has a tropical climate with hot summers and Monsoon seasons. Tenderers must acquaint themselves about the climate of Mumbai City before submitting the tender. The Employer shall in no way be responsible on this account.
- ii) The following indicative information on climatic conditions in Mumbai shall be taken into account by the Contractor. The Contractor shall ensure that due allowance is made for more severe local conditions when Permanent Works are required to operate, for example, with restricted ventilation that may lead to higher local ambient temperatures, and any other factors that may affect the operating environment in any way.
  - (a) Unless specific figures are provided elsewhere, the Permanent Works will generally be required to function at its rated value with the values of ambient temperature and relative humidity appropriate to the location. Certain parts of the Permanent Works may need to be rated for more or less onerous conditions as required by the PS.
  - (b) Clause Details of Environment below gives the different classifications of environment to be encountered. For any type of item, examples of which are installed in more than one environmental class, all examples of the type shall be suitable for installation in the most severe environmental class conditions encountered by any example of the type.
  - (c) The Contractor's attention is drawn to the more severe environmental conditions that may exist during the construction period and shall take adequate measures to protect the Permanent Works against any deleterious effects of such conditions during the time between installation and final completion of the Project.

### DETAILS OF ENVIRONMENT

	Max	Min
Winter (November to February)	30°C	17°C
Summer (March to June)	40°C	25°C
Rainy (July to October)	32°C	20°C

### Wind Pressure

The system is to be designed to give satisfactory service for a wind pressure as per relevant IS codes applicable.

### **Sunshine and other meteorological details**

Sunshine hours and other meteorological details can be obtained by placing a specific request to Meteorological Department.

## **14. PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)**

The contractor shall adopt a reputed system for PMIS and get the same approved by the engineer. The Contractor shall devise and utilize the PMIS such that all documents generated by the Contractor can be transmitted to the Engineer by electronic means (and vice versa) and that all documents generated by either party are electronically captured at the point of origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the Engineer office at site and the Employer's Office by the Contractor.

## **15. CONTRACTOR'S PROJECT ORGANISATION**

- i) The Contractor shall have a competent team of Managers, Engineers, Technical staff etc so as to complete the work satisfactory as per various requirements of the contract.
- ii) A control room with round the clock radio communication or telephone switch board links with all safety offices, works sites, site offices, batching plants, casting yards, workshops, fabrication yard, off site offices, Engineers site office, Resident Engineer's office, testing labs etc shall be maintained and manned round the clock. Residences of all senior project team members shall also be linked with the control room. Vehicles for emergency use should be on stand-by at the control room around the clock.
- iii) The designations of the various project organizations team members shall be got approved by the Engineer before adoption so as to avoid any duplication of the designations with those of the Employer or the Engineer.

## **16. TECHNOLOGY TRANSFER**

The Contractor shall ensure that all local contractors and sub-contractors engaged in the Works are provided with adequate training, guidance, and appropriate opportunities for technology transfer in areas including, but not limited to, installation, testing, and commissioning, as well as instrumentation, safety, and quality assurance etc.

## **17. MAINTENANCE REPORT**

The Maintenance Report shall be submitted as part of the Definitive Design and shall include full details of the long-term inspection and maintenance operations for each major component of trackwork.

- a) The Contractor shall provide inspection and maintenance manuals for the trackwork covering the following areas.
  - Ballastless Special Track forms and ballasted track in
  - Switches and crossings including diamonds and fastenings there.
  - Track plinth/slab, ballast and sleepers& all fastening thereof.
  - Creep anchor and destressing.
  - Special track work of depot.

- b) For each area an inspection checklist shall be supplied giving inspection frequency, items to be inspected, criteria for acceptance, criteria for remedial works and details of the remedial works, including proposed materials and method statements. The recommended regular maintenance regime of each area shall also be given including cleaning methods and frequency for different surfaces; removal of leakage borne salts from concrete surfaces; cleaning of drainage channels, sumps, and pipes; repainting of metallic items.
- c) A long-term monitoring regime shall also be included covering items such as
  - Rails Fastenings
  - Sleepers & ballast
  - Creep and Creep anchor destressing
  - Welds
  - Switches and crossings
  - Buffer stops
- d) Contractor will provide all instruments necessary to carry out the inspections and quality monitoring that are required to judge quality of work during construction phase in sufficient no within the lump sum tender price. Contractor will Also deploy modern instrument of measuring track parameters like trolley, Toe load measuring devices, rail stress measuring instrument, sufficient gauge & level measuring instruments, thermal meters for measuring rail temperature etc., for monitoring parameter during construction entire construction phase.
- e) List of preventive maintenance equipment to be given to O &M organization is mentioned in Volume 6 .

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## **MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**DESIGN, DEVELOPMENT, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF STANDARD GAUGE TRACKWORKS (BALLASTED AND BALLASTLESS) IN KASHELI DEPOT TRACKS FOR LINE 5 CORRIDOR OF MUMBAI METRO RAIL PROJECT OF MMRDA, MUMBAI**

### **TENDER DOCUMENTS**

**CONTRACT NO: MMRDA/MPIU/ML5/CA-303**

### **TENDER DOCUMENTS**

#### **VOLUME 3**

#### **EMPLOYER'S REQUIREMENTS**

#### **SECTION B: FUNCTIONAL**

**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**Metro PIU, 7<sup>th</sup> Floor, New Administrative Building,  
Bandra-Kurla Complex, Bandra (E), Mumbai –400 051, India**

## **SECTION B: EMPLOYER'S REQUIREMENTS – FUNCTIONAL**

### **1. OBJECTIVE**

The objective of the Contract is the design, construction completion, testing, and commissioning of the permanent works by the Contractor (including without limitation, the design, installation and removal of the Temporary Works) and the rectification of defects appearing in Permanent Works in the manner and to the standards and within the time stipulated by the Contract. In full recognition of this objective, and with full acceptance of the obligations, liabilities and risks which may be involved, the Contractor shall undertake the execution of the Works.

### **2. GENERAL**

- 2.1 The design and performance of the Permanent Works shall comply with the specific core requirements contained in these Employer's Requirements –Functional.
- 2.2 The design of the Permanent Works shall be developed in accordance with these Employer's Requirements - Functional, the Contractor's Technical Proposals, submitted along with this tender and the other requirements of the Contract.
- 2.3 The Permanent Works shall be designed and constructed to the highest standards available using proven up-to-date good practice. The Specification shall in any case not specify standards which, in the Engineer's opinion, are less than or inferior to those described in the Technical Specifications contained in the Tender Documents. Construction shall be carried out employing the procedures established by the Contractor in his Quality, Safety and Environmental management plans.
- 2.4 The Contractor shall be responsible for obtaining all necessary approvals from the relevant agencies in the design and construction of the Works.

### **3. SCOPE OF WORKS**

- 3.1. Mumbai Metropolitan Region Authority is implementing Mumbai Metro Rail project in the city of Mumbai in Maharashtra, India. Multiple lines of the Mumbai Metro Project are under implementation. A Mumbai Metro Network Map is annexed in this section, which illustrates the existing, under operation metro rail line, metro rail lines which are currently being implemented as well as future network of planned metro rail lines in the

city of Mumbai. However, this contract is only for the Design and build for Trackwork's within Kasheli Depot and contains the following salient features:

- a. Kasheli Depot with ballasted and ballastless track on standard gauge on at grade.
- b. The depot has 30 stabling lines, 4 Future stabling lines, 5 Inspection lines, 4 workshop lines, 2 shunting lines and separate lines for Engineering siding, 2 Car Unloading, RRV, 2 CMV, Diesel Locomotive, 1 Heavy cleaning, 1 Pit wheel lathe.
- c. There is also a dedicated test track in the depot.
- d. 25 KV AC overhead traction system with Cab Signaling and Automatic Train Protection (ATP) / ATO/ATS based on CBTC system (Communication based Train Control) will be provided on Standard Gauge Corridor.

3.2. The alignment drawings enclosed in Tender drawings. For details refer General Arrangement Drawings in Volume- 5 of the tender document.

3.3. The Permanent and Temporary works shall comprise Design and Construction of Track works in Depot at grade level, Kasheli Depot of Line 5 Metro rail project. The work content in this contract consists of, but not limited to, supplying all labour, materials, tools, plants and necessary machinery as required to complete and commission all the works as listed below.

**Survey and Investigation**

- a) Detailed design of Track works including its all components.
- b) Setting out of final alignment.
- c) Supply, installation, testing and commissioning and all miscellaneous works for the Ballasted and Ballastless track, turnouts and other track appurtenances to the required Standards and specifications.
- d) Supply of all materials whatsoever required for the work such as Rails UIC 60E1 1080 Grade HH, 880 / R 260, check rails, switches & crossings, rail expansion joints (if required), fastenings, buffer stops, reinforcement steel, cement, ballast, sleepers etc. The Contractor will make arrangements for mechanized handling and transportation of all materials (including the materials supplied by the designated contractor, if any for the track linking) to the work site.
- e) Welding of UIC 60E1 rails –Grade 1080 Head hardened and Grade 880 / R 260 rails, including turnout welds, REJ welds (if required), IRJ welds etc. using the specified welding techniques i.e., on track Mobile flash butt welding, AT weld will be allowed, only at location where Flash Butt Welding is not possible, contractor has to take prior permission for these locations from the Engineer.
- f) Provisions of corrective action for missing/inadequate shear connectors in reinforced concrete wherever required for ballast less track.
- g) Design and construction of (i) Ballastless track/ special track, in depot like level crossing track, Column on short and long steel column tracks, embedded track, pit track and (ii) Test Track, plain line tracks, turnouts, crossover, rail expansion joints (if required) buffer stops, check rails etc.

Embedded track and level crossing track should be designed / constructed in such a manner that it should be allowed rail to move after fastener resistance. i.e., embedded material must not interfere in movement of rail due to thermal forces.

- h) Contractor shall follow suitable construction methodology to avoid buckling/crack of concrete in embedded tracks, level crossing tracks etc.
- i) Design and construction of steel column track including supply and fixing Steel Columns, Anchor bolts, Rails, etc., to complete all works as per the drawings given in Volume 5 of Tender document.
- j) Contractor shall consider all the interface requirements as specified in volume - 4 of Tender document.
- k) Implementation of earthing, bonding measures for insulation of the running rails and in the track slab / plinth construction (if required) as per specifications, drawings and in coordination with the Power Supply Contractor.
- l) Way side fixtures such as signage posts, track sign board, SBL Siding Name etc.
- m) Providing office accommodation at site for Engineer.
- n) Testing of components and installation methods.
- o) Integrated testing and commissioning along with Signaling Contractor, Rolling Stock Contractor, Power Supply contractor, communication contractor, Civil contractor, Depot Contractor etc. as required. Such tests shall include both static and dynamic tests for all the tracks.
- p) Procurement, transportation and delivery of spares/tools and storage of spare parts/tools to the designated storage area.
- q) Provide special tools and equipment as per requirements and approved list for the execution of preventive maintenance and repairs
- r) Provision of training for Employer, Engineer & O&M staff about functioning and maintenance of the installed ballasted and Special Ballastless tracks forms, turnouts, and other components to be scheduled for minimum 2 weeks / 80 hours.
- s) Design and Construction of drainage system in ballast less and ballasted track structure to keep the track free of water
- t) Design should be such that the noise and vibration levels are moderated within acceptable levels.

- 3.4. The contractor will be required to provide/secure access for his work/works of interface contractors in co-ordination with the Interface Contractors. The access will be for rails & other track material, and machines, instruments etc. required for laying Track, and installing Interface Contractors' equipment. Such access will be provided / secured by the Contractor as per the programme agreed with the



Interface Contractors & duly approved by the Engineer.

#### **4. ALIGNMENT FOR ENTIRE WORK**

- i) The alignment on viaduct and depot shall be as shown in the tender drawings. The alignment has been developed by the Employer to meet operational and technical criteria. The Contractor shall verify the geometrical correctness of the Alignment. Before the laying of any tracks the Contractor shall inspect and survey the as-built civil works and verify that the designed alignments can be accommodated without infringement of any of the structure gauge clearances required in compliance with the Schedule of Dimensions (SOD).
- ii) The Contractor is permitted to propose minor deviations in alignment duly fulfilling the alignment criteria and tolerances to suit his construction proposals, but he must demonstrate that any such deviations improve the technical and operational performance. Such deviations shall require prior approval of the Employer subject to following conditions: -
  - There is no extra cost to the Employer
  - Changes proposed are essentially required to suit the Contractor's specific design
  - There is no change at the contract boundaries or if there is any, the same is agreed by the Designated Contractors including the contractor of the adjoining section without any extra cost to the Employer.
- iii) The Contractor shall install the track as per alignment approved by the Employer within the permissible tolerances without deviations.
- iv) Alignment should be reviewed by Alignment/track expert of the contractor with respect to safety and comfort of passenger and allowed to do minor modifications in design.
- v) All liabilities of design and safety of all Track related works executed lies with the Contractor

#### **5. CLEARANCES**

- i) The Permanent Works shall not infringe the Structure Gauge as shown on the drawings. Extra clearance shall be provided on curved alignment as per the Schedule of Dimensions.
- ii) The Permanent Works shall provide for the installation by the Designated Contractors of operating equipment for the railway and without infringement of the Structure Gauge.
- iii) Railway clearances:

Various clearances shall be provided as per the schedule of dimensions approved for the Mumbai Metro Rail Project of MMRDA.
- iv) Construction limits:
  - (a) The limits of available space for the works are shown in the drawings of supporting civil structure/ worksite drawings. The Contractor will design the works to contain within that space with minor modification if required for design criteria without effecting existing civil structure.

- (b) In the event of any change in the drawings of supporting structure, the Contractor shall make any adjustments necessary to the design to acknowledge the changes to the limits as then defined.

## **6. DESIGN LIFE**

- i) All PSC concrete sleepers shall have a minimum design life of 50 years. All RCC plinth etc., should have minimum life of 100 years.
- ii) Design life of all PVC, rubber, nylon components of track (like GRSP Liner, Sim etc.), should be minimum 15 years.

## **7. DURABILITY AND MAINTENANCE**

- i) The Permanent Works shall be designed and constructed such that, if maintained reasonably and in accordance with the Contractor's statement of maintainability contained in the Contract, they shall endure in a serviceable condition throughout their minimum lives as described in the Technical Specifications (Design related Criteria).
- ii) The Permanent Works shall be designed and constructed so as to minimize the cost of maintenance whilst not compromising the performance characteristics and ride quality of the railway.

## **8. OPERATIONAL REQUIREMENTS**

- i) The Permanent Works at test track shall be designed for a design speed of 95 kmph to permit the Metro railway to operate safely and satisfactorily at a maximum operational speed of 85 kmph in Main line & test track. The Permanent Works at depot shall be designed for a design speed of 25 kmph to permit the Metro railway to operate safely and satisfactorily at a maximum operational speed of 15 kmph in Depot lines.
- ii) The vertical and horizontal alignments for the depot line track work shall comply with the conditions laid in para 3 of this document above.
- iii) An efficient drainage arrangement in Track Design shall be considered and installed by the Contractor in the Depot to keep the track free of water.
- iv) During construction the Contractor shall be responsible for providing and maintaining adequate flood protection to ensure protection of the works, Rails & other P-Way materials.
- v) In the design and construction of the Works, the Contractor shall, as a fundamental objective and as a priority, ensure that passengers, staff and the public will, throughout the operational period of the Mumbai Metro, and within the confines thereof, be provided with as safe an environment as is reasonably possible.

## **9. ENVIRONMENTAL CONSIDERATIONS AND PROTECTION REQUIREMENTS**

All provisions and conditions contained in the conditions of contract on SHE shall be strictly complied with.

### **9.1. GENERAL**

- 9.1.1 The Contractor shall conform to the Indian Environmental Laws and codes as applicable. The current national standards established by the Ministry of Environment and Forest, Government of India, and other government agencies for control of environmental pollutants such as air, water, noise, and visual impacts/aesthetics shall be followed for compliance during project construction.
- 9.1.2 The Contractor shall comply with all enactments and their amendments, which shall include but are not limited to:
- i) Environment Protection Act, 1986
  - ii) Air (Prevention and control of Pollution) Act, 1981
  - iii) Water (Prevention and Control of Pollution) Act, 1974
  - iv) Notification on Control of noise from DG sets, 2002
  - v) The Noise pollution (Regulation & Control) rules, 2000
  - vi) The Hazardous Waste (Management & handling) Rules, 1989
  - vii) Manufacture, storage and Import of hazardous chemicals Rules, 1989
  - viii) Regulation on Recycling of Waste Hazardous Materials
  - ix) Batteries (Management & Handling) Rules, 2001
  - x) Maharashtra Tree Preservation Act
  - xi) Requirements of Maharashtra Urban Arts Commission and Central Vista Committee.
- 9.1.3 The provisions listed herein regarding Environmental Protection shall apply to and be binding upon the Contractor for any works on the site and the persons employed by sub-Contractors. The Contractor shall ensure that proper and adequate provisions to this end are included in all sub-contracts placed by him.
- 9.1.4 The provisions of this Appendix, however, shall not be applicable in the case of emergency works necessary for saving of life and property or safety of the Works.
- 9.1.5 The Contractor has been issued with the Employer's Environmental Quality Management Manual. Within 20 weeks of notification of acceptance of the Tender, the Contractor shall submit for review by the Employer's Representative, a draft of his own contract specific Site Environmental Plan based on the environmental protection requirements contained in this chapter and on the Employer's Environmental Quality Management Manual and his construction methodology. He shall submit a final version prior to the commencement of the works.

- 9.1.6 This contract specific Site Environmental Plan of the Contractor, shall be consistent with the provisions of the Environmental Management Plan outline, as given in the Employer's Environmental Quality Management Manual.
- 9.1.7 On account payment to be made after three months of issuance of Letter of Acceptance, shall be released, if site environmental plan has been submitted by the contractor and approved by Employer's Representative. Otherwise Rs.1,50,000 (Rupees One lakh fifty thousand as lump sum amount shall be withheld from running bill till compliance of the above.
- 9.1.8 The Contractor shall ensure that audits of all the activities detailed in his Site Environmental Plan are carried out at weekly intervals or at such intervals as the Employer's Representative may require to ensure the continuing effectiveness and compliance with the Site Environmental Plan. The Contractor shall make available on request any document, which relates to his recent internal audits.
- 9.1.9 For closure of Non-Conformance Report, expeditious action shall be taken by the contractor for compliance and the contractor shall ensure closure of non-conformance report within 15 days of its issue. In case of non-closure of report, an appropriate amount shall be withheld from running on account bill for every non-closure of report till the same is closed satisfactorily.
- 9.1.10 The Employer's Representative may conduct quarterly Audits of the Contractor's Site Environmental Plan and its effective implementation on the works site. One-week notice will be given by the Employer's Representative before proceeding with the audit. During the audit by the Employer's Representative, the Contractor shall provide suitably qualified staff to accompany the auditor.
- 9.1.11 Milestone payments will be achieved for successful quarterly audits for which the Employer's Representative has issued a "Notice of No Objection" or a "Notice of No Objection subject to previous milestone delay recouped by achieving faster progress in present or next milestone.
- 9.1.12 The contractor shall carry out its own Environmental Audits after four months of issuance of Letter of Acceptance and every three months thereafter. Submission of Environmental Audit Report duly reviewed and accepted by Employer's Representative along with action taken shall be ensured within one month of due date of such audits. Otherwise, a lump sum amount of Rs. 1,00,000 (Rupees One lakh) shall be recovered for each failure from running bill and this shall not be refunded.

## **9.2. HOUSEKEEPING**

- 9.2.1 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.
- 9.2.2 Following site clearing and before construction of its contracted activities, the Contractor shall remove all trash and debris.
- 9.2.3 The Contractor shall ensure that the workplace is as far as practicable, maintained in a neat and tidy manner. The materials for use and tools and tackles shall be stacked and stored in a manner that is safe and does not cause obstruction to movement of men and machines at site.

- 9.2.4 The Contractor shall maintain the worksite free of trash, garbage and debris. He shall provide and ensure proper uses of refuse containers to ensure that rodents, flee and other pests are not harbored and attracted.
- 9.2.5 These may be 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. The refuse containers shall be kept upright with their lids shut tight. These containers shall be emptied at-least once daily by the Contractor to maintain site sanitation.
- 9.2.6 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 described in (16.2.5) above. Suitable notice shall be deployed prominently for strict compliance of these requirements.
- 9.2.7 Separate containers shall be used for non-biodegradable and reusable/recyclable wastes and properly labelled.
- 9.2.8 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 suitably provided.
  - v) Posters in both Hindi, English and Marathi, which draw attention to the dangers of permitting mosquito breeding, shall be displayed prominently on the Site.

### **9.3. AIR QUALITY**

- 9.3.1 The Contractor shall take all necessary precautions to minimize fugitive dust emissions from operations involving excavation, grading, clearing of land and disposal of waste. He shall not allow emissions of fugitive dust from any transport, handling, construction, Loading and Unloading of ballast or any 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’s Representative.
- 9.3.2 The Contractor shall use construction equipment designed and equipped to minimize or control air pollution. He shall maintain evidence of such design and equipment and make these available for inspection by Employer’s Representative.
- 9.3.3 If after commencement of construction activity, Employer’s Representative 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’s Representative and implemented.

- 9.3.4 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.
- 9.3.5 Dust generating materials shall be:
- (i) Transported in closed containers or covered trucks.
  - (ii) Loaded and unloaded in closed systems or wind protected areas.
  - (iii) Watered as appropriate to minimize dust production.
- 9.3.6 Contractor's transport vehicles and other equipment shall conform to emission standards fixed by Statutory Agencies of Government of India from time to time at Mumbai. The Contractor shall carry out periodical checks and undertake remedial measures including replacement, if required, so as to operate within permissible norms.
- 9.3.7 In the event that approved remedial measures are not being implemented and serious impacts persist, the Employer's Representative may direct the Contractor to suspend work until the measures are implemented, as required under the Contract.
- 9.3.8 The Contractor shall cover loads of materials, debris and soil 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.
- 9.3.9 The Contractor shall be responsible for ensuring that no earth, rock or debris is deposited on public or private right of way as a result of his operations, including any deposits arising from the movement of loaded/unloaded trucks and/or other construction vehicles. In the event of it happening, the contractor shall clean the public/private right of way to the satisfaction of Employer's Representative.
- 9.3.10 The Contractor shall make his own arrangements for water for purposes stated in above clauses and wherever it may be required to control air pollution, dust and debris.
- 9.3.11 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's Representative.
- 9.3.12 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's Representative.
- 9.3.13 The Contractor shall protect structures, utilities, pavements, public and private right of way and other facilities from disfiguration and damage due to contractor's activities including movement of construction equipment and machinery. Should this happen, he shall make good the damage and remedy the situation to the satisfaction of the Employer's Representative.
- 9.3.14 The Contractor shall place excavation materials in the dumping/disposal areas designated in the plans as given in the specifications.

- 9.3.15 The temporary dumping areas shall be maintained by the Contractor at all times until the excavate is re-utilized for backfilling or as directed by Employer's Representative.
- 9.3.16 The Contractor shall place material in a manner that will minimize dust production. Material shall be stabilized each day and wetted, to minimize dust production.
- 9.3.17 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.
- 9.3.18 The Contractor will make water sprinklers, water supply and water delivering equipment available at any time that it is required for dust control use.
- 9.3.19 Dust control activities shall continue even during any work stoppage.
- 9.3.20 At each construction site, the Contractor shall provide storage facilities for dust generating materials and shall be:
- (i) Closed containers/bins or;
  - (ii) Wind protected shelters or;
  - (iii) Mat covering or;
  - (iv) Walled.
- Or any combination of the above to the satisfaction of the Employer's Representative.
- 9.3.21 The Contractor shall submit to the Employer's Representative an Air Monitoring and Control Plan (AMCP) under contract specific Site Environmental Plan to guide construction activity at work sites insofar as it relates to monitoring, controlling and mitigating air pollution. Air monitoring devices used for such monitoring shall be inspected, calibrated, maintained, and used in accordance with the manufacturer's instructions.
- 9.3.22 For the above tunnel works, Suspended Particulate Matter (SPM) shall be monitored, at three locations for two 24-hour samples, every fifteen days. Number of locations can be increased or decreased by the Employer's Representative depending on the extent of construction activity and its proximity to air sensitive receptors. Permissible values for SPM shall be the recorded base line values or national standards, whichever is higher.
- 9.3.23 For its activities within the confined spaces, the contractor shall monitor flammable gases, oxygen, carbon monoxide, carbon dioxide, hydrogen sulphide, oxides of nitrogen, and aldehyde. The contractor shall also monitor for any other poisonous gas that the Employer's Representative shall deem appropriate and necessary.
- 9.3.24 Air monitoring in confined spaces shall be carried out as often as necessary, however, the duration between two sets of readings shall not be more than 4 hours.
- 9.3.25 Within the confined spaces, air shall be considered unfit for workmen to breathe if it contains any of the following:

- (i) Less than 19.5% and more than 22% oxygen by volume.
- (ii) More than 0.5% carbon dioxide by volume.
- (iii) More than 0.01% carbon monoxide by volume.
- (iv) More than 0.001% hydrogen sulphide by volume.
- (v) More than 0.003% oxides of nitrogen.
- (vi) More than 0.5% of methane at any place in the tunnel.
- (vii) More than 0.0005% of aldehyde.

Any other poisonous gas in harmful amounts.

- 9.3.26 A record of all air quality monitoring containing location, date, time, substance, monitoring results and name of person conducting the tests shall be maintained by the contractor and made available for inspection by the Employer's Representative.

#### **9.4. WATER QUALITY**

- 9.4.1 The Contractor shall comply with the Indian Government legislation and other State regulations in existence in Mumbai insofar as they relate to water pollution control and monitoring.
- 9.4.2 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.
- 9.4.3 In the event of any spoil or debris from construction works being deposited on adjacent land 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's Representative.
- 9.4.4 Due to lowering of potable water supplies in Mumbai and subsequent contamination of ground water, the Contractor is not allowed to discharge water from the site without the approval of the Employer's Representative. The Contractor must comply with the requirements of the Central Ground Water 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's Representative, 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.
- 9.4.5 The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to the site are kept safe and free from any debris and any excavated materials arising from the Works. The Contractor shall ensure that earth, bentonite, chemicals, any mud slurry from drilling or grouting and concrete agitator washings etc. are not deposited in the watercourses and not discharged into the drainage system unless treatment is carried out that will remove silt, mud particles, bentonite etc. but are suitably treated and effluents and residue disposed off in a manner approved by local authorities.



- 9.4.6 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 of at a location and in a manner that will cause neither pollution nor nuisance.
- 9.4.7 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.
- 9.4.8 The Contractor shall take measures to prevent discharge of oil and grease during spillage from reaching drainage system or any water body. Drips pans, placed on hard surface shall be used to store oil/grease drums.

## **9.5. NOISE**

### **9.5.1 GENERAL**

- i) The Contractor shall consider noise as an environmental constraint in his design, planning and execution of the Works. 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.
- ii) Without prejudice to the generality of the foregoing, noise level reduction measures shall include the following:
  - (a) 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.
  - (b) the Contractor shall construct acoustic screens or enclosures around any parts of the Works from which excessive noise may be generated.
- iii) The Contractor shall ensure that, as far as ambient noise is concerned, noise generated by work carried out by the Contractor and his sub-Contractors during daytime and night time shall not exceed the background noise levels by 10dB(A) or more when measured at a point outside the premises of the location of the source. When background noise levels are not available, the permissible noise levels shall meet the requirements as given in the Environmental Quality Management Manual. The same may be varied from time to time by and at the sole discretion of the Employer's Representative. 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.
- iv) For ambient noise level compliance, number of monitoring locations shall be at least four. Number of locations can be increased or decreased by the Employer's Representative depending on the extent of construction activity and its proximity to noise sensitive receptors. The other noise

monitoring requirements shall be as given in the Employer's Environment Quality Management Manual.

- v) For noise emanating from generators run with diesel, notification dated 17th May 2002 under Environmental (Protection) Act, 1986 shall apply which require acoustic treatment or acoustic enclosure such that insertion loss of 25dB(A) is obtained or ambient noise standards are met, whichever is on the higher side.

9.5.2 Protection against the effects of occupational noise exposure shall be provided when the sound levels exceed those shown in Table of this section when measured on the A-scale of a standard sound level meter at slow response.

9.5.3 When employees are subjected to sound levels exceeding those listed in Table of this section, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

**TABLE**

Permissible Noise Exposures Duration per Day, Sound Level Hours (Slow Response)

8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115

9.5.4 If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous. In all cases where the sound levels exceed the values shown herein, a continuing, effective hearing conservation program shall be administered.

9.5.5 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

$Fe = (T1 / L1) + (T2 / L2) + \dots + (Tn / Ln)$  where:

$Fe$  = The equivalent noise exposure factor.

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

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

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

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

110 db A 1/4 hour. 100 db A 1/2 hour. 90 db A 1 1/2 hours.

Then,  $Fe = (1/4/1/2) + (1/2/2) + (1\ 1/2/8)$

$Fe = 0.500 + 0.25 + 0.188$

$Fe = 0.938$

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

9.5.7 Construction material should be handled and transported in such a manner as not to create unnecessary noise as outlined below.

9.5.8 Under the Contract, the Contractor shall:

- 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's Representative 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 nighttime, and of his proposed working methods and noise level reduction measures. The NMCP shall include detailed noise calculations to demonstrate the anticipated noise generation 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 shall appear as a regular agenda item in project coordination meetings.

## **9.6. VIBRATION LEVEL LIMITS**

- 9.6.1 The vibration level limits at historical sites adjacent to the alignment shall conform to revised version of the German Standard (DIN 4150). The scheme for monitoring vibration level at these historical sites shall be submitted to Employer's Representative for his approval. The scheme shall include:
  - 9.6.2 monitoring requirements for vibrations at regular intervals throughout the construction period.
  - 9.6.3 pre-construction structural integrity inspections of historic and sensitive structures in project activity.
  - 9.6.4 Information dissemination about the construction method, probable effects, quality control measures and precautions to be used.

## **9.7. WASTE**

- 9.7.1 The Contractor shall handle waste in a manner that ensures they are held securely without loss or leakage thus minimizing potential for pollution.
- 9.7.2 The Contractor shall remove waste in a timely manner. Scrap and waste material shall be removed and disposed off at landfill sites after obtaining approval of Conservancy and Sanitation Engineering Department of Municipal Corporation of Mumbai for its disposal.
- 9.7.3 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 (2) above.
- 9.7.4 The Contractor shall maintain and clean waste storage areas regularly.
- 9.7.5 If encountered or generated as a result of Contractor's activity, then waste classified as hazardous under the "Hazardous Wastes (Management & Handling) Rules, 1989" and 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.
- 9.7.6 The contractor shall ensure that oily waste including oil-soaked rags/cotton is disposed off to agency authorized to dispose such waste. The contractor shall sell discarded batteries to the authorized recycler of such items.

## **9.8. PREVENTION OF MOSQUITO BREEDING**

9.8.1 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 suitably provided.

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

## **9.9. TRAFFIC MANAGEMENT**

The Contractor shall carry out the Works so as to minimize disruption to road and pedestrian traffic. The Contractor shall prepare his traffic management plan based on his proposed construction methodology in co-ordination with Engineer and in conjunction with Mumbai Traffic Police. He shall comply strictly with the approved plan during construction of his works. The design shall provide for temporary road decking wherever necessary to provide minimum no. of traffic lanes as agreed with Mumbai Traffic Police.

## **9.10. SAFETY CERTIFICATION**

The Contractor shall note that the Commissioner for Metro Railway Safety (CMRS) will inspect the Works from time to time for the purpose of determining whether the Mumbai Metro complies, in terms of operational and infrastructural safety, in accordance with the Laws of India. The contractor shall note that CMRS approval is mandatory for commissioning the system. Not with standing other provisions of the Contract, the Contractor shall ensure that the Works comply with the requirements of CMRS in terms of construction to the drawings and shall assist the representatives of CMRS in carrying out their inspection duties and also comply with their instructions regarding rectifying any defects and making good any deficiencies.

## **9.11. STANDARDS**

- i) Equipment, materials, and systems shall be designed, manufactured, and tested in accordance with the latest (up to date of bid submission) issue of International and/or National codes and standards. The Contractor shall submit copies to the Engineer of all codes and standards used for the work.
- ii) Reference to standards or to materials and equipment of a particular manufacturer shall be regarded as followed by the words "or equivalent". The Contractor may propose alternative standard materials, or equipment that shall be equal to or better than those specified. If the Contractor for

any reason proposes alternatives to or deviations from the specified standards, or desires to use materials or equipment not covered by the specified standards, the Contractor shall apply for the consent of the Engineer. The Contractor shall state the exact nature of the change, the reason for making the change and relevant specifications of the materials and equipment in the English language. The decision of the Engineer in the matter of quality will be final.



**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**DESIGN, DEVELOPMENT, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF STANDARD GAUGE TRACKWORKS (BALLASTED AND BALLASTLESS) IN KASHELI DEPOT TRACKS FOR LINE 5 CORRIDOR OF MUMBAI METRO RAIL PROJECT OF MMRDA, MUMBAI**

**TENDER DOCUMENTS**

**CONTRACT NO: MMRDA/MPIU/ML5/CA-303**

**TENDER DOCUMENTS**

**VOLUME 3**

**EMPLOYER'S REQUIREMENTS**

**SECTION C: DESIGN**

**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**Metro PIU, 7<sup>th</sup> Floor, New Administrative Building,  
Bandra-Kurla Complex, Bandra (E), Mumbai –400 051, India**

## **SECTION C: EMPLOYER'S REQUIREMENTS - DESIGN**

### **1. INTRODUCTION**

- 1.1. The Employer's Requirements - Design set out the procedural requirements governing the design of the Permanent Works and their components, including but not limited to turnout diamond assemblies, PSC sleepers, buffer stops, and associated depot track works in accordance with the approved layout and design criteria. These requirements are classified into those applicable during the Design Phase, those applicable during the Construction Phase, and those of general applicability.
- 1.2. In addition to the requirements herein, the Contractor shall, whenever the Engineer so requests, provide information and participate in discussions that relate to design matters.
- 1.3. The Contractor shall engage the Designer who shall undertake and prepare the design of the Permanent Works and Temporary Works. The Contractor shall establish an office for his core design team at the Site in Mumbai. The core design team shall function from this office and all meetings and discussions relating to design shall be held in this office.
- 1.4. All design data of certain nonstandard structure as ascertained by the Engineer shall be proof checked by IIT/ Government Institute of repute. The contractor shall bear all expenditure (Travel lodging boarding etc. including foreign travel) of all factories visit during design phase and approval, FAT etc. for two person one from Engineer and one from Employer.
- 1.5. Designer continues to be represented in Mumbai at all times by staff whose seniority and experience are to the satisfaction of the Engineer and whose representative is available on the Site as necessary or as required by the Engineer.
- 1.6. The Contractor shall submit his Quality Assurance Plan as required at Appendix 6 for the design required by the Contract.

### **2. REQUIREMENTS DURING DESIGN PHASE**

- 2.1. The principal requirements of the Design Phase are the production of the Preliminary Design, the Definitive Design, and the Construction Reference Drawings in line with GAD and depot layout and drawings given in tender. It should be clearly understood that the Tenderer's Technical proposal submitted along with his tender including any modifications to the same during negotiations stage shall only form the basis for further design into the preliminary and Definitive Design, subject to the compliance of the Tender Design with relevant regulations and standards and conforming to the Outline Design Specifications of Technical Specifications.
- 2.2. Preliminary Design

The Preliminary Design shall incorporate the Contractor's tender design developed to sufficiently define the main design elements. In addition, general construction methods and documentation needed to develop the Definitive Design shall be submitted.



- 2.3. Definitive Design shall accord with and incorporate the Preliminary design and shall be the design developed to the stage at which all elements of the structures are fully defined and specified and in particular:
- a) Calculation and analysis are complete fulfilling design criteria.
  - b) All main and all other significant elements are defined.
  - c) All tests and trials and all selection of materials and equipment are complete.
  - d) Shall take full account of the effect on the Permanent works of the proposed methods of construction and of the Temporary Works.
  - e) Interface Management Plan (IMP).
- 2.4. During preparation of the Definitive Design, the Contractor shall complete all surveys investigations and testing necessary to complete the design of the Permanent Works.
- 2.5. The Contractor shall sub-divide the proposed Definitive Design into Design Packages to be submitted in advance of the Definitive Design Submission and to be identified in the Design Submission Programme. The Design Packages are to relate to the significant and clearly identifiable parts of the proposed Definitive Design and shall address the design requirements as described herein. The Design Packages shall facilitate the review and understanding of the Definitive Design as a whole and shall be produced and submitted in an orderly, sequential, and progressive manner.
- 2.6. Separate Definitive Design Submissions may be prepared for those major elements to be procured by sub-contract and which sub-contracts include design. Where such work is to be procured by the Contractor on the basis of outline design, design briefs and performance specifications, such documents may be submitted as Definitive Design Submissions.
- 2.7. Upon issue of the Notice in respect of the Definitive Design Submission, the Contractor shall complete the design in all respects and produce the Construction Reference Drawings, the purpose of which is to illustrate all the Permanent Works and to be the drawings governing construction.
- 2.8. Construction Reference Drawings shall fully detail for the construction of the elements covered by the Definitive Design and shall show in full the works to be constructed.
- 3. REQUIREMENTS DURING CONSTRUCTION PHASE**
- 3.1. The principal requirements relating to design during the Construction Phase are the production of Working Drawings, the preparation of technical submissions as required under the Contract, the compilation of the Final Design and the production of the As-Built Drawings.
- 3.2. Working Drawings shall be prepared as required under the Contract. They shall be endorsed by the Contractor as being in accordance with the Construction Reference Drawings.
- 3.3. The Contractor shall endorse the submissions required under the contract that “all effects of the design comprising the submission on the design of adjacent or other parts of the works have been fully taken into account in the design of these parts”
- 3.4. The Contractor shall submit the Final Design to the Engineer as per the Key Dates.
- 3.5. The Final Design is the design of the Works embodied in:
- a) The latest revisions of the documents comprised in the Definitive Design, taking account of comments in the schedules appended to Notices of No Objection.
  - b) The latest revisions of the Construction Reference Drawings.

- c) co-ordinated interfaces and such other documents as may be submitted by the Contractor at the request of the Engineer to illustrate and describe the Permanent Works and for which a Notice has been issued.
- d) such other documents as may be submitted by the Contractor at the request of the Engineer to illustrate and describe the Works.

**3.6.** The Contractor shall maintain all records necessary for the preparation of the As-Built Drawings. Upon completion of the Works or at such time as agreed to or required by the Engineer, the Contractor shall prepare drawings which, subject to the Engineer's agreement, shall become the As-Built Drawings. All such drawings shall be endorsed by the Contractor as true records of the construction of the Permanent Works and of all temporary works that are to remain on the site. The Contractor shall also show the locations of utilities exposed and retained as directed.

#### **4. DESIGN INTERFACES WITH DESIGNATED CONTRACTOR**

The Contractor shall co-ordinate all design and installation work with the various Designated Contractors and establish the Co-ordinated Installation Plan (CIP). The co-ordinated installation Plan (CIP) shall be developed by the contractor in a format acceptable to the Engineer. The Contractor shall co-ordinate with all interfacing Designated Contractors to produce a detailed programme of access dates, equipment delivery routes and occupation and CIP shall be signed off by each Designated Contractor and Submitted to the Engineer accordingly.

#### **5. DESIGN SUBMISSIONS**

##### **5.1. PRELIMINARY DESIGN SUBMISSION**

##### **5.1.1. GENERAL**

The preliminary design shall provide initial design documents for review and shall be sufficiently detailed to show the main elements of the design and documents required for preparation of the definitive design. It shall also include:

- (a) the quality assurance plan for design.
- (b) a review of the outline design criteria
- (c) Preliminary design calculations
- (d) the submission of design manuals
- (e) the submission of proposed software
- (f) the preliminary off-site testing recommendation
- (g) the submission of specifications proposed for the work
- (h) the identification of design codes and standards
- (i) the CAD procedures
- (j) Preliminary cross section of ballast less track and ballasted turnouts in viaduct
- (k) an alignment reviews
- (l) the preliminary construction methodology
- (m) the design submission programme (update)
- (n) proposed site surveys and other field surveys

- (o) the preliminary monitoring plans

## **5.2. DEFINITIVE DESIGN SUBMISSION**

### **5.2.1. GENERAL**

The Definitive Design Submission shall be a coherent and complete set of documents properly consolidated and indexed and shall fully describe the proposed Definitive Design. In particular, and where appropriate, it shall define:

- a) the dimensions of all major features, structural elements, and members.
- b) all materials.
- c) potential forces and movements due to all possible loadings including rail-structure interaction and actions on the structures, and their accommodation.
- d) all second order effects.
- e) Detailed design calculations.
- f) the layout and typical details of reinforcement in structural concrete members.
- g) the locations and nature of all relevant joints and connections and details thereof.
- h) standard details.
- i) location, geometry and setting-out of all main elements and features.
- j) provisions and proposals for construction interfacing with the Designated Contractors.
- k) Construction sequence and details.
- l) Drainage arrangements.
- m) Vibration and Noise attenuation requirements (if required)

### **5.2.2. DRAWINGS**

The Definitive Design Submission shall include drawings that shall illustrate the proposed Definitive Design and in particular shall include, without limitation:

- a) General arrangements.
- b) Vertical alignment
- c) Horizontal alignment
- d) Fastening system in Ballastless and ballasted track
- e) Crossovers and turnouts
- f) Special Track forms in Depot -Embedded,Pit ,Column etc
- g) Insulated Rail joints
- h) Signs and markers
- i) Buffer Stops , Wheel Stops

j) CWR/LWR Plans

## **6. DESIGN CRITERIA/TECHNICAL STANDARDS OF TRACK STRUCTURE**

### **6.1. SCOPE**

Design Standard /Employer's requirement for construction of ballast less and ballasted track for Kasheli depot in Line 5 corridor MMRDA project.

#### **i) OPERATING ENVIRONMENT**

Track Structure should fulfil generally the following conditions:

Standard gauge – 1435 mm.

Rail Seat inclination (slope): 1 in 20

Static axle load –17 Tonne

Design rail temperature range – As per LWR Manual

#### **ii) TRACK STRUCTURE**

**General: The track structure should fulfil the following requirements:**

- a) The track structure should conform to/ satisfy Schedule of Dimension requirement and other maintenance instructions of MMRDA.
- b) Ride comfort and running safety of track vehicle dynamics should be satisfied.
- c) The track structure should be designed with Long welded / Continuously welded rail on depot line track in case of ballasted as well as ballast less track.
- d) The horizontal and vertical profile should be designed in consultation with Engineer to suit already planned and executed civil work in Depot. The curve should be deigned with maximum transition length with minimum circular curve length of 25 m.

**The technical standards for Track structure deals with the following components-**

- a) Rail and Welding
- b) Sleeper and fastening for ballasted track
- c) Track slab for ballastless track
- d) Specification for Ballasted track and Ballast
- e) Insulated Glued joint (if required)
- f) Turnout, scissors crossover, Derailing switch.
- g) Switch Expansion Joints
- h) CWR and LWR track
- i) Special track structure for depot as per lay out Plan GAD.

- j) USFD for rails and weld.
- k) Turnouts and crossovers.

## **7. RAILS AND RAIL WELDING**

### **7.1. RAILS**

#### **i) GRADE OF RAIL**

- a) Rail to be used on test track shall be UIC 60E1, 1080 grade Head Hardened.
- b) Rail to be used on depot line on, curves and approaches and lead rails of the turnouts of Depot, shall be 60E1 (UIC 60), 1080 Head Hardened.
- c) At other locations on straight line of depot line, the use of 60E1 (UIC 60), 1080 grade HH / 60E1 (UIC 60), 880/ R260 grade rail shall be decided by Engineer as per requirement, depending upon speed, axle load and other factors pertaining to safety and Durability of track structure. However, on curves with small straight track in between, the 60E1 (UIC 60), 1080 grade Head hardened rail should be continued on straight/ curve patches also.

#### **ii) SPECIFICATION:**

- a) The rail shall be class 'A' rails as per IRS-T-12-2009 specification with latest (up to date of bid submission) amendments.
- b) The rail shall be manufactured and tested in accordance with IRS-T-12-2009/EN (with latest amendment date of bid submission). The chosen manufacturers shall be required to submit their inspection and test plan for approval by Metro railway as per IRS-T-12-2009.

#### **iii) GENERAL REQUIREMENTS**

All the rails to be laid in the track structure shall be flat bottom Rails as per latest specifications: IRS T12- 2009. Only new rails will be used for the permanent works.

The broad requirements are as under:

Rail Steel Grade:	1080/880/260R Grade applicable as per approval.
Rail Section Profile:	As per Appendix-II of IRS T12-2009 for UIC 60E1.
Class of Rail:	A Prime rails
Rail Ends:	Undrilled
Colour code:	As per IRS T12-2009
Length of Rail:	18 Meter
Stacking of Rails:	As per IRS Specifications

#### **iv) CLASS OF RAILS**

All rails shall be brand new Class A Prime rails

**v) RAIL MANUFACTURER**

- A)** All Rails Shall be manufactured as per specifications of IRS T12-2009 (up to latest correction slips) Documentary evidence of Head Hardened (HH) rails manufacturing facilities shall be certified by internationally accredited agency/ approved by RDSO (Ministry of Railways).
- B)** The details of supplies made for the Rails should include a performance certificate which should include purchase order details, name of purchaser, the railway projects/ MRTS Project, where used / Being used, the design speed and axle load of the section, quantity of rails supplied and period of supply. The details of address, contact person, fax / e mail is also to be furnished. In absence of the above statement / details, offer will be summarily rejected.
- C)** Additionally, manufactures whose details shall be furnished in the bid by the Contractors along with the following information/confirmation:
  - a) The details of their steel making Process which should be as per IRS T12-2009 Specs or Similar Subject to the approval of Engineer and these shall not be altered during contract performance without PRIOR APPROVAL OF Engineer.
  - b) Detailed method of on-line ultrasonic testing, eddy current testing of rails shall conform to IRS: T-12-2009 with latest correction slip.
  - c) The manufacturer must confirm that its manufacturing process of rails shall comply with the qualifying criteria regarding residual stress, fracture toughness & fatigue as laid down in sub-Para 1 to 3 of Para 22 of IRS: T-12-2009 with latest correction slip.
  - d) The manufacturing process of rails shall be offered to the inspecting agency at the beginning & at intervals as desired by such inspecting agency, to conduct the required tests for qualifying criteria to be satisfied.
  - e) The manufacturer of the rails shall operate an independently approved and audited quality assurance system, conforming to the requirements of ISO 9001 or equivalent.

**vi) RAIL STEEL PARAMETERS**

Rail steel of Grade 1080/880/260R and rails of UIC 60.2 kg/m section shall conform to the Chemical composition & mechanical properties as specified in IRS T12-2009 specifications of Indian Railways upto latest correction slip.

**vii) RAIL SECTION, MARKING & DIMENSIONS**

- a) Rails of nominal UIC 60.21 kg/m as per Appendix-II of IRS T12-2009 shall conform to the dimensions, dimensional tolerances including geometrical defects, markings and shall be subjected to the measurements and tests specified therein.
- b) While handling and transportation of rails, guidelines issued by IR on this important aspect will be strictly followed. This, among other things includes providing suitable dunnage/spacers to protect rails against point contact and the protection of rail ends. At ports, availability of proper facilities for handling of rails will have to be ensured.
- c) A method statement describing in detail the precautions that will be taken during handling and transport of rails and the supervision that will be exercised in ensuring compliance of the right procedures, will be submitted to the engineer for his approval.
- d) The Engineer at his discretion will inspect the rails on arrival at site against any bruising, rubbing nicks and any other damage, reject them and order for their removal from site, if found damaged.
- e) The guidelines issued vide RDSO drawing no. RDSO/T12-6214 will be strictly followed.
- f) The standard length of rails shall be 18.0 meters.
- g) Normally only standard-length rails should be used for the permanent works. The shorter rails may be permitted, if they are not more than 2m shorter than the standard length subject to the provision that such rails should be supplied in pairs to be used opposite each other. However, number of such rails should not exceed 10% of the total requirement for permanent works.

**viii) DEFECT FREE RAILS**

- a) The rails must be free from all detrimental defects having an unfavorable effect on the behavior of the rails in service, such defects include, among others, surface defects & internal defects like cracks of all kinds, flaws, piping, or lack of metal, hot or cold marks, seams, scabs, protrusions etc.
- b) The rails having defect beyond the specified limits, shall be rejected.

**ix) TESTS AND ACCEPTANCE**

- a) The representative(s) of the Engineer and the Employer shall be entitled to observe. by day or night, the method of manufacture and to be present at all tests relating to all batches of casting for this project and to examine the results obtained from such tests.
- b) The manufacturer shall, at his own expense or at the expense of the Contractor, supply all templates & gauges, prepare and supply test pieces and sample of steel, sample of rails, and supply labour and apparatus/equipment, for testing which may be required by the inspecting agency for carrying out all tests as specified in IRS T12-2009 specs. and render reasonable assistance in execution of such tests as desired by the inspecting agency.

**x) GUARANTEE**

Guarantee of the rails will be provided by the Contractor as per the provisions of IRS T12-2009 (Up-to latest correction slips)

**xi) PURCHASE OF RAILS**

The Contractor is free to purchase rails from any domestic or international supplier.

**xii) STACKING OF RAILS-**

Stacking of rails from shall be as per IRS standards.

**xiii) RAIL LAYING TEMPERATURE**

- a) The project length falls in temperature zone II in India as per fig. 1.7 in LWR Manual. The de-stressing temperature will be determined on the basis of the data furnished in figure 1.7 of LWR Manual. Destressing temperature shall be taken from nearby section Engineer (P-Way of Indian Railway)
- b) CWR track lengths installed outside this temperature range shall be de-stressed before the laying Rail.
- c) Neutralization of the stresses in the rails during construction shall be carried out as required by the provisions of the LWR Manual.
- d) Rails after de-stressing shall be checked by a non-destructive rail stress measuring equipment to verify the correctness of the de-stressing temperature. Contractor shall arrange such testing equipment in adequate numbers on its own, which shall also be made available to the Engineer for this purpose. The details of the equipment and its performance characteristics will be submitted to the Engineer and his approval obtained before it is put to use.
- e) The Contractor shall submit detailed process of neutralization of stresses in the rails during construction ensuring that the rails in track remain de-stressed in the prescribed temperature range and shall form part of CWR plans submitted by the Contractor in accordance with above.

**7.2. WELDING OF RAILS:**

- a) The welding of rails should conform to Indian Railway specifications and technical instructions issued from time to time.
- b) All welds will be mobile flash butt weld. Contractor must arrange on track mobile flash butt welding machine.
- c) The present instructions are contained in following documents:
  - **Alumino Thermit Welding:** At location where flash butt weld is impossible.
    - i. Indian Railway Standard specifications for Alumino Thermit Welding of Rails (IRS/T-19 with latest amendment up to date of bid submission)
    - ii. Manual For Fusion Welding of Rails by the Alumino-Thermic Process: Revised-2022 with latest amendment up to date of bid submission
    - iii. Contractor shall conduct sample test for welding different grade of rails as per RDSO AT weld manual before commencing welding work at site. Incase failure of test and retest as stipulated in manual, the Contractor shall develop prototype for welding different grade of rails.
  - **Flash Butt Welding:**
    - i. Manual for Flash Butt Welding of Rails, 2022 with latest amendment up to date of bid submission.



- ii. The FBW machine and its QAP should be approved by RDSO for different grades of Rails.
- d) Only rail panels having a length of not less than 18m except for points & crossings and any other locations approved by the Engineer would be installed in the track which shall be converted to CWR through in-situ welding. In-situ welding will also be carried through mobile flash butt welding plants. Rails would be welded as per the provision of Indian Railway's Manual for Flash Butt Welding of Rails-2022 (herein after referred as FBW Manual). At special locations where the use of mobile flash butt welding plant is not practicable Single shot, auto thimble Alumino Thermic AT underline process may be used, with prior permission of the Engineer.
- e) The design concepts & performance criteria for Single shot, auto thimble Alumino Thermic (AT) weld process shall be as per the internationally accepted norms or as agreed by the Employer during the evaluation of First Stage Technical proposal.
- f) The use of rails with holes shall not be allowed unless specifically permitted by the Engineer for specific locations.

### **7.3. ULTRASONIC TESTING OF RAIL AND WELDS:**

The rails and welds shall be ultrasonically tested in field as per requirement of concerned specification/ manual/ instructions. The testing shall be ensured as per latest provisions of "Manual for Ultrasonic Testing of Rail and Welds- Revised 2022" with latest amendment up to date of bid submission. The provisions of "IRS specification for Ultrasonic testing of Rails/Welds (Provisional), Revised-2022 with latest correction slip" shall also be followed. All track works including turnout shall be tested ultrasonically before commissioning.

## **8. SLEEPER AND FASTENING FOR BALLASTED TRACK**

### **8.1. SLEEPERS STANDARD GAUGE**

- PSC sleeper for standard gauge will be designed by following in principal guidelines of Indian Railway/RDSO and the same shall be approved by Employer and Engineer.
- Wide base flat top rectangular sleeper without cant has to be provided at Turnout and crossover locations. Left hand and right-hand turnout sleeper to be designed separately. The 1 in 20 cant for rail installation has to be provided by steel base plate/chairs.

### **8.2. FASTENING SYSTEM:**

For Ballasted track ERC mark V with 10 mm thick composite GRSP (10 mm composite) and GFN liner of RDSO approved drawing and vendor will be used, duly ensuring the Inspection protocol for fastening components laid down for IR.

## **9. TRACK SLAB FOR BALLASTLESS TRACK, SCISSOR CROSSOVER AND TURNOUTS ETC. (IF REQUIRED)**

Track shall be laid on cast in situ/precast reinforced plinth or slab, herein referred to as the 'track slab'. The track slab shall be designed as plinth beam or slab type ballast less track structure with derailment guards. It shall accommodate the base plates of the fastening system. In case of turnout at ground floor of depot the base slab for track plinth beam /slab also has to be designed by track contractor has to bear all cost, like testing soils and design drawing etc., complete work.

In general, track slab (including sleeper, if any) on which the fastening and rail are to be fitted shall perform the following functions:

- i) Resist the CWR track forces. (Static and dynamic)
- ii) Have adequate edge distance of concrete beyond the anchor bolts to provide resistance against edge failure
- iii) Provide a sturdy level base for uniform transmission of CWR track/rail forces keeping in mind inclination of rail 1 in 20.
- iv) Have geometrical accuracy and enable installation of track to the tolerances laid down.
- v) Ensure drainage.
- vi) Resist weathering.
- vii) Resist corrosion and rusting. Bituminous anti corrosive coating shall be applied for rails as per IR standards before installation. All fittings and fixtures shall be provided anticorrosive treatment. All reinforcement shall be applied with anti-corrosive epoxy coating.
- viii) Be construction friendly, maintainable, and quickly repairable in the event of a derailment. The 'Repair and Maintenance methods' shall be detailed in a Manual to be prepared and made available to Employer/Engineer for approval and to be prepared by contractor.
- ix) Ensure provision for electrical continuity between consecutive plinths/slabs by an appropriate design.
- x) Plinth beam or slab of ballast less track should be suitable for embankment or viaduct /RCC frame structure.
- xi) Proper design of expansion joints suitable for joints of RCC structure.
- xii) Design should be suitable for curves as per SOD of MMRDA.
- xiii) Design should be suitable for depot layout, horizontal and vertical profile and incorporate provision of utilities e.g., cable, wires, ducts, water channels, etc.
- xiv) The detailed design calculations of track slab along with detailed structural drawings as approved by Engineer shall be furnished for record.

## **10. CHECK RAIL / RESTRAINING RAIL**

- i) Check rails/ Restraining Rails shall not be mandatory for curves in depots, yards and non-passenger lines where speed is not more than 25 kmph but sleeper design must have provision to fix check rail in future if required. Check rail should not have any fastening attached to running rail.

## **11. SWITCH EXPANSION JOINT IN CWR TRACK**

- i) Normally switch expansion joint should be avoided in CWR track. If required, the price of these should be treated as included in quoted rate no separate payment will be there.
- ii) Wherever, expansion rail joint shall be used as per latest RDSO drawing Rail expansion shall be manufactured and tested in accordance with RDSO's specifications.

## **12. TURNOUTS, SCISSORS CROSSOVER**

### **12.1. STANDARDS OF TURNOUT:**

#### **12.1.1. Depot lines:**

On depot, the turnouts and diamond crossing shall be of the following standards:

#### **i) STANDARD GAUGE**

- a) All 1 in 7 R-190 type ballasted turnouts with sliding base plate and metallic rollers arrangement under switch rail if back drive is not provided.
- b) 1 in 7 R-190 ballasted Scissors cross-overs consisting of 4 turnouts and 1 diamond crossing with having track centre ~4.5m and ~4.9m as per approved depot layout.
- c) Turnout entry shall be tangential; the switch entry angle shall not exceed 0° 20' 00'
- d) The minimum distance from SRJ to Theoretical Toe of Switch should be 1.5 m
- e) CMS crossing with explosive hardening and weldable leg will be used
- f) There should not be any discontinuity from ATS, Actual Toe of Switch to Heel of crossing.
- g) Layout and Length of 1 in 7 turnouts should be suitable for depot layout and civil work already executed.
- h) Contractor shall design the turnout and CMS crossing suitable for depot layout in which civil work already executed. Therefore, to avoid small pieces of rail between heel of crossing and next SRJ, contractor needs to provide extended legs CMS crossing. No rail piece less than 6.5m will be allowed. Cost of extended leg to be included in quoted rates for turnouts and scissor crossovers. No other extra cost will be payable. To avoid breakage of welded joint and to ensure durability in sharp curves  $\leq R190$  at location of SRJ and buffer joint, spacing of sleeper should be not less than 450mm.
- i) Switch has to be with a sturdy creep anker /creep device to resist forces.
- j) Turn out should be Canted, with can't on steel bearing plates.
- k) The slide chair for switch should have Nickel chrome coating to reduce friction.
- l) Design Speed in Diversion track should be (i) 35 Kmph in 1in 7- 190 R
- m) Track designer should establish the adequacy of the speed potential of the turnout for the purpose for which it is used and the negotiability of the turn out by the rolling stock with a safety margin.
- n) The spares for turnouts including crossing bodies shall be with extended lengths of minimum 600mm as approved by engineer.

- 12.1.2. The requirement for turnouts as specified in the following clauses shall include switch devices, crossings and associated check and lead rails as appropriate and all fitting & concrete sleep
- a) Turnouts (switches, lead, crossings and associated closure & check rails) shall be suitable for installation on PSC sleepers for ballasted track or concrete slab for ballast less track.
  - b) Turnouts shall be manufactured to allow for installation of continuously welded track, CWR should continue through turnout.
  - c) Turnout shall be compatible with proposed rolling stock and its operational characteristics.
  - d) The assembly must ensure continuous electrical contact with the train and all the points shall be operated by electric motors.
  - e) The CMS crossing to be used on mainline shall be subjected to explosive hardening, cant bearing plates.
  - f) All turnouts shall be laid with cant on bearing plates 1 in 20.
  - g) All turnouts and their components shall be designed to minimize electrical leakage from running rails to the ground.
  - h) Scissor crossover should be designed for Track centers not infringing SOD.
  - i) Turnout should have creep anker/stress Indicator without heal block.

## 12.2. GENERAL

- i) On the METRO Depot system modern turnouts and derailing switches shall be used with following parameters:
  - a) Gauge 1435mm
  - b) Crossing Angle (on main lines and loop lines) 1 in 7
  - c) Rail Profile UIC 60E1 of 1080HH
  - d) Speed on turnouts diversion line 35 kmph for 1 in 7
  - e) Axle Load 17 ton
  - f) Radius for Lead curve 190 m for 1 in 7 turn out
  - g) Type of Web Thick web
  - h) Tangential entry and the switch entry angle  $<0^{\circ}-20'-00''$
  - i) Maximum Cant deficiency 85 mm
  - j) Cant on steel base plate/chairs 20mm
  - k) All slide chairs under the switch rail should be nickel chromium plated of suitable thickness and have steel rollers to reduce friction.

- ii) The Contractor shall be responsible for the detailed design manufacturing and assembling of the turnouts and derailing switches suitable for above requirements. The Contractor shall also be responsible for design, supply and installation of track fixture and all PSC sleepers required for turnout including the interlocking arrangements. Necessary coordination with the Signaling & Telecommunication Contractor will be done by the Contractor.
- iii) The left hand and right-hand turnouts shall be designed with separate concrete bearers and shall have provision of anti-creep fastenings and other relevant fastenings and fixtures. Steel/cast iron bearing plates shall be provided on the concrete bearers with the fixtures on the bearing plates ensuring the right orientation of the rails (cant 1 in 20). Design of these concrete bearers and the relevant fastenings and fixtures will be cleared at detailed design stage. The signaling system shall be designed and installed by Signaling and Telecommunication Contractor and the Contractor shall be required to interface with appointed Signaling and Telecommunication Contractor for all the information/details, pertaining to signaling installations/equipment for the detailed design of turnouts.
- iv) The Contractor shall procure the turnout sets from reputed manufacturers having a "Quality Assurance Programme" which shall be submitted for prior agreement of the Engineer.
- v) Prior to the mass procurement of turnouts, at least one turnout shall be completely pre-assembled and offered for inspection and clearance by the Engineer at factory.
- vi) All turnouts shall be pre-assembled at a workshop. After these are cleared by the Engineer these shall be dismantled and transported to site in special vehicles for laying them in position using cranes of appropriate capacity.
- vii) The Contractor shall be fully responsible for procuring all the raw materials including the rails and sleepers as per laid down performance and design criteria using his own arrangements.

### **12.3. RAILS FOR TURNOUTS**

- i) For manufacturing stock, lead, intermediate sections and closure rails 1080HH 60.21kg section with IRS: T-12-2009 specifications of rail shall be used.
- ii) For switch rails, thick web section manufactured out of asymmetrical rail section shall be used stock rails shall be of special grade steel (minimum 1080HH grade as per IRS: T-12-2009) and have hardened heads for better life.

### **12.4. SWITCH ASSEMBLY**

- i) Each thick web switch device shall consist of 2 stock rails, one left hand and one right hand and two switch rails, one left hand and one right hand, complete set of PSC sleepers in case of ballasted track along with all fittings e.g., slide chairs, base plates/special base plates, brackets, rail pads, insulating bushes, washers, all stretcher bars, various blocks, bolts and nuts, any special fittings like pack drive etc.
- ii) The switch rail shall be one piece without any weld or joint within the switch rail length.
- iii) The end of the asymmetrical switch rail shall be forged to UIC 60 rail profile and shall be suitable for welding or for installation of insulated glued joint.
- iv) The switch shall provide suitable flange way clearance (Min.60 mm), between the stock rail and switch rail at the end of the head in open position as specified by the Engineer. The turn-out system shall be designed to prevent the switch lifting.

- v) Switches made from asymmetrical thick web rails shall be machined carefully to achieve the profile at different locations. It shall be connected to other rail sections by forging of sufficient length.
- vi) The manufacturer shall be responsible to make provisions in switches (stock rail and switch rail) for all the required connections for point machine, clamp lock and any other provisions necessary for connecting the signaling equipment duly interfacing with appointed signaling Contractor.

#### **12.5. INTERMEDIATE SECTION**

- i) The fittings for intermediate rails shall be suitably designed to ensure full compatibility and effective fixation of the rails with PSC sleepers with the desired toe load as that of the elastic fastenings in the main line.

#### **12.6. CROSSING ASSEMBLY**

- i) Standard fixed nose CMS crossings shall be provided on all crossings.
- ii) All crossings on the metro depot shall be 1 in 7 weldable Cast Manganese Steel (CMS) (manufactured from Austenitic Manganese steel as defined in IRS: T-29-2000) crossing for the turnouts.
- iii) All CMS crossings shall have welded leg extensions of 60.21 kg/m (60 UIC) 1080 grade rails. This shall be achieved by flash butt - INOX or equivalent welding in the plant with suitable thickness to CMS crossings and leg extension duly approved by Engineer. This shall have to undergo standard test regime pertaining to this type of welding. INOX weld shall be tested as per RDSO guidelines.
- iv) Check rails in all turnouts shall have the facility for the adjustment of check rail clearances up to 10 mm over and above the initial designed clearance.
- v) Each check rail end shall be properly flared by machining.

#### **12.7. ELASTIC FASTENINGS FOR TURNOUTS**

- i) Fastenings for the turnouts shall be elastic type and compatible with the main line rail to sleeper fastening system in ballasted track to maintain line and levels.
- ii) The design of the fastenings for the turnouts shall be suitable for 17 Tonne axle loads.
- iii) Contractor has to provide fastening system to resist all dynamic forces, thermal forces and all forces due to rail operation for different types of tracks in depot and submit for Engineer's approval.

#### **12.8. TYPE AND GEOMETRY OF TURNOUT**

Detailed design of all turnouts, scissors, and crossover should comply the following geometrical parameters.

- (i) 1 in 9 turnouts: (If Applicable)

The design shall be tangential with a switch angle not exceeding 0°20'00". It is desirable that the radius of lead rail of turnout is not less than 300m for 1 in 9. And 190m for 1 in 7 All clearances shall be in accordance with relevant provisions of SOD.

- (ii) 1 in 7 turnouts:

The design shall be tangential with a switch angle not exceeding 0°20'00". It is desirable that the radius of lead rail of turnout is not less than 190m. All clearances shall be in accordance with relevant provisions of SOD.

- (iii) 1 in 7 R-190 Scissors Crossover (4 no's Turnout and one diamond)

The basic geometry of the turnouts of scissors crossover shall be same as that of corresponding ordinary turnouts as mentioned above.

#### **12.9. OPERATING REQUIREMENT OF TURNOUT, SCISSOR CROSSOVER:**

Track layout design shall permit trains to operate at maximum capability wherever possible. Turnouts and crossover shall be selected such that they do not form a restriction to the operating speed on depot line. Switches and crossings shall not be located on transition curves or vertical curves.

##### **Speed:**

The turnout shall be designed for the speed on mainline side (95 Kmph) equal to the speed as on mainline track. The minimum speed potential of the various turnouts and scissors crossover on the Turnout side should be as follows:

#### **STANDARD GAUGE**

- i) 1 in 7 type turnouts with 190 m radius (speed potential of 35Kmph)
- ii) Scissors crossover 1 in 7 types with 190 m radius (speed potential of 35Kmph)

#### **12.10. TECHNICAL SPECIFICATION OF TURNOUT, SCISSOR CROSSOVER**

##### **i. GENERAL**

- a) All the points shall be capable of being operated by electric motors in accordance with the signaling specification.
- b) The top surfaces of PSC sleeper/RCC slab supporting rail seat of turnouts and scissors crossover shall be flat without any cant/slope.
- c) The track form of the turnout shall have uniform resilience as that of the adjoining track form.
- d) The fixation of turnouts, scissor cross-over on track slab shall be through base plates/bearing plates.

##### **ii. RAILS**

- a) ALL The rails used in turnouts shall be 1080 grade Head Hardened.
- b) The rails used for manufacturing of turnouts shall satisfy the following conditions:

- i. The rails shall be manufactured and tested in accordance with IRS/T-12-2009 with latest amendment or EN specification for Imported Rails.
- ii. The section of rails shall be 60E1 (UIC60) for stock, lead and 60E1A1 (ZU1-60) for switches.
- iii. The rails shall qualify as Class 'A' rails as per IRS/T-12-2009.
- iv. The rails shall be with ends un-drilled.
- v. The rails shall be of grade 1080HH and be suitable for being welded by alumino-thermic or flash butt welding technique.

**iii. Switches**

- i) Each switch device shall consist of two stock rails, one left hand and one right hand and two thick web switch rails, one left hand and one right hand.
- ii) The Thick web switch rail shall be one piece with no weld or joint within the switch rail length.
- iii) The end of the asymmetrical switch rail shall be forged to 60E1 (UIC60) rail profile with minimum length of 500 mm. The forged switch rail end shall be suitable for welding or installation of insulated rail joint.
- iv) Slide chairs in the switch portion shall be coated with an appropriate special coating, so as to reduce the point operating force and to eliminate the requirement of lubrication of sliding surfaces during service.
- v) Switches shall provide suitable flange way clearance between the stock rail and the switch rail with the switch rail in open position at JOH (minimum 60mm). The Turnout (if required) shall be provided with second drive or other suitable arrangement to ensure minimum gap of 60mm at JOH as well as proper housing of switch rail with stock rail up to JOH. 1 in 7 turnouts may be or may not be provided with second drive arrangement, however minimum gap of 60mm at JOH as well as proper housing of switch rail with stock rail up to JOH should be ensured. Also, the switch rail must move freely during operation and no reversal of stress should be created during point operation (This may need extra stretcher bar or second/back drive). The normal opening of switch at toe of switch shall be kept as 160mm.
- vi) The switch manufacturer shall include provision for all holes required to main drive machines, stretcher bars and detection equipment to suit the requirements of the signaling and switch operating system duly chamfered to avoid stress concentration at the edge of the holes.
- vii) The switches shall be designed with an anti-creep device at the heel of switch to withstand thermal forces of the CWR track.
- viii) The switches and all slide chairs shall be same for ballasted and ballastless turnouts.



#### **iv. Crossings**

- i) All crossings shall be cast manganese steel (CMS) crossings with weldable leg rails of minimum 1.2m length undrilled for welding into the overall turnout. Extended length shall be required for depot to avoid small piece of rails between two turnouts.
- ii) The CMS crossings shall be manufactured from Austenitic Manganese steel as per UIC 866.
- iii) All CMS crossings shall have welded leg extensions of 60E1 (UIC60) rails. This shall be achieved by flash butt welding of buffer transition rail piece of suitable thickness (25 MM to 40 MM) to CMS crossings and rail leg extension.
- iv) All CMS crossings on depot line shall have a minimum initial hardness of 340 BHN. All the CMS crossing increased hardness has to be tested with explosion hardening.
- v) All CMS crossings and their welded leg extensions for all turn out in depo bulb area (this may need extra leg length of 1080 HH rails should layout) and scissor crossovers shall be suitably dimensioned so as to eliminate the necessity of providing small cut rail pieces for the purpose of inter-connection. However, the need for providing insulated glued joints from signaling requirement point of view shall be taken care of in the design, if required.
- vi) The provision of rail cant shall be taken care of on the top surface of the CMS crossing and the bottom surface of all CMS crossing shall be flat.

### **13. TRACK STRUCTURE AND ROAD SURFACE AT LEVEL CROSSINGS**

- i) Ballasted /Ballast less track structure will be continued through the level crossing.
- ii) The level crossing shall have a track friendly and relatively maintenance free road surface. Track/Road Infrastructure at Level Crossing, indicative shall be as per drawing attached in Volume 5 .

The Contractor shall be responsible to provide the level crossings in depot as per approved drawings. The Contractor shall submit the requirement and design of RCC slab/ RCC blocks, to be provided within the track and outside the track at level crossing for the approval of the Engineer. The Contractor shall also be responsible to provide these slab/blocks at level crossing within the track and up to a maximum distance of 5 m from the center line of the track.

### **14. CHECK RAILS (BALLASTLESS TRACK)**

- i) The check rail section shall be 33C1 (UIC33) or similar without any direct connection with running rails.
- ii) Check rails shall have the facility for the adjustment of check rail clearances up-to 10mm over and above the initial designed clearance.
- iii) The check rail connections in turnouts shall be through specially designed bearing plates / brackets.
- iv) All the check rails shall be higher by 25mm above running rails. The lengths and positions of the check rail in diamond crossings shall provide safety and be compatible with the overall track layout.

## **15. SLEEPER FOR PLAIN LINE, TURNOUTS AND DERAILING SWITCH**

Sleeper shall be of pre-stressed concrete, mono-block, suitable for installation in track both with and without signaling circuits and with electrification.

Sleepers shall be designed to provide a minimum service life of 50 years under 17 tonne axle load for depot line.

The sleeper base surface shall be rough cast while the top and side surface shall be smooth to prevent retention of moisture and foreign materials.

Sleepers must be suitable for installation by track laying machines and sleeper insertion equipment of a type used for isolated sleeper laying.

The sleeper must be able to transfer all the relevant track forces generated by train operations and the forces of rail expansion and contraction due to temperature.

SGCI insert should be compatible with 10mm thick GRSP.

Design Requirements for PSC Sleepers

- (A) The sleepers should satisfy the following design requirement:

### **Design Parameters**

- (i) Rail sleeper fastening – Elastic resilient type
- (ii) Spacing of sleepers for plain line
  - a) In Depot - 650 mm center to center.
  - b) In Test Track – 600 mm center to center
  - c) For Curve of sharper radius spacing shall be adjusted per design requirement.
- (iii) Ballast cushion – 250 mm for depot, Test track -300 mm
- (iv) Ballast profile suitable for LWR/CWR
- (v) Turnout and Scissor crossover- 250mm

### **Specifications and Drawings (With latest amendment)**

- (i) Special Cement – IRS T 40 1985
- (ii) HTS wire plain and strand – BIS – 1785 (Pt-1) 1983 and BIS 6006
- (iii) Polyethylene dowels – Provisional 1997 Drg. No. RDSO 3002 Alt-3
- (iv) IRS Specification for Turnout Sleeper T- 45 2021
- (v) IRS Bridge code 2014
- (vi) Code of Practice for Pre-stressed Concrete IS-1343

(B) The design should satisfy the following additional requirements-

- i) The connections of the slide chairs and bearing plates/special bearing plates/brackets shall be designed for easy installation and maintenance. All the fittings shall be suitably designed to ensure full compatibility & also to ensure interchangeability of slide chairs between ballasted and ballast less turnouts.
- ii) For attaining suitable cant of the rail, as provided on mainline and depot line, (excluding crossing and switch portion), suitably designed pads of appropriate material shall be provided between rail pad & PSC sleeper. Also fastening system should be designed to get the desired Toe Load.
- iii) The detailed design of Monoblock PSC sleepers for the turnouts and scissor crossover along with structural drawings shall be checked and approved by Engineer and proof checked by IIT.
- iv) The Minimum design life of all PSC sleeper will be 50 years.

#### 15.1. PSC SLEEPERS FOR TURNOUTS

- i) Separate concrete bearers shall be designed for left hand and right hand turnouts equipped with steel cast iron bearing plates with the fixtures on the bearing plates ensuring right orientation of the rails.
- ii) The design of the sleepers shall be in accordance with the design parameters, specifications of raw materials, specifications of finished products, codes and manual listed for main line PSC mono-block sleepers.
- iii) The design criteria and requirements of the PSC sleepers for the turnouts shall be such as to provide length and fixtures such as to accommodate and fix the turnout components on the sleepers firmly, including check rails, stretcher bars etc.
- iv) Sleeper for turnout shall be wide base rectangular sleeper flattop and bottom without any cant

#### 15.2. PRESTRESSED CONCRETE SLEEPERS

##### 15.2.1. General

Mono-block pre-stressed precast concrete sleepers all be used on all metro tracks for main lines, depot lines, sidings, conforming to the following general requirements and parameters.

- a) Gauge (measured at 14 mm from the top of the rail) 1435mm
- b) Minimum length of the sleeper  $\geq 2500\text{mm}$ 
  - Top width  $\geq 180\text{mm}$
  - Minimum Depth of sleeper  $\geq 200\text{mm}$
  - Bottom width of sleeper  $\geq 230\text{mm}$
- d) Maximum operation speed of trains in depot 25 km/h
- e) Design life 50 years
- f) Maximum Axle Load 17 tons
- g) The track shall track circuited for adequate electrical resistance as stated in IRS T-39-2021

- h) Type of traction 25KV electric
- i) Rail section to be catered for is UIC 60E1 60.21 kg/m
- j) Fastening (rail to sleeper) are to be a self-tensioning elastic fastening system.
- k) Ballast cushion below bottom of sleeper is to be a minimum of 250mm and 300mm for test track, Slope of ballast profile below the sleeper shall be taken as  $H / V = 1.5/1$

#### 15.2.2. DESIGN REQUIREMENTS.

- i) For the design and manufacture of sleepers Contractor may refer to Drawing no. any RDSO approval drawing, or The Contractors may however use other proven design of confirming to the requirements, of approved vendors.
- ii) For the ease and uniformity in maintenance of tracks on the entire depot line metro Corridor, the geometrical shape of the PSC sleepers shall be in accordance with RDSO T-7008 with tolerances of dimensions as per approved Inspection test Plan by Engineer.

#### 15.2.3. DESIGN PARAMETERS FOR THE PSC SLEEPERS

The important design parameters to be considered for the PSC sleepers shall be:

- a) Design load and ballast reaction are to be as set out in the applicable RDSO standard for PSC sleepers
- b) Ballast pressure 5 kg/cm<sup>2</sup>
- c) Load distribution factor 0.50
- d) Dynamic augment for speed and rail wheel 2.5
- e) Centre binding co-efficient 0.4
- f) Factor of safety for resisting bending moment 2
- g) Load factor at rail seat bottom for bending moment 3
- h) Static Bending Test Loads
  - Cracking Loads (KN) shall be for Centre Top, Centre Bottom. Rail Seat as per RDSO.
  - Failure Load at Rail Seat KN)
- i) Initial prestress force – upto 75 % of breaking load
- j) Losses in prestress -30% of initial prestress or as per actual Design Qualification Tests

#### 15.2.4. DESIGN QUALIFICATION TESTS [If required]

- i) The Design of all types of PSC sleepers and elastic fastenings with rail will be agreed by the Engineer before manufacturing process is initiated by the Contractor. If required prior to agreement by the Engineer, the Contractor's design for the concrete sleepers and fastenings shall be subjected to qualification tests, as listed below, which inter alia require that 40 pre-production sleepers from 3 separate concrete pours be tested.
- ii) The Engineer shall select 8 separate complete sleepers plus 3 sleepers which shall be cut in half to produce 3 sleeper blocks equipped with rail fastening system identical to that on the concrete sleepers furnished for testing.

### Minimum Design Qualification Tests

Test Type	Track Sleeper	Turnout Sleeper
Rail Seat Vertical Load	X	X
Centre Moment Test	X	--
Rail Seat Repeated Load Test	X	X
Fastener Insert Test	X	X*
Fastener Uplift Test	X	X*
Fastener Repeated Load Test	X	X*
Lateral Load Restraint Test	X	X*
Longitudinal Restraint Test	X	X*
Bond or Tendon Anchorage Ultimate Load Test	X	X
Rail Pad Test	X	X*

Note:

X = 1 required

X\* = Test not required if the fastening system provided is identical to the fastening system for concrete track sleepers, and the test on the track concrete sleeper has been successful.

- iii) The Contractor shall check his design of PSC sleeper for 17 tonnes axle load as per the "design qualification tests" as detailed in the table above. Likewise design of prestressed concrete sleeper for special locations like derailling switches, SEJ, level crossings etc shall also have to follow a similar process.
- iv) The "design qualification test" results shall form part of Design process of sleepers.

#### 15.2.5. MANUFACTURE OF PSC SLEEPERS

- i) The sleepers shall be supplied by RDSO approved sleeper manufacturer.
- ii) The Contractor shall submit for the Engineer's agreement his proposed method of manufacturing of pre-stressed concrete sleepers which shall cover the following in addition to the technical specification for manufacturing and supply of plain line PSC sleeper and technical specification for manufacturing and supply of turnout PSC sleeper:
  - a) Manufacturing method
  - b) Moulds
  - c) Production machines
  - d) Moulding/de-moulding
  - e) Mould cleaning
  - f) Pin and spacer bar assembly / removal
  - g) Wire hauling/placement
  - h) Tensioning equipment
  - i) Concrete placing / vibrating
  - j) Control of minimum strength at transfer
  - j) Curing
  - k) De-tensioning and wire cutting
  - l) Loading, handling, storage and transportation

- iii) The proposed method of manufacturing must have been used for manufacturing mono-block PSC sleepers which have already been laid in tracks and have given satisfactory performance in similar environmental conditions for a continuous period of five years.

#### 15.2.6. Deleted

#### 15.2.7. CONCRETE FOR PSC SLEEPERS

- 1) The concrete used for manufacturing PSC sleepers shall fulfil the following requirements:
  - a) Minimum Compressive strength ( $f_c$ ) is to be 55 N/mm<sup>2</sup> for M55 and 60 for M60
  - b) Minimum Compressive strength prior to the transfer of the pre-stress load is to be 40 N/mm<sup>2</sup>
  - c) Minimum bending stresses
    - i. Compressive 0.4 $f_c$
    - ii. Tensile 0.04 $f_c$
  - d) modulus of rupture 5.0N/mm<sup>2</sup>
  - e) Cement shall conform to IRS T-40 or any other similar or equivalent International Standards, the provisions, as stated in clause 32 of IRS.T-39 2021 Standards for use of cement in the concrete shall be followed to the satisfaction of the Engineer.
  - f) The process and quality control tests shall conform to IS:383(for Aggregate Testing) and IRS T-39 2021 standards.

#### 15.2.8. HIGH TENSILE STEEL (HTS) WIRES

- i) HTS in the form of plain wires or strands shall conform to IS:1785- Part-I and IS:6006 respectively or equivalent International Standards.
- ii) HTS shall be procured from reputed BIS approved or equivalent international approved manufacturers and each consignment shall be accompanied with the test certificate.
- iii) The prescribed test regime in above mentioned IS codes shall be exercised and checked by the Engineer who will satisfy himself regarding the quality of the material.

#### 15.2.9. INSPECTION AND QUALITY CONTROL

- i) The quality control test regime shall be exercised by the inspecting agency as nominated by the Employer and the Engineer for approving the manufacturing factory of PSC sleepers to ensure manufacture of good quality sleepers.
- ii) All the necessary precautions, stage tests and quality control checks as described in IRS: T-39-2021 specifications and as stipulated in the approved Design shall be followed. Contractor may suggest an alternative inspection and quality control regime for concrete sleepers which can be adopted by the Engineer after due scrutiny.
- iii) In case of the failure in the prescribed tests in the lot, retesting can be permitted as prescribed in Para 5.3.7.4 of IRS: T-39- 2021) - specifications.
- iv) Each lot of sleepers for plain line and turnouts shall be inspected by RITES/ Railway/ RDSO

#### 15.2.10. MARKING AND PAINTING

- i) All the sleepers shall have legible permanently inscribed and painted markings on the top as per the drawings agreed by the Engineer.
- ii) The accepted sleepers after inspection and electrical resistance test shall bear the passing marking of the inspecting officer in indelible paint.

#### 16. LOCKING SYSTEM:

- i) The locking system shall be completely encapsulated so that there is no contamination or impairment by dust or weather conditions.
- ii) The locking system shall be designed to have a modular structure to allow installation and replacement of lock in short time.
- iii) Installation and adjustment shall be done without any additional machining at site.
- iv) There shall be no influence on operation of the lock by longitudinal relative displacements of the switches caused by temperature changes.

#### 17. MONITORING SYSTEM:

- i) Safety and maintenance relevant functions of a turnout shall be monitored by a monitoring system. In case of irregularity in track or lack of maintenance, the monitoring system shall send online messages about problems.
- ii) The monitoring system shall have a modular system structure for being easily expandable.
- iii) It shall automatically generate error messages.
- iv) It shall have a continuous data acquisition with facility for storage of data.

#### 18. SWITCH EXPANSION JOINT: (IF REQUIRED)

- i) The SEJ for ballasted track shall be laid on PSC sleepers whereas the SEJs for ballastless track, if required, shall be laid on reinforced concrete slab.
- ii) The rail section for all SEJs shall be UIC 60, 1080 HH grade as per IRS-T-12-2009.
- iii) The SEJ for ballasted track shall be designed for a maximum gap of 80 mm.
- iv) The SEJ for ballast less track should be designed for the maximum gap required as per design.
- v) The ballasted SEJ shall be as per RDSO drawing T-6902 & T-6922 with modification to standard Gauge.
- vi) The ballasted SEJ for STANDARD GAUGE shall be laid with PSC sleepers as per RDSO drawing T-4149 with reduced length required for standard gauge. For Standard Gauge, PSC sleeper shall

be designed such that SEJ to RDSO drawing along with its bearing plates/chairs may be accommodated for installation of SEJ.

- vii) Sleepers used for SEJs shall be flat and cant will be provided through CI chair.
- viii) The SEJ shall be suitable for two-way directional traffic
- ix) Switch Expansion Joints (SEJs) shall be manufactured from rail compatible with the rail proposed for the CWR.
- x) Contractor may refer-IR drawing RDSO RT-6902 for 60 kg, RT-6922 for 60 kg, which are under trial. Contractor may refer above drawings and other relevant drawings for Switch Expansion Joints. Proven designs from reputed manufacturers giving satisfactory performance on operating environment similar other Metro system can also be considered for adoption.
- xi) Contractor shall submit, complete design details along with design acceptance & acceptance tests to the Engineer for prior approval before procuring the same.
- xii) SEJS shall be manufactured and supplied with all corresponding PSC sleepers, fittings, fastenings and fixtures as required for easy installation into the track.

#### **19. FASTENING SYSTEM FOR:**

##### **a) Ballastless track/ Special Track (Column Track)**

The fastening system installed in the ballastless track shall comply to the performance criteria issued by Ministry of Railways, Govt. of India at Annexure-C2 of "Procedure for Safety Certification and Technical Clearance of Metro Systems- December 2015" issued by Urban Transport and High-Speed Directorate of the Research Designs & Standards Organisation (RDSO) Ministry of Railways and must be approved by Ministry of Railways. This document is also annexed at Annexure C-2 of these Tender Documents.

The fastening system for ballastless track including their components thereof, which is already approved by Ministry of Railways, upto the date of opening of Tender, shall only be considered, for this purpose. Approval letters of Ministry of Railways, Govt. of India, along with Drawings and Documents, Design Calculations, Test Reports of each component, Inspection and Test Procedure etc shall be furnished by the Tenderer. No deviations will be accepted regarding the same. All iron fastener should be coated with anti-rust coating based on IRS /ISO specification with minimum 5 years guarantee.

##### **b) Ballasted Track**

Fastenings System has to be procured from RDSO approved vendor. The minimum toe loads has to be 1200-1500 KG /ERC mark V with suitable GFN /Metal Liner and GRSP has to be used. The design life of GRSP pad, Liner life should be minimum 15 years.

##### **c) Rail to sleeper elastic fastening system**

- i) All ballasted tracks, laid on PSC sleepers shall be equipped with self-tensioning elastic fastening system, similar to that being used on Indian Railways, having the following components:
  - a) Elastic fastening clip compatible with the rail/ sleeper assembly having a nominal toe load



on the rail of 12 KN/clip of appropriate international standard which meets the requirement.

- b) Cast in insert as to suit the elastic fastening.
- C) An under-rail pad compatible with toe load, sleeper and rail profile.
- d) Type of liner is to be used after interface with Systems Contractor.
- e) Contractor shall furnish relevant analysis and simulation data to the Engineer to substantiate that all fastenings shall have a minimum service life of 15 years after laying in track.
- ii) The components set out above should be compatible with each other and provide an effective fastening system so as to ensure effective sleeper to rail resistance is more than sleeper to ballast resistance with adequate factor of safety.
- iii) The design of the fastening system as a whole shall be as per the technical requirement of Depot layout and as approved by the Engineer.
- iv) The fastening assembly shall be subjected to "design qualification tests" along with the PSC sleepers for which the acceptance values derived on the basis of the design shall be submitted along with design details.

## **20. BUFFER STOP**

- i) Buffer stop should be designed for full load with 6 car Train set for impact speed of 25 kmph in test track and for empty load for 6-car train set for impact speed of 10 kmph in depot stabling lines.
- ii) Wheel stopper to be designed for 5kmph shunting movement in work shop and IBL lines.
- iii) Buffer stop should be able to stop train within available stopping distance as per approved drawing for depot lines.
- iv) Buffer stop has to be design considering friction coefficient in wet condition.
- v) Buffer stop should be designed in such a manner that It must not lift and caused excessive deflection/Bending of Track and without damaging the Rolling stock.
- vi) Buffer stop should be designed such that initial impact reaction should not come on few fasteners, for 25 kmph satiable under frame (Foundation) with ample no. of Impact transferring clamps should be designed to stop deflection/bending of track and damage of fasteners.
- vii) Buffer stop should have factor of safety and additional friction shoe should be provided in safety length i.e., after buffer body.
- viii) Buffer stop should have sufficient length to accommodate all shoes and clamps.

## **21. BALLAST SUPPLY AND LAYING**

- i) Specification of ballast has to be as per RDSO guideline with latest amendment.
- ii) All ballast shall be procured from the quarries approved by the Engineer.
- iii) All ballast shall be machine crushed and comply with the specifications set out in IRS GE 1 with latest specification correction slip.

- iv) When transported by road vehicle all ballast shall be dampened prior to leaving the quarry.

## **22. DOCUMENTS**

### **22.1. CONTRACT SPECIFICATION**

The Specification included in the Contractor's Technical Proposals together with the Outline Design Specification and Outline Construction Specifications shall be amplified so as to specify comprehensively the design and construction of the Permanent Works.

### **22.2. DESIGN MANUAL**

The Design Manual shall incorporate all design requirements, standards, codes, loading cases, permissible movements and deflections, limit states, design stresses and strains, material properties and all other documents or matters which are relevant to and govern the design. The Design Manual shall refer to all materials, codes and standards used, making clear their specific applications. The Design Manual shall be produced so that it can be used by those involved in the preparation or review of the design of the Permanent Works as a comprehensive reference text and efficient working document.

### **22.3. INTERFACE REPORT ON DESIGNATED CONTRACTORS**

This will include the following:

Details of the design and construction of the Works adjacent to other contracts. Details of provisions for the Designated Contractors, indicating arrangements for accesses, fixings, casting-in, openings, supports and the like; updated interface management plan relating to design integration and co-ordination.

### **22.4. TESTING AND COMMISSIONING REPORT**

Details of proposals for testing and commissioning procedures for all relevant elements and equipment contained in the Permanent Works.

### **22.5. MAINTENANCE REPORT**

A report updating the Statement of Maintainability in the Contractor's Technical Proposals and detailing maintenance routines necessary for the achievement of the required lives of the various elements of the Works.

### **22.6. SUPPORTING DOCUMENTS**

The Definitive Design Submission shall be accompanied by the following documents, which will be considered by the Engineer in his review of the Definitive Design Submission. Where relevant or required, these documents shall be accompanied by a design note stating clearly how information has been used in the design of the Permanent Works.

## **22.7. SURVEY REPORT**

A report on all survey work undertaken by the Contractor, including coordinates, and setting-out.

## **22.8. TEMPORARY WORKS DESIGN REPORT**

A report which provides sufficient information on the design of the Temporary Works to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the review of the Definitive Design.

## **22.9. CONSTRUCTION / INSTALLATION ANALYSIS REPORT**

A report containing a stage-by-stage construction / installation sequence for all structures / equipment.

## **22.10. CONSTRUCTION METHOD STATEMENT**

A report which provides sufficient information on the methods of construction and Contractor's Equipment to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the review of the Definitive Design.

## **22.11. PROJECT SCHEDULE REVIEW**

- (i) The Contractor shall, prior to submitting the Definitive Design Submission, review the Project Schedule against the current version of the Design Submission Programme.
- (ii) In the event that the Contractor considers that there are any discrepancies or inconsistencies between the Design Submission Programme and the Project Schedule, the Contractor shall submit with the Definitive Design Submission its proposed revisions to the Project Schedule such that the discrepancies or inconsistencies are removed.
- (iii) The Contractor shall provide details of submissions of the proposed Working Drawings and their anticipated timing during the Construction Phase and shall identify information required from or actions to be undertaken by the Employer or others which are necessary to permit the completion of the design of the Permanent Works and the Working Drawings. Desired Dates for the receipt required by the Contractor of such information or for the completion of such actions shall be included with appropriate justification.

## **22.12. REPORT ON THE USE OF WORKS AREAS**

A report updating the proposals from those contained in the Contractor's Technical Proposals for the use of Works Areas, site security and their reinstatement, detailing the station accesses and accesses facilities.

### **Notices on Definitive Design Submission**

The Contractor may make Definitive Design Submissions and seek separate Notices in respect of:

- a) The temporary works for construction of Track
- b) Not Used

- c) All works related to track

The issue of such separate Notices under (a) and (c) above shall be conditional upon the Contractor having demonstrated, to the satisfaction of the Engineer, that the effect of each structure on other structures, utilities, etc., has been fully accommodated in the design and employer requirement and technical specification mention in contract has been fulfilled.

#### **22.13. DESIGN SUBMISSIONS - CONSTRUCTION REFERENCE DRAWINGS SUBMISSIONS**

- i) The Construction Reference Drawings shall be derived directly from the Definitive Design and shall detail and illustrate in full the Permanent Works. The Construction Reference Drawings shall form part of the Working Drawings to be used for construction purposes.
- ii) Prior to the submission of any Construction Reference Drawings, the Contractor shall prepare and submit a comprehensive register of all such drawings, demonstrating to the satisfaction of the Engineer that the Employer's Requirements are fully addressed and that the proposed Construction Reference Drawings are adequate in scope and extent to cover the complete construction of the Permanent Works.
- iii) Unless otherwise required by the Engineer, the Construction Reference Drawings shall include detailed drawing, Turnout, CMS crossing, Scissor Crossing, PSC sleeper, other track components, Plinth Slab, bar bending schedules, bar reference drawings, fabrication or shop drawings as well as other schedules or erection drawings which are to be provided by the Contractor during the Construction Phase.

#### **22.14. DESIGN SUBMISSIONS - CONSTRUCTION PHASE**

- i) On the issue of a Notice in respect of the Construction Reference Drawings the Contractor shall produce the proposed Working Drawings. These shall either be identical to the Construction Reference Drawings or shall be further drawings developed in accordance with the Construction Reference Drawings such as Track Layout drawings along with Design Basis Report, Design manual, Alignment Design and Repot, site sketches, bar bending schedules, bar reference drawings, fabrication and shop drawings, construction erection, installation sequences etc. duly signed by the Authorized chief Designer along with Track designer. All such drawings shall comply with the requirements of the Contract.
- ii) Prior to submission of the proposed Working Drawings, the Contractor shall endorse the appropriate original paper drawings as "Good for Construction". If the Engineer so requires, the endorsed original shall be submitted to the Engineer who shall, if he has no objection to the contents of the submission, further endorse the original by stating that he has no objection to the proposed Working Drawings. On the endorsement by the Engineer, the original will forthwith be returned to the Contractor as the Working Drawings.
- iii) Only the Working Drawings endorsed as in 7(2) above or those that the Engineer has expressly stated as not requiring his endorsement shall be issued to the Site. The Construction of the Works shall be strictly in accordance with these Working Drawings.
- iv) The Contractor shall finalize details of the proposed method of construction and submit such finalized details to the Engineer for review. The proposed method shall have no adverse effects on

the partially completed Permanent Works and shall ensure the Works are statically and, if appropriate, aerodynamically stable.

- v) The Contractor shall undertake and submit a stage-by-stage construction sequence and the effect of any Temporary Works and the Contractor's Equipment on the Permanent Works. This analysis shall be in sufficient detail to demonstrate that the Contractor's proposals are safe and have no adverse effects upon any parts of the Permanent Works.
- vi) As-Built Drawings, endorsed by the Contractor shall be submitted to the Engineer for approval in electronic format using a commercially available Civil 3D/ Bentley and CAD program.

#### **22.15. DESIGN SUBMISSIONS - REVIEW PROCEDURES**

- i) Submissions of Detailed Design and drawing Data shall be reviewed by the Engineer. The form and detail of the review shall be as determined by the Engineer and will not release or remove the contractor's responsibility for the design under the contract.
- ii) The issue of a Notice shall be without prejudice to the issue of any future Notices.
- iii) The Contractor shall, prior to the submission of the Detailed Design Data, obtain all required and/or statutory approvals that relate to that submission including, where appropriate, the approval of the Concerned Government Authorities, and demonstrate that all required approvals have been obtained.
- iv) Design data of certain nonstandard structures as ascertained by engineer shall be proof checked by IIT/ government institute of repute.
- v) All design data shall be submitted by 2no. of copies duly signed by authorized signatory.

#### **22.16. DESIGN SUBMISSION PROGRAMME**

- i) The Contractor shall prepare the Design Submission Programme which is to set out fully the Contractor's anticipated programme for the preparation, submission and review of the Design Packages, the Definitive Design Submission, and the Construction Reference Drawings Submissions and for the issue of Notices in relation thereto.
- ii) The Design Submission Programme shall:
  - a) be consistent with and its principal features integrated into the Works Programme and show all relevant Key Dates.
  - b) identify dates and subjects by which the Engineer's decisions should be made.
  - c) make adequate allowance for periods of time for review by the Engineer and other review bodies.
  - d) make adequate allowance for the design and of specialist works.
  - e) include a schedule identifying, describing, cross-referencing, and explaining the Design Packages into which the Contractor intends to divide the Definitive Design & Construction Reference Drawings; and

- f) Indicate the Design Interface and Co-ordination periods for each Designated Contractor.
- iii) The Contractor shall submit the Design Submission Programme to the Engineer within fifteen 15 days of the date of Notice to Proceed, and thereafter up-dated versions thereof at intervals of not more than 15 days throughout the Design Phase.

#### **22.17. PROGRAMME FOR SUBMISSIONS DURING THE CONSTRUCTION PHASE**

In accordance with Employer's Requirements - General, the Contractor shall identify submissions required during the Construction Phase.

#### **22.18. DESIGN CALCULATIONS**

- i) Unless otherwise required by the Engineer, calculations relevant to the preliminary design, Definitive Design and Construction Reference Drawings shall be submitted for review with the respective Design Packages or Submissions. The above calculations shall have been certified by the Contractor's designer and checker before submitting to the Engineer. The Engineer may require the submission of applicable software including in-house software programmes / worksheets developed by the Contractor, computer input and programme logic for his review prior to the acceptance of the computer output.
- ii) The Contractor shall prepare and submit a comprehensive set of calculations for the Definitive Design in a form acceptable to the Engineer. Should the design of the Permanent Works be revised thereafter, and such revision renders the calculations as submitted obsolete or inaccurate, the Contractor shall prepare and submit the revised calculations.
- iii) Similarly, the Contractor shall submit such further calculations as have been prepared in connection with the Construction Reference Drawings.
- iv) Calculations to be included as part of the submission herein shall comprise the up-to-date calculations in respect of the Definitive Design, the Construction Reference Drawings and such further calculations which the Contractor has prepared during the production of Working Drawings.
- v) Copies of EXCEL spreadsheets and computer model data files sufficient to regenerate the model and re-run the analysis should be submitted together with the calculations to the Engineer.
- vi) The Contractor shall submit all calculations necessary to support proposals relating to the construction methods.

#### **23. DOCUMENTS REQUIREMENTS**

- i) Drawings shall be prepared generally to A1 size or as per the Railway requirements, but to ISO AO size where appropriate. Appendix 7 defines the Drawings and CAD Standards required for drawing preparation and submittal.
- ii) The Contractor shall submit 6 copies of his design and/or drawings for review by the Engineer. After receipt of "No Objection" from the Engineer's Representative, the Contractor shall submit 6 copies of design and/or drawing for the use of the Engineer.
- iii) The submission of drawings may be by CAD Media files and Appendix 7 specifies the drawing submission requirements for CAD Media files.

### ATTACHMENT C 1 DESIGN CERTIFICATE

This design Certificate refers to design submission no. .... , which comprises of Design submission / Construction Reference Drawings submission, working drawing submission scheduled in the attached transmittal, in respect of:

*(Description of Permanent Works to which the submission refers)*

#### DESIGNER'S STATEMENT:

We certify that:

- (a) the outline designs, and performance specifications of those elements of the Permanent works as illustrated and described in the documents scheduled and employer requirements in the attached transmittal, complies with the design basis criteria and other contract provisions.
- (b) an in-house check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the Works as illustrated and described in the documents scheduled in the attached transmittal.
- (c) all necessary and required approval relating to the design of the Works, as illustrated and described in the documents listed in the attached transmittal, have been obtained.
- (d) all effects of the design comprising the submission on the design of adjacent or other parts of the works have been fully taken into account in the design of those parts.

Signed by Designer's Authorized Representative /Signed by proof checker

Name : .....  
Position : .....  
Date : .....

#### CONTRACTOR'S CERTIFICATE:

We certify that all design has been performed utilizing the skill and care to be expected of a professionally qualified and competent designer, experienced in work of similar nature and scope. This further certifies that all works relating to the preparation, review, checking and certification of design has been verified by us and the design proposed by the designer has been accepted by us vide clause 4.2 of GCC.

Signed by Contractor's authorized representative

Name : .....  
Position : .....  
Date : .....

#### Note 1

*The Contractor shall insert one of the following, as applicable; during design phase .*

- (i) the Contractor's Technical Proposals
- (ii) the Contractor's Technical Proposals and Design Packages Nos..... for which a Notice of No Objection has been issued.
- (iii) Design Packages Nos .....for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.
- (i) The Definitive Design

## SAMPLE DRAWING TEMPLATE

(a) 'Design Quality Assurance' by designer & contractor:

DESIGN QUALITY ASSURANCE			
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the design consultants and the contractor.			
By Designer			By Contractor
Sig. :	Sig. :	Sig. :	Sig. :
Date. :	Date. :	Date. :	Date. :
Name :	Name :	Name :	Name :
Designed by	Checked by	Approved by	Accepted By

(b) Notice of 'No Objection' from Employer's representatives:

Notice of 'No Objections' from Employer			
	REMARKS	Date	Signature
Employer's Representative	Reviewed		
Employer's Representative	Reviewed & comments as marked on drawing		
Employer's Representative	Reviewed & No objection issued with comments as marked on Drawing		

### Section C

[Contractor to attach copies of necessary and required approvals]



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**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**DESIGN, DEVELOPMENT, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF STANDARD GAUGE TRACKWORKS (BALLASTED AND BALLASTLESS) IN KASHELI DEPOT TRACKS FOR LINE 5 CORRIDOR OF MUMBAI METRO RAIL PROJECT OF MMRDA, MUMBAI**

**TENDER DOCUMENTS**

**CONTRACT NO: MMRDA/MPIU/ML5/CA-303**

**TENDER DOCUMENTS**

**VOLUME 3**

**EMPLOYER'S REQUIREMENTS  
SECTION D: CONSTRUCTION**

**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**Metro PIU, 7<sup>th</sup> Floor, New Administrative Building,  
Bandra-Kurla Complex, Bandra (E), Mumbai –400 051, India**

## **SECTION D: EMPLOYER'S REQUIREMENTS – CONSTRUCTION**

### **1. CONTRACTOR'S SUPERINTENDENCE**

- i) The Contractor shall submit a Staff Organisation Plan. This plan shall be updated and resubmitted whenever there are changes to the staff. The plan shall show the management structure and state clearly the duties, responsibilities, and authority of each staff member.
- ii) The site agent and his associates/supervisors shall have experience and qualification appropriate to the type and magnitude of the Works. Full details shall be submitted of the qualifications and experience of all proposed staff to the Engineer for his approval.

### **2. CHECKING OF THE CONTRACTOR'S TEMPORARY WORKS DESIGN**

The Contractor shall, prior to commencing the construction of the Temporary Works, submit a certificate to the Engineer signed by him certifying that the Temporary Works have been properly and safely designed and checked and that the Contractor has checked the effect of the Temporary Works on the Permanent Works and has found this to be satisfactory.

### **3. THE SITE**

Works Areas are those areas identified in Appendix 2A to these Employer's Requirements and on the Drawings.

### **4. USE OF THE SITE**

- i) The Site or Contractor's Equipment shall not be used by the Contractor for any purpose other than for carrying out the Works in the scope of this contract, except that, with the consent in writing of the Engineer, the Site or Contractor's Equipment may be used for the work in connection with other contracts under the Employer.
- ii) Rock crushing plant shall not be used on the Site.
- iii) The location and size of each stockpile of materials, including excavated materials, within the Site shall be as permitted by the Engineer. Stockpiles shall be maintained at all times in a stable condition.
- iv) Entry to and exit from the Site shall be controlled and shall be only available at the locations for which the Engineer has given his consent.

### **5. ACCESS TO THE SITE**

- i) The Contractor shall make its own arrangements, subject to the consent of the Engineer, for any further access required to the Site.
- ii) In addition, the Contractor shall ensure that access to every portion of the Site is continually available to the Employer and Engineer.

Following the handover of the Works to the Employer, the Employer will be responsible for all matters relating to security and safety therein. Access to the Site by the Contractor shall be in accordance with any procedures, requirements and conditions defined in Appendix 9 to these Employer's Requirements.

## **6. ACCESS TO OUTSIDE THE SITE**

The Contractor shall be responsible for ensuring that any access or egress through the Site boundaries are controlled such that no disturbance to residents or damage to public or private property occur as a result of the use of such access or egress by its employees and sub-contractors.

## **7. SURVEY OF THE SITE**

A survey shall be carried out of the Site to establish its precise boundaries. Existing ground levels of the Works Areas shall also be recorded. The survey shall include a photographic survey sufficient to provide a full record of the state of the Site before commencing the Work with particular attention paid to those areas where reinstatement will be carried out later on. The survey shall be carried out before the site clearance wherever possible and in any case prior to the commencement of work in any Works Area. The survey shall be carried out by the Contractor and agreed with the Engineer.

On or before the Contractor is granted access to a certain portion of the Site, the Contractor shall carry out a survey jointly with the Other Contractors executing works on that portion of the Site. The Contractor shall advise the Engineer of the date of the joint survey at least 1 week in advance of the date

## **8. BARRICADES AND SIGNBOARDS**

- i) The Contractor shall erect barricades as per Tender Drawing and gates around its areas of operations to prevent entry by unauthorized persons to his Works Areas and necessary identity cards /permits should be issued to workers and staff by the contractor. The Contractor shall submit proposal for barricades of the complete perimeter of all works areas to the Engineer. Painting of the barricades shall be carried out to the design and colors as directed by the Engineer and the Contractor shall carry out re-painting of the entire barricades on an **annual basis**. No work shall be commenced in any Works Area until the Engineer has been satisfied that the barricades installed by the Contractor are sufficient to prevent, within reason, unauthorized entry. The cost of all this barricade is included in quoted price.
- ii) Project signboards shall be erected not more than four (4) weeks, or such other period as the Engineer has given his consent, after the date of commencement of the Works. The types, sizes and locations of project signboards shall be agreed with the Engineer before manufacture and erection. Other advertising signs shall not be erected on the Site.
- iii) The consent of the Engineer shall be obtained before hoardings, fences, gates or signs are removed. Hoardings, fences, gates and signs which are to be left in positions after the completion of the Works shall be repaired and repainted as instructed by the Engineer.
- iv) Hoardings, barricades, gates and signs shall be maintained in clean and good order by the Contractor until the completion of the Works, whether such hoardings, fences, gates and signs have been installed by the Contractor or by others and transferred to the Contractor during the period of

the Works. All the fencing, hoardings, gates and signs etc. shall be mopped minimum once in a **week** and washed **monthly**.

- v) All hoardings, barricades, gates and signs installed by the Contractor shall be removed by the Contractor upon the completion of the Works, unless otherwise directed by the Engineer.
- vi) Hoarding/ barricades can be reused after removing from one place to other locations / sites provided they are in good condition and approved by Engineer.
- vii) Damage/worn-out barricades /hoarding shall be replaced by contractor within 24 hours. Engineer 's decision regarding need for replacement shall be final and binding and if no action is taken by contractor, the Engineer may get it repaired through other agency and the cost of any repairs will be deducted by the Engineer from any payment due to the Contractor.

## **9. CLEARANCE OF THE SITE**

All Temporary Works which are not to remain on the Site after the completion of the Works shall be removed prior to completion of the Works or at other times instructed by the Engineer. The Site shall be cleared and reinstated to the lines and levels and to the same condition as existed before the Works started except as otherwise stated in the Contract.

## **10. SURVEY**

- i) The Contractor shall relate the construction of the Works to the Site Grid. To facilitate this, survey reference points have been established and the Engineer will provide benchmarks in the vicinity of the Site.
- ii) The Contractor shall interface with designated civil contractors to take over the reference coordinates system (x, y, z) of the project area as defined. Additional points are required to be established by the Contractor along alignment from the reference coordinate system including benchmark thus providing survey control for the work areas. The Contractor may also establish additional survey control markers as local grids or reference system for setting out particular sub-set of work.
- iii) The Contractor shall carefully protect all the survey reference points, benchmarks, setting out points, monuments, towers and the like from any damages and shall maintain them and promptly repair or replace any points damaged from any causes whatsoever. The Contractor shall regularly recheck the position of all setting out points, benchmarks and the like to the satisfaction of the Engineer.
- iv) Upon handover to the Contractor, the survey reference points will become the responsibility of the Contractor. The Contractor shall, by annual or more frequent review, ensure that these survey points continue to remain consistent with the benchmarks.
- v) Before the commencement of the actual Track work activities, the Contractor shall set out track center line or an offset to the track center line, the changes of horizontal and vertical alignment and the position of turnouts, diamond crossings and other special Track work.
- vi) The Contractor shall summarize the alignment details including the relevant chainage of the points and shall submit to the Employer for approval.

## **11. SAFETY, HEALTH, AND ENVIRONMENTAL REQUIREMENTS**

The Contractor shall comply with in the conditions stipulated in the Conditions of contracts on Safety, Health & Environment (SHE).

### **11.1. TRAINING OF CONTRACTOR'S EMPLOYEES/STAFF/WORKERS: -**

Contractor shall provide a training/workshop on safety, Health & Environment (SHE) to all its workers/staff/employees/subcontractors of at least 2 weeks (96hrs.) at the time of induction. Before postings of any his workers/staff/employees/subcontractors, the contractor shall give a certificate that the said person had undergone the requisite SHE training. Noncompliance of the above will invoke penalties as per condition of contract on SHE, Vol-2 of Tender Document.

In case of any mishap/ accident-causing death/injury to public or damage to public/private property or damage to public/private vehicles or damage to railway property, the employer, will impose a penalty to the contractor as deemed fit and appropriate in addition to the cost of damage caused due to the mishap/accident.

### **11.2. USE OF "TRACTOR TRANSMISSION TYPE" PICK AND CARRY HYDRA CRANE: -**

"Tractor Transmission type" Pick and Carry Hydra crane – 1st Generation model shall not be allowed. Contractor shall mobilize "Truck Transmission type" pick and carry hydra crane – 3<sup>rd</sup> and 4th Generation model only.

The safety standards of the sub-contractors are to be properly assessed prior to the placing of contracts and the Contractor shall employ only sub-contractors with a track record of maintaining the highest safety standards.

The Engineer reserves the right to order the immediate removal and replacement of any item of Contractors equipment or temporary works, which in his opinion, is unsatisfactory for its purpose or is in an unsafe condition.

## **12. OTHER SAFETY MEASURES**

### **A. SITE SAFETY, HEALTH & ENVIRONMENT PLAN**

1. The Contractor shall, within **60 days** of the date of Notice to Proceed, prepare and submit to the Engineer for review his proposed safety, Health and Environment plan which shall contain as a minimum those items set out in Conditions of Contract on Safety, Health & Environment Plan.
2. The Contractor shall conform to the Indian Environmental Laws and codes as applicable. The current national standards established by the Ministry of Environment and Forest, Government of India and other government agencies for control of environmental pollutants such as air, water, noise and visual impacts/aesthetics shall be followed for compliance during project construction.

2.1.1 The Contractor shall comply with all enactments and their amendments, which shall include but are not limited to:

- a) Environment Protection Act, 1986
- b) Air (Prevention and control of Pollution) Act, 1981
- c) Water (Prevention and Control of Pollution) Act, 1974
- d) Notification on Control of noise from DG sets, 2002

- e) The Noise pollution (Regulation & Control) rules, 2000
  - f) The Hazardous Waste (Management & handling) Rules, 1989
  - g) Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
  - h) Regulation on Recycling of Waste Hazardous Materials
  - i) Batteries (Management & Handling) Rules, 2001
  - j) Maharashtra Tree Preservation Act
  - k) Requirements of Maharashtra Urban Arts Commission and Central Vista Committee.
3. The provisions listed herein regarding Environmental Protection shall apply to and be binding upon the Contractor for any works on the site and the persons employed by sub-Contractors. The Contractor shall ensure that proper and adequate provisions to this end are included in all sub-contracts placed by him.
4. For closure of Non-Conformance Report, expeditious action shall be taken by the contractor for compliance and the contractor shall ensure closure of non-conformance report within 15 days of its issue. In case of non-closure of report, an amount of Rs.15, 000/- (Rupees Fifteen thousand only) shall be withheld from running on account bill for every non-closure of report till the same is closed to the satisfaction of engineer.
- B. FIRE REGULATIONS AND SAFETY**
1. The Contractor shall provide and maintain all necessary temporary fire protection and firefighting facilities on the Site during the construction of the Works and shall comply with all requirements of the Local Fire Services Department. These facilities may include, without limitation, sprinkler systems and fire hose reels in temporary site buildings, raw water storage tanks and portable fire extinguishers suitable for the conditions on the Site and potential hazards.
2. The Contractor shall submit details of these facilities to the Engineer for review prior to commencement of work on the Site.
3. If, in the Engineer's opinion, the use of naked lights may cause a fire hazard, the Contractor shall take such additional precautions and provide such additional firefighting equipment (including breathing apparatus) as the Engineer considers necessary. The term "naked light" shall be deemed to include electric arcs and oxyacetylene or other flames used in welding or cutting metals.
4. Oxyacetylene burning equipment will not be permitted in any confined space. Burning equipment of the oxypropane type shall be used.
- C. HAZARD AND RISK ASSESSMENTS**
1. The Contractor shall, prior to the commencement of any operation carry out a detailed hazard and risk assessment. The results of such assessments shall be recorded, and the records kept for inspection by the Engineer.
2. The Contractor shall produce detailed method statements for all medium and high-risk operations and shall submit them to the Engineer for his consent prior to commencement of any task to which they relate.
3. The Contractor shall produce and implement a Permit to Work system for all high-risk operations. The Permit to Work system shall be submitted to the Engineer for consent before application.

**D. EXPLOSIVES**

1. Explosives shall not be used without prior written consent of the Engineer. Before consent to blasting is granted, the Contractor shall prepare a Specification as to the size of charge, the method of firing and any other restrictions that may be imposed from time to time.
2. Where the Engineer has consented to the use of explosives, the Contractor shall be responsible for obtaining the requisite licenses and permits for complying with all statutory requirements for blasting.
3. The storage, transportation and use of explosives shall at all times be governed by the Explosives Acts and such other statutory regulations which may be applicable and as imposed by the Statutory Authorities.

**E. HIGH-CAPACITY CRANE**

No High-Capacity Crane shall be used without the prior written consent of the Engineer.

**F. STANDBY EQUIPMENT**

The Contractor shall provide adequate stand-by equipment to ensure the safety of personnel, the Works and the public. These measures shall include as a minimum the following: -

- a) stand-by pumping and generating equipment for the control of water.
- b) stand-by equipment and spares for illumination of the Works; and
- c) Stand-by generating equipment and equipment for the lighting for the works.

**G. CO-OPERATION**

The Contractor shall provide full co-operation and assistance in all safety surveillance carried out by the Engineer or the Employer. Any breaches of the Site Safety Plan or the statutory regulations or others disregard for the safety of any persons may be the reason for the Engineer to exercise his authority to require the site agent's removal from the Site.

**H. CARE OF THE WORKS**

1. Unless otherwise permitted by the Engineer all work shall be carried out in dry conditions.
2. The Works, including materials for use in the Works, shall be protected from damage due to water. Water on the Site and water entering the Site shall be promptly removed by temporary drainage or pumping systems or by other methods capable of keeping the Works free of water. Silt and debris shall be removed by traps before the water is discharged and shall be disposed of at a location or locations to which the Engineer has given his consent.
3. The discharge points of the temporary systems shall be as per the consent of the Engineer. The Contractor shall make all arrangements with and obtain the necessary approval from the relevant authorities for discharging water to drains, watercourses etc. The relevant work shall not be commenced until the approved arrangements for disposal of the water have been implemented.
4. The methods used for keeping the Works free of water shall be such that settlement of, or damage to, new and existing structures do not occur.



5. Measures shall be taken to prevent flotation of new and existing structures.

**I. PROTECTION OF THE WORKS FROM WEATHER**

Work shall not be carried out in weather conditions that may adversely affect the Works unless proper protection is provided to the satisfaction of the Engineer.

Permanent Works, including materials for such Works, shall be protected from exposures of weather conditions that may adversely affect such Permanent Works or materials.

During construction of the Works storm restraint systems shall be provided where appropriate. These systems shall ensure the security of the partially completed and ongoing stages of construction and in all weather conditions. Such storm restraint systems shall be installed as soon as practicable and shall be compatible with the right of way, or other access around or through- out the Site.

The Contractor shall at all times programme and order progress of the work and make all protective arrangements such that the Works can be made safe in the event of storms.

**J. PROTECTION OF THE WORK**

The finished works shall be protected from any damage that could arise from any activities on the adjacent site/ works.

**13. DAMAGE AND INTERFERENCE**

1. Work shall be carried out in such a manner that there is no damage to or interference with:

(a) Railway track (b) watercourses or drainage systems; (c) utilities; (d) structures (including foundations), roads, including street furniture, or other properties; (e) public or private vehicular or pedestrian access; (f) monuments trees, graves or burial grounds other than to the extent that is necessary for them to be removed or diverted to permit the execution of the Works. Heritage structures shall not be damaged or disfigured on any account. The Contractor shall inform the Engineer as soon as practicable of any items which are not stated in the Contract to be removed or diverted but which the Contractor considers need to be removed or diverted to enable the Works to be carried out. Such items shall not be removed or diverted until the consent of the Engineer to such removal or diversion has been obtained.

2. Items which are damaged or interfered with as a result of the Works and items which are removed to enable work to be carried out shall be reinstated to the satisfaction of the Engineer and to at least the same condition as existed before the work started. Any claims by Utility Agencies due to damage of utilities by the Contractor shall be borne by the Contractor.

The Contractor shall excavate by hand where damage may be caused by the operation of mechanical plant adjacent to any utilities.

Except with the prior approval of the Mumbai Fire Services, no damage or interference with existing fire hydrants and valves shall be caused.

Prior to trench excavation, the Contractor shall carry out investigations to locate utilities by means of hand-dug inspection pits. The locations and number of inspection pits required in meeting the Contractor's obligations to establish the location of existing utilities and underground features shall be determined by the Contractor. The Contractor shall note that many existing pipes/ducts/cables may not be shown in the records kept by the utility undertakings and may only be exposed as the excavation proceeds. The trench excavation shall be carried out by hand where there are utilities adjacent to or within the excavation works and the Contractor shall have allowed in his programme

the time required for the exposing, temporary support and diversion of these recorded or unrecorded utilities should any pipes/ducts/cables or cover tiles be exposed, the respective utility undertaking shall be contacted to determine if all the utilities have been located. Cover tiles and utilities shall only be removed by the utility undertakings concerned.

#### **14. UTILITIES**

Please refer Employer's Requirement – Functional

#### **15. STRUCTURES, ROADS AND OTHER PROPERTIES**

The Contractor shall immediately inform the Engineer of any damage to structures, roads or other properties.

##### **ACCESS**

Alternative access shall be provided to all premises if interference with the existing access, public or private, is necessary to enable the Works to be carried out. The arrangements for the alternative access shall be as agreed by the Engineer and the concerned agency. Unless agreed otherwise, the permanent access shall be reinstated as soon as practicable after the work is complete and the alternative access shall be removed immediately as it is no longer required, and the ground surfaces reinstated to the satisfaction of the Engineer. Proper signage and guidance shall be provided for the traffic / users regarding diversions.

##### **REMOVAL OF GRAVES AND OTHER OBSTRUCTIONS**

If any graves and other obstructions are required to be removed in order to execute the Works and such removal has not already been arranged for, the Contractor shall draw the Engineer's attention to them in good time to allow all necessary arrangements and authorizations for such removal, and it shall not itself remove them unless the Engineer has given consent.

##### **PROTECTION OF THE ADJACENT STRUCTURES AND WORKS**

The Contractor shall take all necessary precautions to protect the structures or works being carried out by others adjacent to and, for the time being, within the Site from the effects of vibrations, undermining and any other earth movements or the diversion of water flow arising from its work.

##### **TREES AND OTHER SIMILAR OBSTRUCTIONS**

Trees which are to be retained or which are not required to be removed in order to carry out the Works, shall be protected from damage at all times by methods reviewed without objection by the Engineer. Materials, including excavated materials, shall not be banked around such trees and they shall not be trimmed or cut without having been reviewed without objection by the Engineer.

If any trees or other obstructions are required to be removed during the execution of the Works which are not specifically required to be removed or otherwise catered for, the Contractor shall draw the attention of the Engineer to them and shall not remove them without having received a notice of no objection from the Engineer.

##### **NOISE CONTROL ON WORKS SITE**

All Contractor's Equipment shall be effectively "sound-reduced" by means of silencers, mufflers, acoustics linings or shields or acoustic sheds or screens to levels prescribed in the relevant Noise Control Ordinance and measured outside the nearest occupied property or to the satisfaction of the Engineer. The Contractor shall provide details of proposed noise control measures to the Engineer for review prior to the use of any Contractor's Equipment on the Site.

Provided that the provisions of this Paragraph shall not be applicable in the case of emergency work necessary to save life or property or for the safety of the Works or in the case of blasting operations necessitated by urgency and reviewed by the Engineer.

The Contractor shall provide a sound level meter (as specified in Appendix of this Specification), reviewed without objection by the Engineer, for the exclusive use of the Engineer at all times during the continuance of the Contract.

## **Spoil Disposal**

The Contractor shall make his own enquiries and arrangements regarding the location and the availability of spoil disposal areas and reclamation and shall pay all costs of complying with all regulations and requirements of Relevant Authorities in connection with the use of such areas. These areas are not within the control of the Employer and no claims will be entertained in respect of non-availability of a particular area or changes in the costs of arrangements for the use thereof.

The Contractor shall be responsible for all necessary liaison to ensure compliance with the requirements of unproductive disposal of any surplus excavated rock or soft material which is suitable for filling.

The Contractor shall conform to all pertinent Environmental Protection Ordinances and be liable for any breach of such Ordinances committed by himself and/or his sub-contractors during the disposal of surplus excavated material and water from the Site.

## **16. WORK ON ROADS**

### **16.1. TRAFFIC MANAGEMENT PLAN**

The Contractor shall develop a detailed Traffic Management Plan for the work under the contract. The purpose is to develop a Traffic Management Plan to cope with the traffic disruption as a result of construction activities by identifying strategies for traffic management on the roads and neighborhood's impacted by the construction activities. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract.

#### **Principles for Traffic Management**

The basis for the Plan shall take into consideration four principles:

- (1) to minimize the inconvenience of road users and the interruption to surface traffic through the area impacted by the construction activities.
- (2) to ensure the safety of road users in the impacted area.
- (3) to facilitate access to the construction site, and to maintain reasonable construction progress.
- (4) to ensure traffic safety at each construction site.

#### **Integrated Traffic Management Plan**

The Contractor shall prepare an integrated plan showing the arrangements to be made for accommodating road and pedestrian traffic, at individual construction sites and continuously along the alignment, to smooth traffic operations and for the safety of both construction workers and road users. The Plan shall consider different measures such as:

- (1) proper phasing and timing of traffic signals.

- (2) modifications to intersection geometry.
- (3) changes in lane usage.
- (4) parking prohibitions.
- (5) re-location of bus stops.
- (6) reducing width of footpaths and median.
- (7) right-turn prohibition.
- (8) work site access management.
- (9) minimizing the duration of any road closure.
- (10) reversible lane operations.
- (11) modification of roadway alignment affected by the construction, which shall be in conformance with the requirements and regulations defined by the relevant authorities; and may include widening of roads, Construction of temporarily new road etc.
- (12) other traffic engineering measures as may be applicable.

## **16.2. MITIGATION OF TRAFFIC DISTURBANCES**

The Contractor shall manage the vehicular and pedestrian right of way during the period of construction. The Contractor shall take account of the need to maintain essential traffic requirements, as these may influence the construction process.

The Contractor shall include local traffic diversion routes and assess traffic impacts caused by the construction in the affected areas. Signage layout shall be included to ensure that adequate motorist information will be provided for traffic diversions.

Where it becomes necessary to close a road or intersection, or supplementary lanes are required to satisfy the traffic demands, traffic diversion schemes to adjacent roadways shall be developed with quantitative justifications. The Contractor shall co-ordinate with all relevant authorities.

Other considerations include:

- (1) The minimum lane widths for fast traffic and mixed traffic shall follow the regulations of the different authorities.
- (2) Any roads or intersections that have no alternative access shall not be fully closed for construction.
- (3) Emergency access to all properties shall be maintained at all times.
- (4) Access to business premises and property shall be maintained to the extent that normal activities are not seriously disrupted.
- (5) Minimum footpath width shall be 1.5 m, unless otherwise indicated. The footpath shall be *separated* from vehicle traffic and not necessarily immediately adjacent to vehicle traffic.
- (6) Where existing footbridges and underpasses are demolished or closed, provisions shall be made for pedestrian crossing to minimize the conflicts between a traffic lane.
- (7) Construction traffic shall be separated from other traffic wherever possible;
- (8) Any traffic related facilities (bus stops, parking, etc.) which are affected by the construction

works shall be maintained or relocated to appropriate locations.

- (9) Motorists, pedestrians, workmen, plant and equipment shall be protected from accident at all times;
- (10) Roadway designs, traffic management schemes, and installation of traffic control devices shall be in conformance with the requirements and regulations defined by the relevant authorities; and Where applicable, utility diversions shall be incorporated in the traffic management plan.

### **16.3. APPROVAL FOR TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL**

The Contractor shall make all arrangements with and obtain the necessary approval from the transport authorities and the Police Department for temporary traffic arrangements and control on public roads. In the event that the Contractor, having used its best endeavors, fails to secure the necessary approval from the transport authorities and the Traffic Police Department for temporary traffic arrangements and control on public roads, then the Employer will use its best endeavors to assist the Contractor to secure such approval but without responsibility on the part of the Employer to do so.

#### **1. TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL**

- i) Temporary traffic diversions and pedestrian routes shall be surfaced and shall be provided where work on roads or footpaths obstruct the existing vehicular or pedestrian access. The relevant work shall not be commenced until the approved temporary traffic arrangements and control have been implemented.
- ii) Temporary traffic arrangements and control for work on public roads and footpaths shall comply with the requirements of the Traffic Police. Copies of documents containing such requirements shall be kept on the Site at all times.
- iii) Temporary traffic signs, including road marking, posts, backing plates and faces, shall comply with the requirements of the Traffic Police and should be in accordance with the requirements of Ministry of Surface Transport. All overhead traffic management signs that are fixed to bridges and gantries shall be illuminated at night. Pedestrian routes shall be illuminated at night to a lighting level of not less than 50 lux.
- iv) Adequate number of traffic marshals shall be deployed for smooth regulation of traffic.
- v) Temporary traffic arrangements and control shall be inspected and maintained regularly, both by day and night. Lights and signs shall be kept clean and legible. Equipment which are damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced promptly.

#### **2. PARTICULARS OF TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL**

- i) The following particulars of the proposed temporary traffic arrangements and control on public roads shall be submitted to the Engineer for consent at least 28 days before the traffic arrangements and control are implemented:
- ii) Details of traffic diversions and pedestrian routes.

- iii) Details of lighting, signage, guarding and traffic control arrangements and equipment.
- iv) Any conditions or restrictions imposed by Traffic Police or any other relevant authorities, including copies of applications, correspondence and approval.
- v) Where concrete barriers are used to separate flows of traffic, the barriers shall be in a continuous unbroken line. No gaps shall be left between any section of the barrier.
- vi) Site perimeter fencing and barriers along the roadway, shall have flashing amber lights positioned on the top of them every 50 meters apart and at every abrupt change in location. Directly below the flashing light shall be fixed, in the vertical position, a white fluorescent light with a waterproof cover.

### **3. USE OF ROADS AND FOOTPATHS**

- i) Public roads and footpaths on the Site in which the work is not being carried out shall be maintained in a clean and passable condition.
- ii) Measures shall be taken to prevent the excavated materials, silt or debris from entering gullies on roads and footpaths; entry of water to the gullies shall not be obstructed.
- iii) Surfaced roads on the Site and leading to the Site shall not be used by tracked vehicles unless protection against damage is provided.
- iv) Contractor's Equipment and other vehicles leaving the Site shall be loaded in such a manner that the excavated material, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted. The wheels of all vehicles shall be washed, when necessary, before leaving the Site to avoid the deposition of mud and debris on the roads.

### **4. REINSTATEMENT OF PUBLIC ROADS AND FOOTPATHS**

Temporary diversions, pedestrian access and lighting, signing, guarding and traffic control equipment shall be removed immediately when they are no longer required. Roads, footpaths and other items affected by temporary traffic arrangements and control shall be reinstated to the same condition as existed before the work started or as permitted by the Engineer immediately after the relevant work is complete or at other times permitted by the Engineer. The cost of same shall paid as per the BOQ.

The Contractor shall submit his design for the reinstatement to the relevant authorities and obtain their prior approval to carrying out the work. Reinstatement works shall include:

- 1) Parking bays
- 2) Footpath and kerbs
- 3) Road Signage
- 4) Street Lighting
- 5) Landscaping
- 6) Traffic Lights and Control Cable
- 7) Road painting

## **17. SITE ESTABLISHMENT**

### **CONTRACTOR'S SITE ACCOMMODATION**

- (1) The Contractor shall provide and maintain its own site accommodation at locations consented to by the Engineer. Offices, sheds, stores, mess rooms, garages, workshops, latrines and other accommodation on the Site shall be maintained in a clean, stable and secure condition. The Contractor shall comply with the requirements of Appendix 8 to the Employer's Requirements.

In addition, Contractor shall provide & maintain field offices for use of Employer and Engineer Staff during the contract period at Depot of area not less than 250 sqm with toilet & electricity facility including services for office upkeep including office staff, communication system, 03 numbers of latest version desktop computers supporting all software, multipurpose colour printers with scanner (A3), drinking water, tea/coffee, consumable, furniture, security etc. The Contractor shall also provide 3 no. air-conditioned vehicle 7-seater for Employer on 24 x 7 basis for 3000km/month during the entire Contract period. No extra cost will be payable for these mandatory facilities to Employer and Engineer.

### **LATRINES AND WASH PLACES**

- (2) The Contractor shall provide latrines and wash places for the use of its personnel and all persons who will be on the Site. The size and disposition of latrines and wash places shall accord with the numbers and dispositions of persons entitled to be on the Site, which may necessitate their location on structures and, where necessary there shall be separate facilities for males and females. The capacities and layout shall be subject to approval of the Engineer. The Contractor shall arrange regular disposal of effluent and sludge in a manner that shall be in accordance with local laws/regulations.
- (3) The Contractor shall be responsible for maintaining all latrines and wash places on the Site in a clean and sanitary condition and for ensuring that they do not pose a nuisance or a health threat. The Contractor shall also take such steps and make such provisions as may be necessary or directed by the Engineer to ensure that vermin, mosquito breeding etc. are at all times controlled.

### **SITE UTILITIES AND ACCESS**

- (4) The Contractor shall be responsible for providing water, electricity, telephone, sewerage and drainage facilities for contractors site offices, structures, and buildings and for all site laboratories in accordance with Appendix 14 to these Employer's Requirements and all such services that are necessary for satisfactory performance of the Works. The Contractor shall make all arrangements with and obtain the necessary approval from the relevant civil and utility authorities for the facilities.
- The contractor shall be responsible for provision of power supply for his works. The Employer cannot guaranty provision of adequate, continuous power supply however assistance will be given in obtaining the necessary permissions for site generators and the like.
- (5) Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, acceptable and stable condition. For lengths of roadway longer than 100 m and where vehicle movements exceed one hundred (100) movements/day and heavy commercial vehicle are to ply the Contractor shall provide paved surfacing of adequate thickness and quality to the satisfaction the Engineer.
- (6) Any operation of the Works that interferes with the checking of lines and levels shall be temporarily



suspended at the request of the Engineer until the checking is complete.

#### **SUBMISSION OF PARTICULARS**

- (7) The following particulars shall be submitted to the Engineer for his consent not more than fifty-six (56) days after the date of commencement of the Works:
  - (a) drawings showing the formation works and the layout within earmarked area for the Contractor's offices, project signboards, principal access and other major facilities required early in the Contract, together with all service utilities.
  - (b) drawings showing the details to be included on the project signboards and diversion boards.
  - (8) Drawings showing location of stores, storage areas, shall be submitted to the Engineer for his consent as early as possible but in any case, not less than twenty-eight (28) days prior to when such facilities are intended to be constructed on the Site.

#### **18. SECURITY**

- (1) The Contractor shall be responsible for the security of the Site for the full time the Site is in its possession, except for the specific case of the Railway Envelope after handover to the Railway Operator. It shall set up and operate a system whereby only those persons entitled to be on the Site can enter the Site. To this end, the Contractor shall with the consent of Engineer provide the specific points only at which entry through the security fence can be effected and shall provide gates and barriers at such points of entry and whereby maintain a twenty-four (24) hours security guard, and such other security personnel and patrols elsewhere as may be necessary to maintain security.
- (2) The Contractor shall maintain all site boundary fences in first class condition and shall so arrange site boundary fences at all access drainage points of work areas that its use of such access points etc., are not restricted by the system or method of achieving the required security measures. Notices shall be displayed at intervals around the Site to warn the public of the dangers of entering the Site.
- (3) During the progress of the Works the Contractor shall maintain such additional security patrols over the areas of the Works as may be necessary to protect its own and its sub-contractor's work and equipment and shall co-ordinate and plan the security of both the work under this Contract and the work of others having access to and across the Site and the Works.
- (4) In order to operate such a security system, it will be necessary to institute the issue of unique passes to personnel and vehicles entitled to be on the Site, and which may need to be separately identifiable according to the shifts being worked on Site. The Contractor shall at the outset determine, together with the Engineer, a system and the design of passes to suit the requirements of the foregoing and to suit the methods of work to be adopted by the Contractor. The Contractor shall at all times ensure that the Engineer has an up to date list of all persons entitled to be on the Site at any time. The contractor shall also introduce a system of issue passes to any outsider or person/vehicles belonging to agencies other than employer/ Engineers who may have to visit the site in connection with work.
- (5) The Contractor shall liaise with the Designated Contractors and the contractors responsible for the adjacent and other interfacing contracts and ensure that coordinated security procedures are operated, in particular in respect of vehicles permitted to pass through the Site and/or the adjacent sites in the latter periods of the Contract.
- (6) Security and checking arrangements as felt necessary shall be provided with advice and help of Police.



## **19. TESTING**

### **A. GENERAL**

- (1) The Contractor shall provide and perform all forms of testing procedures applicable to the Works and various components and the interfacing of the Works with the other Contract works and shall conduct all necessary factory, site and acceptance tests.
- (2) All testing procedures shall be submitted at least thirty (30) days prior to conducting any Test. The Testing procedures shall show unambiguously the extent of testing covered by each submission, the method of testing, the Acceptance Criteria, the relevant drawing (or modification) status and the location.
- (3) The testing Procedures shall be submitted, as required, by the Contractor during the duration of the contract to reflect changes in system design or the identification of additional testing requirements.
- (4) The Engineer shall have the facilities for monitoring all tests and have access to all testing records. Ample time shall be allowed within the testing programmes for necessary alterations to equipment, systems, and designs to be undertaken, together with re-testing prior to final commissioning.
- (5) The Contractor is reminded that at some point, the High Voltage Power Supply system will be energized and the additional precautions for the safety of staff and co-ordination of activities after power-on shall be anticipated in its testing and commissioning programs.
- (6) All costs associated with the Testing shall be borne by the Contractor, unless otherwise specified, including the services of any specialized personnel or independent assessors. The Contractor shall also bear any expenses incurred due to resetting caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.
- (7) Unless agreed in writing by the Engineer, the personnel engaged on testing shall be independent of those directly engaged in the design or installation of the same equipment.
- (8) All testing equipment shall carry an appropriate and valid calibration label.
- (9) If any third-party test of material is required, the same shall be carried out by the Contractor in NABL approved laboratory at its own cost.
- (10) USFD testing to be conducted by RDSO approved 3<sup>rd</sup> party for all rails, turnouts and welds. All costs associated with the Testing shall be borne by the Contractor

### **B. BATCHES, SAMPLES AND SPECIMENS**

- (1) A batch of material is a specified quantity of the material that satisfies the specified conditions. If one of the specified conditions is that the material is delivered to the Site at the same time, then material delivered to the Site over a period of a few days may be considered as part of the same batch if in the opinion of the Engineer there is sufficient proof that the other specified conditions applying to the batch apply to all of the material delivered over the period.

- (2) A sample is a specified quantity of material that is taken from a batch for testing and which consists of a specified amount, or a specified number of pieces or units, of the material.
- (3) A specimen is the portion of a sample that is to be tested.

#### **C. SAMPLES FOR TESTING**

- (1) Samples shall be of sufficient size and in accordance with relevant Standards to carry out all specified tests.
- (2) Samples taken on the Site shall be selected by, and taken in the presence of, the Engineer or Engineer's representative and shall be suitably marked for their identification. An identification marking system should be evolved at the start of works in consultation with the Engineer.
- (3) Samples shall be protected, handled and stored in such a manner that they are not damaged or contaminated and such that the properties of the sample do not change.
- (4) Samples shall be delivered by the Contractor, under the supervision of the Engineer or Engineer's representative, to the specified place of testing. Samples on which non-destructive tests have been carried out shall be collected from the place of testing after testing and delivered to the Site or other locations instructed by the Engineer.
- (5) Samples which have been tested may be incorporated in the Permanent Works provided that:
  - (a) the sample complies with the specified requirements.
  - (b) the sample is not damaged; and
  - (c) the sample is not required to be retained under any other provision of the Contract.
- (6) Additional samples shall be provided for testing if in the opinion of the Engineer:
  - (a) material previously tested no longer complies with the specified requirements; or
  - (b) material has been handled or stored in such a manner that it may not comply with the specified requirements.

#### **D. TESTING**

- (1) The Contractor shall be responsible for all on-site and off-site testing. All appropriate laboratory tests shall be carried out in the NABL laboratory, unless otherwise permitted or required by the Engineer. Where the laboratory is not appropriately equipped and/or staffed for some tests, or if agreed to by the Engineer, tests may be carried out in other laboratories (third party) provided that:
  - (a) they are accredited for the relevant work to a standard acceptable to the Engineer; and
  - (b) particulars of the proposed laboratory are submitted to the Engineer for his consent.
- (2) The tests shall be done in the presence of the Engineer or his authorized representative.
- (3) Equipment, apparatus, and materials for the tests carried out by the Contractor shall be provided by the Contractor. The equipment and apparatus shall be maintained by the Contractor and shall be calibrated before the testing starts and at regular intervals as permitted by the Engineer. The

equipment, apparatus and materials for tests shall be removed by the Contractor as soon as practicable after the testing is complete.

- (4) The Contractor shall be entitled in all cases to attend the testing carried out in the Employer's or other laboratories, to inspect the calibration certificates of the testing machines and to undertake the testing on counterpart samples. Testing of such samples shall be undertaken in laboratories complying with Clause 19 (a) above and particulars of the laboratory proposed shall be submitted to the Engineer for consent prior to the testing.
- (5) Attendance on tests, including that by the Engineer, Contractor, and Designer, shall be as laid down in the Quality Assurance procedures.

#### **E. COMPLIANCE OF BATCH**

- (1) The results of tests on samples or specimens shall be considered to represent the whole batch from which the sample was taken.
- (2) A batch shall be considered as complying with the specified requirements for a material if the results of specific tests of the specified properties comply with the specified requirements for the properties.
- (3) If additional tests are permitted or required by the Engineer but separate compliance criteria for the additional tests are not stated in the Contract, the Engineer shall determine if the batch complies with the specified requirements for the material on the basis of the results of all tests, including the additional tests, for all properties.

#### **F. RECORDS OF TESTS**

- (1) Records of tests carried out by the Contractor shall be kept by the Contractor on the Site and a report shall be submitted to the Engineer within seven (7) days, or such other time stated in the Contract or in the Quality Assurance Programme, after completion of each test. In addition to any other requirements, the report shall contain the following details:
  - (a) material or part of the Works tested.
  - (b) location of the batch from which the samples were taken or location of the part of the Works; if applicable, the batch from which the samples were taken for test, the size and description of samples and the method of sampling
  - (c) place of testing.
  - (d) date and time of tests.
  - (e) weather conditions in the case of tests.
  - (f) technical personnel supervising or carrying out the tests.
  - (g) size and description of samples and specimens.
  - (h) method of sampling.
  - (i) properties tested.
  - (j) method of testing.
  - (k) readings and measurements taken during the tests.

- (l) test results, including any calculations and graphs.
  - (m) specified acceptance criteria; and
  - (n) other details stated in the Contract.
- (2) Reports of tests shall be signed by the site agent or his assistant, or by another representative authorized by the Contractor.
- (3) If requested, records of tests carried out by the Employer's staff or by the Engineer shall be given to the Contractor.

## **20. RECORDS**

### **A. DRAWINGS PRODUCED BY THE CONTRACTOR**

Drawings produced by the Contractor for submission to the Engineer shall generally be to ISO A1 size. They shall display a title block with the information as detailed in Appendix 7 to these Employer's Requirements or as advised. The number of copies to be submitted to the Engineer shall be as stated in the Contract, or as required by Engineer.

### **B. PROGRESS PHOTOGRAPHS**

- (1) The Contractor shall provide monthly progress photographs which have been properly recorded to show the progress of the works to the Engineer. Sufficient photographs shall be taken on locations agreed with the Engineer to record the exact progress of the Works. Two sets of photographs shall be provided on CD ROM format with two sets of colour prints of 175 mm x 125 mm size.
- (2) The Contractor shall mount each set of each month's progress photographs in a separate album of a type to which the Engineer has given his consent and shall provide for each photograph two typed self-adhesive labels, one of which shall be mounted immediately below the photograph and one on the back of the photograph. Each label shall record the location, a brief description of the progress recorded and the date on which the photograph was taken.
- (3) All photographs shall be taken by a skilled photographer whose name and experience shall be submitted to the Engineer for consent and approval received. Processing shall be carried out by a competent processing firm to the satisfaction of the Engineer.
- (4) The Contractor shall ensure that no photography is permitted on the Site without the agreement of the Engineer. Contractor should be aware of the local regulations and conditions with regard to Photography in some "RESTRICTED AREA" in Mumbai.

### **C. RECORDS OF WAGE RATES**

The Contractor shall keep monthly records of the average, high and low wage rates for each trade/tradesman employed on the Site and records shall be made available to the Engineer during inspection.

## **21. MATERIALS**

- (1) Materials and goods for inclusion in the Works shall be new unless the Engineer has consented otherwise. Preference shall be given to local materials where available. Approved Manufacturers/Suppliers of important items have been given in Appendix 10 of this document. These materials shall be procured only for these manufacturers/Suppliers.
- (2) Certificates of tests by manufacturers which are to be submitted to the Engineer shall be current and shall relate to the batch of material delivered to the Site. Certified true copies of certificates may be submitted if the original certificates could not be obtained from the manufacturer.
- (3) Parts of materials which are to be assembled on the Site shall be marked to identify the different parts.
- (4) Materials which are specified by means of trade or proprietary names may be substituted by materials from a different manufacturer which has received the consent of the Engineer provided that the materials are of the same or better quality and comply with the specified requirements.
- (5) Samples of materials submitted to the Engineer for information or consent shall be kept on the Site and shall not be returned to the Contractor or used in the Works unless permitted by the Engineer. The samples shall be used as a mean of comparison which the Engineer shall use to determine the quality of the materials subsequently delivered. Materials delivered to the Site for use in the Works shall be of the same or better quality as the samples which have received consent.

## **22. PROVISION AND DISPOSAL OF EARTHWORKS MATERIAL**

- (1) The Contractor shall be responsible for the provision of all classes of earthworks material required for the Works, whether sourced from the excavations within the Contract or obtained from any other sources, which are located outside the Site, for which the Engineer has given the consent.
- (2) All excavated material, excluding waste material, bentonite fluid and bentonite contaminated material shall be disposed of at the appointed site only. The above excavated material shall not be accumulated near Railway track/premises. This material shall be placed and compacted in accordance with the Construction Specification for Earth Works or as otherwise directed by the Engineer's Representative. The disposal of waste material, bentonite fluid and material contaminated with bentonite shall be the full responsibility of the Contractor and these materials shall be disposed of by the Contractor at an approved location. The dumping sites provided by the Employer shall not be used for disposal of waste material, bentonite fluid or material contaminated with bentonite.
- (3) Rock deposited as fill material at the dumpsites shall be capable of compaction with single pieces no larger than 300mm.

## **23. RESTORATION OF AREAS DISTURBED BY CONSTRUCTION**

Unless otherwise directed by the Engineer, any areas disturbed by the construction activity, either inside or outside the Project Right of Way, shall be reinstated as follows:

All areas affected by the construction work shall be reinstated to their original condition, with new materials, including but not necessarily limited to, sidewalks, parking lots, access roads, adjacent roads properties and landscaping. Grass cover shall be provided for any bare earth surface areas, along with proper provisions for surface drainage.

## **24. PACKAGING, STORAGE, SHIPPING AND DELIVERY**

### **A. STORAGE**

- I) The contractor shall provide and maintain acceptable storage facilities for the permanent works, equipment and materials of all kinds intended for use in carrying out the works or for incorporation into the works.
- ii) The contractor shall prepare, protect and store in an agreed manner all permanent works, contractor's equipment, equipment and materials so as to safeguard them against loss or damage from repeated handling, from climatic influences and from all other hazards arising during shipment or storage on or off the site.
- iii) Secure and covered storage shall be provided by the contractor for all permanent works, contractor's equipment, equipment, and materials which are other than those having been reviewed without objection by the engineer as suitable for open storage.

### **B. GENERAL PRECAUTIONS**

Appropriate precautions in accordance with the GCC, contractor's safety regulations, the regulations of the employer, and statutory regulations shall be taken in respect of all hazardous, toxic, inflammable, etc. materials.

### **C. PACKAGING PROCEDURES**

- I) All required inspection/test certificates shall be supplied and packed together with individual material. all packaging materials and procedures shall be subject to review by the engineer.
- ii) All empty cases, crates or packages, whether or not returnable, shall be removed from the site by the contractor or stored by the contractor in such a way that they do not interfere with the progress of the works of project contractors.
- iii) Two copies of packing lists and quality certificates shall be attached to each case or package to be shipped. one copy shall be placed inside the package and the second copy shall be enclosed in a watertight enclosure on the outside of each case or package. a copy of packing lists and quality certificates shall be sent to the engineer after each package of the works, the equipment, spare parts and other items to be shipped have been shipped.

### **D. SHIPPING**

- i) Without prejudice to any other provisions of the contract, the contractor shall be responsible for all legal requirements, duties, dues, taxes and other such requirements and expenditures required for the importation of the works, the equipment, spare parts and other items to be supplied under the contract into Mumbai.
- ii) The contractor shall clear the works, the equipment, spare parts and other items to be supplied under the contract through customs authorities/Indian sea port in accordance with all government of India enactments.

- iii) The contractor shall provide Spares for Depot and mainline including Turn out at the end of the completion period.
- iv) The Contractor shall handover the spares at the time of handing over of works to the O&M team at designated location.

#### **E. DELIVERY**

- I) The contractor shall deliver the works and all items to be supplied under the contract to the site.
- ii) The contractor shall unload the works and all items to be supplied under the contract at the designated delivery point and positioning or storing them
- iii) Any part of the works or any item to be supplied under the contract that is damaged in transit shall not be considered as delivered until repairs or replacements have been made and all necessary spare parts or items have been delivered to the site.
- iv) All documents, manuals, drawings, and other deliverables shall be delivered to an address in Mumbai to be designated by the engineer in writing.
- v) The contractor shall store and secure the works, equipment, spare parts and other items until the same have been inspected and are considered delivered at the designated point by the engineer.
- vi) An item shall be considered delivered when all damage have been repaired and all documentation and post-delivery preparation have been completed to the satisfaction of the engineer
- vii) The contractor shall provide Spares for Depot and mainline including Turn out.
- viii) The Contractor shall procure and handover the spares at the time of handing over of works to the O&M team at designated location and time as agreed by Engineer/Employer.

#### **25. TEMPORARY WATER AND ELECTRICITY SUPPLY**

##### **Applicability**

Where the Contractor is required to provide temporary electrical supplies, or to use, extend or expand on temporary supplies installed by others, all such activity shall be executed in accordance with clauses 18.3 to 18.18 inclusive.

When the Contractor makes use of temporary electrical supplies provided by other, he will observe and comply with the requirements of this Chapter.

#### **26. WORK ON SITE**

- i) The Contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Engineer for review not later than 4 weeks before the appointment and who shall be solely responsible for ensuring the safety of all temporary electrical equipment on Site. The Contractor shall not install or operate any temporary Site electrical systems until this representative is appointed and has commenced duties.

- ii) The name and contact telephone number of the representative having been reviewed without objection by the Engineer shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.
- iii) The Contractor shall submit schematic diagrams and the details of the equipment for all temporary electrical installations, and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for review.
- iv) All electrical installation work on Site shall be carried out in accordance with the requirements laid down in BS 7375 and the Specification. All work shall be supervised or executed by qualified and suitably categorized electricians, who are registered as such under the Electricity Ordinance 1990/Electricity (Registration) Regulations 1990.

## **27. ELECTRICAL GENERAL**

Temporary electrical Site installations and distribution systems shall be in accordance with: -

- (1) Indian Electrical Regulations.
- (2) The Power Companies" Supply Rules.
- (3) Electricity and its subsidiary Regulations.
- (4) IEE Wiring Regulations (16th Edition)
- (5) BS 7375 Distribution of Electricity on Construction and Building Sites.
- (6) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites
- (7) BS 6164 Safety in Tunnelling in the Construction Industry.
- (8) Any other applicable national standards

## **28. MATERIALS, APPLIANCES AND COMPONENTS**

All materials, appliances and components used within the distribution system shall comply with BS 4363 and BS 7375 Appendix A.

## **29. DESIGN CONSIDERATIONS**

- i) Distribution equipment utilized within the temporary electrical distribution system shall incorporate the following features: -
  - (1) flexibility in application for repeated use.
  - (2) suitability for transport and storage.
  - (3) robust construction to resist moisture and damage; and
  - (4) safety in use.



- ii) All cabling shall be run at high level whenever possible and firmly secured to ensure they do not present a hazard or obstruction to people and equipment.
- iii) The installation on Site shall allow convenient access to authorized and competent operators to work on the apparatus contained within.

### **30. MAINS VOLTAGE**

- i) The Site mains voltage shall be as the Electricity Companies' Utility supplies, 415V 3-phase 4 wire system.
- ii) Single-phase voltage shall be as the Electricity Companies' Utility supplies, 230V supply.
- iii) Reduced voltages shall conform to BS 7375.

#### **30.1 TYPES OF DISTRIBUTION SUPPLY**

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

- (1) fixed plant - 415V 3 phase;
- (2) movable plant fed by trailing cable - 415V 3 phase;
- (3) Installations in Site buildings - 230V 1 phase
- (4) fixed flood lighting - 230V 1 phase;
- (5) portable and hand held tools - 115V 1 phase;
- (6) Site lighting (other than flood lighting) - 115V 1 phase; and
- (7) Portable hand-lamps (general use) - 115V 1 phase.

When the low voltage supply is energized via the Employer's transformer, any power utilized from that source shall be either 415V3 phase or / 230V single phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.

#### **30.2 PROTECTION OF CIRCUITS**

- i) 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.
- ii) Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with:-
  - (1) BS 88;
  - (2) BS EN 60898; and
  - (3) BS 7375;
  - (4) Any other appropriate Indian Standards.

### **31. EARTHING**

- i) 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.
- ii) Earthing systems shall conform to the following standards: -
  - (1) IEE Wiring Regulations (16th Edition)
  - (2) BS 7430
  - (3) BS 7375
  - (4) IEEE Standard 80 Guide for Safety in AC Substation Grounding.

### **32. PLUGS, SOCKET OUTLETS AND COUPLERS**

Low voltage plugs, sockets and couplers shall be colour coded in accordance with BS 7375 and constructed to conform to BS EN60309. High voltage couplers and 'T' connections shall be in accordance with BS 3905.

### **33. CABLES**

- i) Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required. Supply cables up to 3.3KV shall be in accordance with BS 6346. The cable armoring shall be used as the earth return in conditions where the cable is continuously extended and not subject to continuous movement after installation.
- ii) 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 standards 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
  - c) BS 6500 insulated flexible cords and cables.
- iii) 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 for armored PVC insulated cables; and BS 6708 Flexible cables for use at mines and quarries.
- iv) All cables which have a voltage to earth exceeding 65 V (except for supplies from welding transformers to welding electrodes) shall be of a type having a metal sheath and/or armour which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.
- v) 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.
- vi) For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.

- vii) Cables which have applied to them a voltage to earth exceeding 12 V but not normally exceeding 65 V shall be either one of the types as described in clause 0 above or alternatively of a type insulated and sheathed with a general purpose or heat resisting Elastomers.
- viii) All cables that are likely to be frequently moved in normal use shall be flexible cables.
- ix) Flexible cables shall be in accordance with BS 6500 and BS 7375.

#### **34. LIGHTING INSTALLATION**

- i) Lighting circuits shall be run separate from other sub-circuits and shall be in accordance with BS 7375 and BS 4363.
- ii) Voltage shall not exceed 55 V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.
- iii) Luminaries shall have a degree of protection not less than IP 54. In particularly bad environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.
- iv) Where the Engineer requires Site inspection of the Works, the Contractor shall upgrade the lighting level to a minimum of 200 lux by localized lighting in all areas.
- v) Use of wire guards or other such devices shall provide mechanical protection of luminaries against damage by impact whenever risk of damage occurs.

#### **35. ELECTRICAL MOTORS**

Totally enclosed fan cooled motors to BS 4999: Part 105 shall be used.

Motor control and protection circuits shall be as stipulated in BS 6164. Emergency stops for machinery shall be provided.

#### **36. INSPECTION AND TESTING**

Electrical installations on Site shall be inspected and tested in accordance with the requirements of the IEE Wiring Regulations (16th Edition).

#### **37. IDENTIFICATION**

Identification labels of a type reviewed without objection by the Engineer shall be affixed to all electrical switches, circuit breakers and motors to specify their purpose.

#### **38. MAINTENANCE**

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

### **39. MAINTENANCE RECORD**

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

### **40. METERING**

- i) For the purposes of the clause, “construction works” shall mean the Works excluding both the Contractor's on and off Site, fabrication facilities, workshops, work-yards, offices, and stores.
- ii) The Contractor shall install a separately metered and invoiced supply or supplies of electricity for: -
  - (1) Site fabrication facilities.
  - (2) Site workshops and work-yards; and
  - (3) Site offices and stores.
- iii) The Track contractor shall arrange for his own separate construction power and water supply.

### **41. MOCK-UPS, PROTOTYPES AND SAMPLES**

#### **41.1 Requirements**

- i) The Contractor shall produce mock-ups, prototypes and samples as specified in the Technical Specification.
- ii) Samples may be subject to testing and investigation by the Employer and shall in no way be incorporated into the Permanent Works.
- iii) Samples shall become the property of the Employer.

#### **41.2 Purpose**

- iv) The mock-ups, samples and prototypes shall demonstrate the proposed design and/or design options. Any mock-ups shall increase in levels of detail and finish as the design progresses.
- v) Mock-ups and prototypes may generally be produced initially with “dummy” equipment items unless otherwise specified, so long as there is sufficient detail to evaluate the operability and/or maintainability aspects of the proposed layout.
- vi) The mock-ups and prototypes shall be constructed at the Contractor's premises unless otherwise specified in the technical specification.

### **38.2 Review**

- i) The Engineer will conduct a minimum of three formal reviews initially at the place of manufacture.
- ii) The complete and agreed mock-ups and prototypes shall be suitable for transportation to, and display in Mumbai for final review by the Engineer and the Employer.
- iii) The Contractor shall transport and set up such mock-ups and prototypes at a nominated site in Mumbai. After each review, the Contractor shall incorporate the Engineer's review comments into the mock-ups and prototypes prior to the next scheduled review.



**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**DESIGN, DEVELOPMENT, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF STANDARD GAUGE TRACKWORKS (BALLASTED AND BALLASTLESS) IN KASHELI DEPOT TRACKS FOR LINE 5 CORRIDOR OF MUMBAI METRO RAIL PROJECT OF MMRDA, MUMBAI**

**TENDER DOCUMENTS**

**CONTRACT NO: MMRDA/MPIU/ML5/CA-303**

**TENDER DOCUMENTS**

**VOLUME 3**

**EMPLOYER'S REQUIREMENTS  
APPENDICES**

**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

**Metro PIU, 7<sup>th</sup> Floor, New Administrative Building,  
Bandra-Kurla Complex, Bandra (E), Mumbai –400 051, India**

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 1- DRAWING LIST**

The Tender Documents contains a set of reference/Tender drawings that are applicable to the Contract Works. The Tenderer shall incorporate Into the Tender only those drawings from that set which amplify aspects of the Contractor's Technical Proposals. General information drawings will not be included in the Contract.

**[ Given in Vol-V Tender Drawings ]**

## EMPLOYER'S REQUIREMENTS

### APPENDIX 2A-WORKS AREAS

The Track work Contractor will be provided 5000 sqm inside the depot partly for storage by employer. Contractor shall use the available space and develop the work space and storage yard at his own cost this which should include space for Site Offices, batching plant, stacking of Rails, storage of all types of materials as per specifications at his own cost, with proper safety and security arrangement and prepare the level bed for the storage of track components, however any other requirement for Work Area Contractor is required to make his own arrangements for the short-term lease of suitable site(s). Proposed details shall be provided in the Tenderer's Technical Proposals. The Employer may provide assistance to acquire the temporary possession of Government land, **if available**, which shall be handed back within 28 days of the substantial completion of the works. However, no claims/additional cost shall be payable to the Contractor for not making available Government land by Employer. Also, the Contractor shall make his own arrangements for the disposal of suitable spoil arising from the works. Such arrangements will be subject to the Employer's review and acceptance.



## APPENDIX 2B- Detailed Program of Work

The Contractor shall prepare and submit his detailed Program of Work to achieve key dates of various activities on time. The Contractor shall complete the work in a phased manner by fixing priorities to different stretches of work to give access to the other interfacing contractors as per the requirement of project from time to time and as per the key dates indicated below:

### PART A:

**Depot:** Ballasted Track – Shunting line 1 and 2, Connectivity to mainline and Inspection and Workshop Line ,RRV Test Track and Ballast less Track for coach delivery 1&2, Scissor Crossover , level crossings.

Key Dates	Description of Stage	Key dates in Weeks (from date of issue of Notice to Proceed)	Liquidity Damages for non-achievement of Key dates (% of the Contract price per week)
KD-01	Submission of Preliminary Design & Drawings, Submission of Detail work program & establishing the site office.	4	0.01%
KD-02	Submission of Definitive Design including specifications, design Manual, survey report and Interface Report with Designated Contractors, Complete in all respect.	8	0.01%
KD-03	Manufacturing and commencement of delivery of Rails, fastenings for plain line track and sleepers.	20	0.01%
KD-04	Completion of Manufacturing and delivery of Tracks, switches and crossings including fastenings thereof.	28	0.01%
KD-05	Completion of Installation of Track & switches and crossings.	41	0.01%
KD-06	Acceptance Tests for Track for integrated testing with Designated contractors and Submission of as built drawings, maintenance manuals etc.	43	0.01%

**PART B:**

**Depot Works:** Approach Track of all Stabling Yard all balance shunting lines, outdoor tracks, shunting lines, Ballast less Track of Stabling Yard level, HWT, BDP track, Pit wheel lathe building track, CMV & OHE workshop, Inspection and Maintenance workshop tracks, and all balance track works.

Key Dates	Description of Stage	Key dates in Weeks (from date of issue of Notice to Proceed)	Liquidity Damages for non-achievement (% of the Lump Sum price per week of delay for the Key Dates)
KD-07	Submission of Preliminary Designs and Drawings and Submission of Detailed Works Program.	10	0.01%
KD-08	Submission of Definitive Design including specifications, design Manual, survey report and Interface Report with Designated Contractors, Complete in all respect	18	0.01%
KD-09	Manufacturing and commencement of delivery of Tracks, fastenings for plain line track	32	0.01%
KD-10	Completion of Manufacturing and delivery of Tracks, switches and crossings including fastenings thereof.	56	0.01%
KD-11	Completion of Installation of Track & switches and crossings.	76	0.01%
KD-12	Acceptance Tests for Track for integrated testing with Designated contractors.	82	0.01%
KD-13	Submission of as built drawings, maintenance manuals and Preparation of documents for CMRS inspection and approval	85	0.01%

**Note:**

- All key dates shall be referred from the commencement date of contract.
- The site shall be made available progressively and if some part is not made available then the extension of time shall be allowed only to the work/KD of that particular part.

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 3 - PROJECT CALENDAR**

- (1) The Project Weeks shall be commenced on a Monday. A day shall be deemed to commence at 0001 hours on the morning of the day in question. Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week.
- (2) Requirements for the computation of Key Dates are given in Appendix 2B to the Employer's Requirements.
- (3) A 7-day week calendar shall be adopted for various (Work) programme schedules for scheduling purposes.
- (4) For Project purposes, the presentation shall be in 'Week'" units.

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 4-PROGRAMME REQUIREMENTS**

#### **1. GENERAL**

##### **Purpose of Programme**

There are two primary purposes for the requirement of Programme (Scheduling) information described in this document:

- a. Evaluation of Tender
- b. Status Reports during Construction

To provide the Engineer with status reports for managing, monitoring and coordinating the awarded contracts during their execution within the overall multi-contract project schedule.

The requirements are organized in two stages. The first stage is a requirement for all Tenderers and shall be submitted as part of Tender. The second stage is a requirement of the Employer and describes a series of reports to be submitted by the Contractor to the Engineer during the execution of the contract, following the award of Contract.

- (2) The Tenderer/ Contractor shall programme his work at all times to meet the Key Dates stated in Appendix 2B to the Employer's Requirements and the specified interface periods for the design and installation of the Works with those of the Designated Contractors and shall during the progress of the Works constantly monitor his progress against the programmes described below.
- (3) The Tenderer/ Contractor shall include in all programmes his work obligations towards shared access, shared Site areas and other coincident or adjacent Works Areas.
- (4) The Works Programme, and all more detailed or revised versions, shall be submitted to the Engineer in hard copy as well as soft copy for his consent in accordance with the provisions of the GCC.

#### **2. METHODOLOGY**

- (1) The computerized Critical Path Method (CPM) network using the Precedence Diagramming Method (PDM), has been selected by the Employer as the technique for contract management system and in co-coordinating the multi-contract project. This technique shall also be employed by the Tenderer in preparing their Tender submissions and by the Contractor in their Construction Stage submissions.
- (2) Unless otherwise agreed by the Engineer, all programmes submitted by the Contractor shall be produced using computerized Critical Path Method (CPM) Networks developed implementing the Precedence Diagramming Method (PDM) with Cost Loaded Charts and Tables.
- (3) The Contractor shall implement and use throughout the duration of the Contract, a computerized system to plan, execute, maintain and manage the planning, design, pre-construction, construction, and sub-contracts in executing the CPM scheduling by PDM. The reports, documents and data provided shall be an accurate representation of the current status of the Works and of the work remaining to be accomplished; shall provide a sound basis for identifying problems, deviations from the planned works, and for making decisions; and shall enable timely preparation of the same for presentation to the Engineer.

### 3. PROGRAMME MANAGEMENT SOFTWARE

- (1) CPM programming software used shall be Primavera Project Planning (P6) Program or latest version. Any other compatible system capable of direct file interchange capability with software program used by the Employer - Primavera (P6) Program or latest version can be used with Engineer's consent. Scheduling software and relevant instruction manuals, licensed for use in connection with the contract, shall be provided by the Contractor according to the Employer's specifications
- (2) The Tenderer may use a system other than Primavera but will be required to demonstrate that full electronic data transfer to Primavera is available and that the various levels of reporting and coding capabilities are at least equivalent to Primavera. Compatibility and comparable performance between Primavera and the Tenderer's proposed system shall be demonstrated in his Tender submission. Should compatibility not be demonstrated to the Employer's satisfaction the Contractor shall utilize Primavera for , status updating and revision of all the Programmes during the duration of the Contract. Upon the Engineer's consent of a system other than Primavera, the Contractor shall supply the Engineer with an original licensed copy, including manuals and approved training of the software and any subsequent versions thereof at no extra cost.

### 4. (Not Used)

### 5. POST CONTRACT AWARD

- 5.1 The Contractor shall develop his Tender Programme into the Initial Works Programme including an outline Narrative Statement and submit within fifteen "(15) days"/ "2 weeks" of the date of the Notice to Proceed and its more detailed version within thirty "(30) days" / "4 weeks" of receiving the Engineer's consent to the proposed Initial Works Programme.
- 5.2 The first Three Month Rolling Programme shall be submitted within thirty (30) days of the date of Notice to Proceed and all subsequent editions shall accompany the Monthly Progress Report. The Monthly Progress Reports shall also include a Programme Update as described below. These programmes shall subsequently be updated as described below.
- 5.3 Following the Contractor's Initial Works Programme submission but in any case no later than 8 weeks from the date of award of contract/Notice to proceed, the contractor shall make submissions of the detailed **Works Programme** suitably amended to take into account the programmes of Designated Contractors. It is the Contractor's responsibility to ensure timely co-ordination with the Designated Contractors to review, revise and finalize his Initial Work Programme so as not to affect the progress of Works/ and or the works of the Designated Contractors. The resubmitted programme when approved by the Engineer shall form the **Baseline Programme** against which actual progress of the Contract shall be reckoned. As the work progresses, it may be necessary to update/ revise the Baseline programme but such updating shall only be carried out with the prior consent of the Engineer or when directed by them.
- 5.4 For Initial & Detail Work Programme submission, one (1) original and six (6) copies each of the following Programmes and Reports shall be submitted to the Engineer:
  - a) Programme: Baseline CPM Network
  - b) Programme: Baseline Milestone based Cost Activity Schedule
  - c) Baseline Schedule Report
  - d) Narrative
  - e) Baseline Physical Progress 'S' curve
  - f) Baseline Resource Charts

The Engineer shall review and comment on the Contractor's programmes and information submitted under this Clause. The Engineer will confirm his consent or otherwise of the submissions within fifteen (15) calendar days.

- 5.5 The Engineer shall require the Contractor to re-submit within seven (7) calendar days if he is of the opinion that the programmes and information submitted by the Contractor is unlikely to meet the Contract key dates.
- 5.6 If in the opinion of the Engineer, any of the Contractor's revised programmes or Baseline Schedule Report is not acceptable, it shall be construed as a failure of the Contractor to meet a Milestone.
- 5.7 Notwithstanding the above, the Engineer may at any time during the course of the Contract require the Contractor to reproduce the computer-generated Baseline Schedule Report described above to reflect actual activity dates and generate schedules based upon "what if" statements. The initial computer-generated report after receiving the Engineer's consent will serve as the base against which the contract progress will be measured. Any changes to the Report reflected in subsequent Baseline Schedule Reports shall also require the Engineer's consent.
- 5.8 Failure to include any element of work required for performance of the Contract shall not relieve the Contractor from completing all works required under the Contract to achieve the original or any extended key completion date.

## **6. WORKS PROGRAMME**

- (1) The Works Programme shall show the Contractor's plan for organizing and carrying out whole of the Works.
- (2) The Works Programme shall be a computerized Critical Path Method (CPM) network developed using the Precedence Diagramming Method (PDM) and shall be present in bar chart and time-scaled network diagram format to a weekly or monthly time scale.
- (3) Tasks in the Works Programme shall be sufficiently detailed to describe activities and events that include, but are not limited to, the following:
  - a) Key Dates,
  - b) All physical work to be undertaken in the performance of the Contract obligations, including Temporary Works,
  - c) The requested date for issue of any drawings or information by the Engineer,
  - d) Incorporation of principal aspects of the Design Submission Programme,
  - e) Procurement of major materials and the delivery and/or partial delivery date on-Site of principal items of Contractor's Equipment,
  - f) Any off-site work such as production or pre-fabrication of components,
  - g) Installation of temporary construction facilities,
  - h) Interface periods with Designated Contractors or utility undertakings,
  - i) Design, supply and/or construction activities of sub-contractors,
  - j) Any outside influence which will or may affect the Works.

- (4) The Works Programme shall show achievement of all Key Dates.
- (5) Activity descriptions shall be unique, describing discrete elements of work. Any activity creating an imposed time or other constraint shall be fully defined by the Contractor.
- (6) The Works Programme shall be organised in a logical work-breakdown-structure including work stages and phases and shall clearly indicate the critical path(s).

Each activity in the Works Programme shall be coded to indicate:

- (a) Activity ID and Activity Code.
  - (b) The Engineer may request additional activity coding to the extent available without restraint to the Contractor's utilisation of the programme software. When requested, the Contractor shall add the required additional coding to the Programme. The Contractor shall use additional code fields as requested to comply with the requirements and for the use of the Contractor.
- (7) Activity duration shall not exceed two (2) weeks, unless otherwise consented to by the Engineer, except non-construction activities such as submittals, submittal reviews, procurement and delivery of materials or equipment. The Contractor shall submit a Programme/Project Calendar cross reference clearly indicating the allowance for holidays.
  - (8) The Works Programme, in each submission, shall be accompanied by an Activity Report and a Narrative Statement as described below in both electronic (pen-drive or CD-R) and hard copy format (time scale logic diagrams in A1 size, reports in A4 size).
  - (9) Activity Report shall list all activities, and events in the Works Programme, sorted by activity identification number.

The Activity Report shall include the following for each activity and event:

- (a) Activity identification number and description,
- (b) Duration expressed in Days,
- (c) early and late start, & early and late finish dates. Planned start and finish dates,
- (d) Calculated total float and free float,
- (e) Predecessor and successor(s), accompanying relationships and lead/lag duration,
- (f) Imposed time or date constraints,
- (g) Calendar.

## **7. Narrative Statement**

The Narrative shall be a comprehensive statement of the Contractor's plan and approach for the execution of the Works and the achievement of key dates, handover dates, submission dates and any intermediate dates. It shall incorporate outline method statements in respect of major items of work including construction sequences and primary item of plant, Construction Equipment, Temporary Works and the like. It shall fully explain the reasons for the main logic links in the Programme and include particulars of how activity duration is established. This shall include estimated quantities, production rates, hours per shift, workdays per week and a listing of the major items of Construction Equipment planned for use on the project. Activities, which may be expedited by use of overtime or additional shifts, shall be identified, and explained. A listing of holidays, and other special non-workdays being used for the computer reports shall be included.

## **8. Baseline Physical Progress 'S' Curve**

The Contractor shall also submit a forecast Cumulative Physical Progress 'S' curve based on the time-phased distribution of cost in the CPM Network Logic Diagram, expressed in percentage terms. This 'S' curve shall be generated from the computerized CPM Network Logic Diagram.

## **9. Baseline Resource Charts**

The Contractor shall also submit a Resource Charts, generated from the Contractor's CPM Network Diagram, showing the anticipated manpower and main Construction Equipment usage during the execution of the Project.

As an additional monitoring facility, indicator resources shall be assigned to relevant activities for the major items of work. Resource indicators may be input as a daily rate, expected required rate, or as an activity total in the relevant units. These are purely indicative quantities and do not form part of contract.

All submissions of proposed Works Programmes subsequently, after approval of the Initial Works Programme, shall include the actual physical progress of work and forecast of the remaining work. Actual progress shall be stated in percent complete, remaining duration, and actual start and finish dates for each activity in the Works Programme.

## **10. INITIAL WORKS PROGRAMME**

- (1) The Initial Works Programme submitted as under Clause 5.1 need not include the full details given under Clause 6 above. It should be a condensed version with combined activities of longer. The outline Narrative Statement shall be in sufficient detail to clearly show the Contractor's intention.
- (2) Within fifteen (15) days of the Engineer's consent to the Initial Works Programme, the Contractor shall submit to the Engineer an expanded and more detailed version of the Initial Works Programme containing all of the information and detail required under Clause 5 above.
- (3) Such submission shall make use of the Tender Programme submitted earlier but refined to include the best estimates of dates for the work of Designated Contracts which has impact on the Contractor's programme. Such programmes shall be amended subsequently to incorporate the actual dates/schedule of the affecting contracts. It is the Contractor's responsibility to ensure timely co-ordination with the Designated Contractors to finalise the Initial Programme, without affecting progress of the work.

## **11. WORKS PROGRAMME REVISIONS**

- (1) The Contractor shall immediately notify the Engineer in writing of the need for any changes in the Works Programme, whether due to a change of intention or of circumstances or for any other reason. Where such proposed change affects timely completion of the Works or any other Key Date the Contractor shall within seven (7) days of the date of notifying the Engineer submit for the Engineer's consent its proposed revised Works Programme and accompanying Narrative Statement. The proposed revised Works Programme shall show the sequence of operations of any and all works related to the change and the impact of changed work or changed conditions.
- (2) If at any time the Engineer considers the actual or anticipated progress of the work reflects a significant deviation from the Works Programme, he may request the Contractor to submit a proposed revised Programme which together with an accompanying Activity Report and Narrative Statement, shall be submitted by the Contractor within seven (7) days after the Engineer's instruction. The proposed revised Works Programme shall show the sequence of operations of any and all work related to the change and the impact of changed work or changed conditions.
- (3) All activities that have negative float must be analyzed by the Contractor to identify the impact on the



timely completion of the Works or on the achievement of Key Dates.

## **12. THREE MONTH ROLLING PROGRAMME.**

- (1) The Three-Month Rolling Programme shall be an expansion of the current Works Programme, covering sequential periods of three months. The Three-Month Rolling Programme shall provide more detail of the Contractor's plan, organization and execution of the work within these periods. In particular, the Contractor shall expand each activity planned to occur during the next three (3) month period, if necessary to a daily level of detail.
- (2) The Three-Month Rolling Programme shall be developed as a Critical Path Method (CPM) network, and shall be presented in bar chart and time-scaled network diagram format. Bar charts shall be presented on an A4 and time-scaled networks diagrams on an A1 size reproducible media. Tasks in the programme shall be derivatives of and directly related to tasks in the approved Works Programme.
- (3) The Contractor shall describe the discrete work elements and work element inter-relationships necessary to complete all works and any separable parts thereof including work assigned to sub-contractors.
- (4) Activity duration shall not exceed two (2) weeks unless otherwise consented to by the Engineer.
- (5) Each activity in the Three-Month Rolling Programme shall be coded, or described so as clearly to indicate the corresponding activity in the Works Programme

## **13. THREE MONTH ROLLING PROGRAMME REVISIONS AND UPDATE**

- (1) The Three Month Rolling Programme shall be extended forward each month as described under Clause 5 (1) above. Each submission of the Three-Month Rolling Programme shall be accompanied by a Programme Analysis Report, describing actual progress to date, and the forecast for activities occurring over the next three-month period.
- (2) If the Three Month Rolling Programme is at variance with the Works Programme, the Programme Analysis Report shall be accompanied by a supporting Narrative Statement describing the Contractor's plan for the execution of the activities to be undertaken over the three-month period, including programme assumptions and methods to be employed in achieving timely completion.
- (3) The Contractor shall revise the Three Month Rolling Programme or propose revisions of the Works Programme, or both, from time to time as may be appropriate to ensure consistency between them.

## **14. THREE WEEK ROLLING BAR CHART SCHEDULE**

Once a week, on a day mutually agreed to by the Engineer and the Contractor, a meeting will be held to assess progress by the Contractor during the previous work week. The Contractor shall submit a construction schedule listing activity completed and in-progress from the previous week and the activities scheduled for the succeeding two weeks based on the detailed Works Programme. Copies of the schedule shall be submitted on A3 sized paper.

## **15. PROJECT CALENDAR**

For the Project, the Contractor shall adopt 7 days a week calendar, identical calendar for the purpose of programming and Execution of Works. Official documents shall be transacted during 5 days week - Monday through Friday, except for National (Govt. of India) Holidays. For Project purposes, a week begins at 0001 hours on a Monday and ends at 2359 hours on a Sunday. The completion of an activity or the achievement of an event when given a week number shall be taken to mean midnight

on the Sunday at the end of the numbered week. An access date or activity start date when given as a week number shall be taken to mean 0001 hours on a Monday of the Numbered week.

**16. PROGRAMMING PERSONNEL**

The Contractor shall submit, as part of its Staff Organisation Plan, the names and required information for the staff to be employed on Works Programming. The principal Works Programmer shall hold reputable professional qualifications acceptable to the Engineer including at least five (5) years' relevant experience in programming. Others in the group shall have at least three (3) years' experience in such work. The programmers shall be employed by the Contractor full time on the Contract until the completion or such earlier time the Engineer may give his consent.

**17. PROGRAMME AND REPORT SUBMISSION FORMAT**

The Contractor shall submit one (1) original and six (6) copies and one (1) reproducible (for Programmes) of all submissions to the Engineer. All submissions shall be in AO, A1, A3 or A4 size, as appropriate except as may otherwise be agreed by the Engineer. In addition, the computerized programme and report shall be submitted in 3-1/2 inches diskettes (similarly for submissions required under Clause 5.4).

The format for all Programme and Report submissions shall be strictly in accordance with the format as stated herein or as requested by the Engineer.

**18. FAILURE TO SUBMIT PROGRAMME**

Failure of the Contractor to submit any programme, or any required revisions thereto within the time limits stated for acceptance by the Engineer, shall be sufficient reason for not making the relevant stage on account payment by the Engineer

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 5 -MONTHLY PROGRESS REPORTS**

#### **1. GENERAL**

- (1) The Contractor shall submit to the Engineer, a Monthly Progress Report. This Report shall be submitted by the end of each calendar month and shall account for all work actually performed from 26<sup>th</sup> day of the last month and up to and including the twenty-fifth (25<sup>th</sup>) day of the month of the submission. It shall be submitted in a format to which the Engineer shall have given his consent and shall contain sections/sub-sections.

#### **2. FINANCIAL STATUS**

- (1) A narrative review of all significant financial matters, and actions proposed or taken in respect to any outstanding matters.
- (2) A spread sheet summarising each activity, the budget, costs incurred during the period, costs to date, costs to go, cost forecast (total of costs to date and costs to go) and cost variance (difference between cost forecast and budget).
- (3) A spread sheet indicating the status of all payments due and made.
- (4) A report on the status of any outstanding claims. The report shall in particular provide interim updated accounts of continuing claims.

#### **3. PHYSICAL PROGRESS**

- (1) It shall describe the status of work performed, significant accomplishments, including critical items and problem areas, corrective actions taken or planned and other pertinent activities, and shall, in particular, address interface issues, problems and resolutions.
- (2) It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Programme.

#### **4. PROGRAMME UPDATE (For Entire Project)**

Programme updating shall include:

- (a) the monthly Programme Update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the twenty-fifth (25<sup>th</sup>) of the month together with estimates of remaining duration and expected activity completion based on current progress. The Programme Update shall be accompanied by an Activity Report and a Narrative Statement. The Narrative Statement shall explain the basis of the Contractor's submittal:
  - (i) Early Work and Baseline Submittals – explains determination of activity duration and describes the Contractor's approach for meeting required Key Dates as specified in the Contract.
  - (ii) Updated Detail Programme Submittals – state in narrative the Works actually completed and reflected along Critical Path in terms of days ahead or behind allowable dates. Specific requirements of narrative are:
    - If the Updated Detailed Work Programme indicates an actual or potential delay to Contract Completion date or Key Dates, identify causes of delays and provide explanation of Work affected and proposed corrective action to meet Key Dates or

mitigate potential delays. Identify deviation from previous month's critical path.

- Identify by activity number and description, activities in progress and activities scheduled to be completed.
- Discuss Variation Order Work Items, if any.

(b) The Programme Status which shall:

- Show Works Programme status up to and including the current report period, display Cumulative progress to date and a forecast of remaining work.
- Be presented as a bar-chart size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings.

(c) The Activity Variance Analysis which shall analyse activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works Programme.

## **5. KEY DATES STATUS**

A report on the status of all Key dates due to have been achieved during the month and forecasts of achievement of any missed Key dates, and those due in the next month.

## **6. THREE MONTH ROLLING PROGRAMME**

The monthly issue of the Three-Month Rolling Programme.

## **7. PLANNING AND CO-ORDINATION**

- (1) A summary of all planning/co-ordination activities during the month and details of outstanding actions.
- (2) A schedule of all submissions and consents/approvals obtained/outstanding.

## **8. PROCUREMENT REPORT**

- (1) A summary of all significant procurement activities during the month, including action taken to overcome problems.
- (2) A report listing major items of plant and materials which will be incorporated into the Works. The items shall be segregated by type as listed in the Specifications and the report should show as a minimum the following activities:
  - (a) purchase Order Date - Scheduled/Actual,
  - (b) manufacturer/Supplier and Origin,
  - (c) letter of Credit Issued date,
  - (d) manufacturer/Supplier Ship Date - Scheduled/Actual,
  - (e) method of Shipment,
  - (f) Arrival Date in India- Scheduled/Actual.

## **9. PRODUCTION AND TESTING**

Deleted

**10. SAFETY**

A review of all safety aspects during the month including reports on all accidents and actions proposed to prevent further occurrence.

**11. ENVIRONMENTAL**

- (1) A review of all the environmental issues during the past month to include all monitoring reports, mitigation measures undertaken, and activities to control environmental impacts.

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 6-QUALITY ASSURANCE**

#### **1. General**

The Contractor shall implement a Project Quality Management Plan in accordance with ISO-9001 "Quality System - Model for Quality Assurance in Design/, Production, Installation and Servicing" to ensure that all materials, workmanship, plant and equipment supplied and work done under the contract meets the requirements of the contract. This plan shall apply to all activities related to the quality of items, including designing, purchasing, inspecting, handling, assembling, testing, storing, and shipping of materials and equipment and different elements of construction work and installations of system components.

The Quality Plan to be prepared by the Contractor and submitted to the Engineer shall follow the requirements of ISO 9000 and address each element therein.

Registration of the Contractor's organization, or subcontractors or sub-consultants is not required for this Project but the Project Quality Management Plan as submitted shall meet the intent of the ISO 9000 requirement in that there is a comprehensive and documented approach to achieving the project quality requirements.

#### **2. Quality Assurance Management Plan**

The Project Quality Management Plan (PQMP) shall as a minimum address the quality system elements as required by ISO 9001, generally noting the applicability to the Contractor's Works Programme for the Project. Procedures or Quality Plans to be prepared by others (Suppliers, Subcontractors, and Sub-consultants) and their incorporation in the overall PQMP shall be identified.

The Contractor shall provide and maintain a Quality Assurance Plan (QA) to regulate methods, procedures, and processes to ensure compliance with the Contract requirements. The QA Plan, including QA written procedures, shall be submitted to the Engineer for his review.

Adequate records shall be maintained in a readily retrievable manner to provide documented evidence of quality monitoring and accountability. These records shall be available to Employer at all times during the term of the Contract and during the Defects Liability Period and for a five-year period thereafter.

The Plan shall identify:

- Design Process: shall control, check and verify the accuracy, completeness and integration of the design shall be performed by certified personnel and in accordance with documented procedure that have the written consent of the Engineer.
- Special Processes: shall control or verify quality shall be performed by certified personnel and in accordance with documented procedures that have the written consent of the Engineer.
- Inspection and Test: Inspection and testing instructions shall provide for reporting non-conformances or questionable conditions to the Engineer; Inspection shall occur at appropriate points in the installation sequence to ensure compliance with drawings, test specifications, process specifications, and quality standards. The Engineer shall designate, if necessary, inspection hold points into installation or inspection planning procedures.
- Receiving Inspection: These procedures shall be used to preclude the use of nonconforming materials and to ensure that only correct and accepted items are used and installed.

- Identification and Inspection Status: a system for identifying the progressive inspection status of equipment, materials, components, subassemblies, and assemblies as to their acceptance, rejection, or non-inspection shall be maintained.
- Identification and Control of Items: an item identification and traceability control shall be provided.
- Handling, Storage, and Delivery: provide for adequate work, surveillance and inspection instructions.

The Plan shall ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, and defects in materials and equipment shall be promptly identified and corrected.

The Plan shall provide for establishing and maintaining an effective and positive system for controlling non-conforming material including procedures for the identification, segregation, and disposal of all non-conforming material. Dispositions for the use or repair of non-conforming materials shall require the Engineers consent.

### **3. Plan Implementation and Verification**

The Plan shall clearly define the QA Organization. Management responsibility for the QA shall be set forth on the Contractor's policy and organization chart. The Plan shall define the requirements for QA personnel, their skills and training. Records of personnel certifications shall be maintained and monitored by the QA personnel. These records shall be made available to the Engineer for review, upon request.

The QA operations shall be subject to the Engineers, Employer or Employer's authorized representative's verification at any time, including surveillance of the operations to determine that practices, methods and procedures of the plan are being properly applied; inspection to measure quality of items to be offered for acceptance; and audits to ensure compliance with the Contract documents.

The contractor's Quality Audit Schedule shall be submitted to the Engineer for consent every three months or more frequently as required.

The results of Quality Audits shall be summarized in the Contractor's monthly reports.

The Contractor shall provide all necessary access, assistance, and facilities to enable the Engineer to carry out on-site and off-site surveillance of Quality Assurance Audits to verify that the quality system which has the consent of the Engineer is being implemented fully and properly.

## EMPLOYER'S REQUIREMENTS

### APPENDIX 7-DRAFTING AND CAD STANDARDS

#### 1. INTRODUCTION

- (1) The purpose of this document is to define the minimum Drafting and CAD standard to be achieved by the Contractor for all drawings produced by the Contractor for the purpose of the Works.
- (2) By defining a common format for the presentations of drawings and CAD files, the exchange of drawn information is improved and will maximize the use of CAD in the co-ordination process.
- (3) All submissions shall be made to the Employer's Requirement in a format reviewed without objection by the Employer's Requirement and in accordance with the requirements in:
  - (a) the Contract.
  - (b) the Document Submittal Instructions to Consultants and Contractors.
- (4) Paper and drawing sizes shall be "A" series sheets as specified in BS 3429.
- (5) The following software latest and update version compatible for use with Intel-Windows based computers shall be used, unless otherwise stated, for the various electronic submissions required:

Document Type	Electronic Document Format
Text Documents	MS Word,
Spread Sheets	MS Excel,
Data Base Files	MS Access,
Presentation Files	MS PowerPoint,
Programmes Ver2.0a	Primavera for Windows, Suretrack
AutoCAD Graphics	CorelDraw / AutoCAD
Photographic	Adobe Photoshop,
Desktop Publishing	Page Maker
CADD Drawings	AutoCAD

Required software for rail track alignment design/ redesign is Bentley Rail Track or its variants or any other equivalent Track Alignment Design Software capable of regression analysis and capable of turnouts layout and placement. In case of use of equivalent software, Contractor shall take prior approval of Employer/ Engineer.

- (6) Media for Electronic File Submission  
One copy shall be submitted in latest soft copy format.



(7) Internet File Formats/Standards

- (a) The following guidelines shall be followed when the Contractor uses the Internet browser as the communication media to share information with the Employer.
- (b) All the data formats or standards must be supported by Microsoft Internet Explorer version 3 or above running on Windows 10 / latest version.
- (c) The following lists the file types and the corresponding data formats to be used on Internet. The Contractor shall comply with them unless prior consent is obtained from the Employer's Requirement for a different Data format:

File Type	Data Format
Photo Image	Joint Photographic Experts Group (JPEG)
Image other than Photo	GIF or JPEG
Computer Aid Design files (CAD)	Computer Graphics Metafile (CGM)
Video	Window video (.avi)
Sound	Wave file (.wav)

- (8) The following states the standards to be used on Internet when connecting to database(s). The Contractor shall comply with them unless prior consent is obtained from the Employer's Requirement for a different standard:

Function to be Implemented	Standard to be Complied With
Database connectivity	Open Database Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hypertext Markup Language (HTML)

The hard copy of all documents shall be the contractual copy.

## 2. GENERAL REQUIREMENTS

### 2.1 General

- (1) The Contractor shall adopt a title block similar to that used in the Drawings for all drawings prepared under the Contract.
- (2) Each drawing shall be uniquely referenced by a drawing number and shall define both the current status and revision of the drawing.
- (3) The current status of each drawing shall be clearly defined by the use of a single letter code as follows:

- P - Preliminary Design Drawing
- D - Definitive Design Drawing

C	-	Construction Reference Drawing
W	-	Working Drawing
B	-	As-Built Drawing
M	-	As Manufactured Drawing
E	-	Employer's Drawing

## **2.2 Types of drawings**

- 1) 'Design drawings' mean all drawings except shop drawings and as-built drawings.
- 2) 'Working drawings' are design drawings of sufficient detail to fully describe the Works and adequate to use for construction or installation.
- 3) Site drawings and sketches are drawings, often in sketch form, prepared on site to describe modifications of the Working drawings where site conditions warrant changes that do not invalidate the design.
- 4) 'Shop drawings' are special drawings prepared by the manufacturer or fabricator of various items within the Works to facilitate manufacture or fabrication.
- 5) 'As-built drawings' show the Works exactly as constructed or installed. They are usually prepared by amending the working drawings to take into account changes necessitated by site conditions and described in Site drawings. These drawings shall be completed on a regular basis as the works progress and shall not be left until completion of the entire works.

## **3. COMPUTER AIDED DESIGN & DRAFTING (CAD) STANDARDS**

### **3.1 Introduction**

#### Scope of Use

Data input procedures between the Engineer and contractors must be coordinated, and the key parameters used to form CAD data files must be standardized. The production of all CAD data files shall comply with the following requirements.

### **3.2 Objectives**

The main objectives of the CAD standards are as follows:

- (a) To ensure that the CAD data files produced for Project are coordinated and referenced in a consistent manner.
- (b) To provide the information and procedures necessary for a CAD user from one discipline or external organization to access (and use as background reference), information from a CAD data file prepared by another discipline or external organization.
- (c) To standardize the information contained within CAD data files which may be common to more than one discipline such as drawing borders, title boxes, grid lines etc.
- (d) To establish procedures necessary for the management of CAD data files.
- (e) To ensure all contractors use 'Model space' and 'Paper space' in the production of their CAD files'.

### **3.3 General**

- (1) To facilitate co-ordination between contractors, it is a requirement that all drawings issued by contractors for co-ordination or record purposes shall be produced using CAD methods. Drawings shall be issued in digital format in addition to the paper copies.
- (2) The intent of the issue of digital information is to aid the related design by others. The definitive version of all drawings shall always be the paper or polyester film copies which have been issued by the contractor or organization originating the drawing.
- (3) Drawings and drawing packages issued for co-ordination, record purposes or for acceptance shall be accompanied by a complete set of the corresponding CAD data files.
- (4) Any contractor or organization making use of the CAD data from others shall be responsible for satisfying himself that such data is producing an accurate representation of the information on the corresponding paper drawing which is satisfactory for the purpose for which he is using it. Provided the general principles of this section have been achieved by the originator of the CAD data, contractors making use of the CAD data from others shall not be entitled to require alterations in the manner in which such CAD data is being presented to them.
- (5) In particular, automatic determination of physical dimensions from the data file shall always be verified against the figured dimensions on the paper or polyester drawings. Figured dimensions shall always be taken as correct where discrepancies occur.

### **3.4 Terminology & Associated Standards / Guidelines**

Any terminology used within this section that is ambiguous to the user shall be clarified with the Employer's Requirement. British Standard BS1192 is used in principle as a guide for drawing practice, convention, CAD data structure and translation.

### **3.5 Paper Drawings**

- (1) For the Project "Paper" drawings are considered to be the main vehicle for the receipt and transmittal of design and production information, typically plans, elevations and sections.
- (2) The Project wide accepted media for the receipt and transmittal of "Paper" drawings will be paper and polyester film of various standard ISO 'A' sizes. The composition of this information shall be derived from a CAD "Model".
- (3) The CAD derived "Paper" drawing composition will reflect a window of information contained within a CAD "Model Space" file together with a selection of information contained within the associated CAD "Paper Space" file.

### **3.6 CAD Data Creation, Content & Presentation**

A consistent method of CAD data creation, together with content and presentation is essential. The method of CAD "Model Space and Paper Space" creation is as follows:

- (1) Model Space Files
  - (a) Typically, CAD "Model Space" files are required for general arrangement and location plans and will consist of a series of other "Model Space" referenced CAD files covering the total design extents at a defined building level (the number of referenced files should be kept to an absolute minimum). Data contained within a CAD "Model Space" files is drawn at full size (1:1) and located at the correct global position and orientation on the Project Grid / or defined reference points.

- (b) Each CAD "Model Space" file will relate to an individual discipline. Drawing border / text, match / section lines or detailed notation shall NOT be included within a CAD "Model Space" file. Dimensions shall be included within a CAD "Model Space" but located on a dedicated layer. Elevations, Long Sections and Cross Sections shall also be presented in CAD "Model Space" as defined above, but do not need to be positioned and orientated on the Project Grid.
- (2) Paper Space CAD Files
  - (a) Paper Space" CAD files are utilized to aid the process of plotting "Paper" drawings and are primarily a window of the CAD "Model Space" file. A "Paper Space" CAD file will typically contain drawing borders, text, match or section lines & detailed notation. Once these files are initially set up and positioned the majority of "Paper Drawing" plots at various approved scales are efficiently and consistently generated by displaying different combinations of element layers and symbology contained within the "Paper Space" file and the referenced "Model Space" files.
  - (b) The purpose is to ensure that total co-ordination is achieved between the CAD "Model Space" file and the "Paper Drawing" output during the revision cycle of the design and production process. Duplicated data in "Model and Paper Space" files will not be acceptable unless an automatic update link exists between the two data sets. "Paper Space" files are not typically required as part of the CAD Media Receipt from contractors, unless specifically requested.

### **3.7 CAD Quality Control Checks**

- (1) Random CAD Quality Control Audits will be carried out by Engineer on all CAD media received and transmitted.
- (2) These checks DO NOT verify the technical content of the CAD data received or transmitted (as this is the responsibility of the originating organization), however compliance with Project CAD and Drafting Standards shall be checked.
- (3) In addition, all contractors who transmit and receive CAD data from the Project shall have CAD quality control procedures in place. A typical quality control procedure shall contain CAD data quality checking routines coupled with standards for CAD data transmittal and archiving.

### **3.8 CAD Data Transfer Media and Format**

When CAD data is received & transmittal between Engineer and the Contractor, the media shall be as follows:

- (f) Data Exchange Format - AutoCAD Release 14 (.DWG) or the latest versions.
- (g) Operating System - / Window NT 3.51 /Windows 95/98 or the latest versions
- (h) Data Transfer Media:
  - Pen-drives
  - 12cm Compact Disc (650 MB) is highly preferred
  - Portable SCSI hard disk (return to the Contractor upon data transfer) with software
- (i) All floppy diskettes or tapes must be labelled on the data shield with:
  - (i) Name of Company
  - (ii) Project Title
  - (iii) Drawing File names (for diskettes only)

(vi) Diskette No. / Total No. of diskettes or Tape No. / Total No. of Tapes

- (j) All media shall be submitted with a completed Form (CAD Disk/Tape Sheet)
- (k) The Contractor must ensure the supplied media is free from virus. SUB-directories on tapes or disks are not permitted. If CAD Data is created using UNIX, archive commands must be unrooted.

### **3.9 CAD Media Receipt & Transmittal**

- (1) CAD Media Transmittal (from the Contractor to Engineer) - this will consist of the following:
  - (a) CAD Digital Media (disk(s), CD's or tape (s)) shall typically contain CAD "Model Space" and "Paper Space" files.
  - (b) CAD data sheet
  - (c) CAD issue / revision sheet
  - (d) CAD Quality Checklist confirming compliance.
  - (e) Plot of each "Model Space" file issued on an A1 drawing sheet (to best fit).
- (2) The above CAD media will be collectively known as "CAD Media Transmittal Set". The CAD data file transmittal format required by Employer' Representative from all contractors shall be in AutoCAD (version 14)
- (3) All CAD media received from contractors will be retained by Engineer except for SCSI disk (if used) as an audit trail / archive of a specific contractor's design evolution.
- (4) CAD Media Receipt (from Engineer to the Contractor)
  - (a) CAD media should normally be obtained from the respective interfacing contractor(s), but should Engineer issue CAD media it will consist of the following:
    - (i) CAD Digital Media (disk (s) or tape (s)) typically contain only CAD "Model Space" files.
    - (ii) CAD data sheet.
    - (iii) CAD issue / revision sheet
  - (b) The above CAD media will be collectively known as the "CAD Media Receipt Set". The CAD data file transmittal format used by Engineer to all contractors will be in AutoCAD (version 14)
  - (c) Each CAD transmittal disk / tape will be labeled with proper disk label as approved by the Engineer. Any CAD data transmitted without this label is assumed to be provisional information not to have been quality checked and therefore not formally issued.

### **3.10 Revisions**

All 'Revisions', 'In Abeyance' and 'Deletions' shall be located on a common layer. This layer can be turned on or off for plotting purposes.

The following example text indicates the current CAD file revision, i.e. 'Revision [A]'. This shall be allocated to a defined layer on all CAD "Model Space" files, in text of a size that will be readable when the CAD "Model Space" file is fitted to the screen, with all levels on.

### **3.11 Block Libraries, Blocks, & Block Names**

- (1) All Construction Industry symbols produced as CAD Cells shall typically conform to British Standard BS1192 - part 3.
- (2) All Blocks created shall be Primitive (i.e. NOT Complex) and shall be placed Absolute (i.e. NOT Relative).

- (3) The Contractor's specific block libraries shall be transmitted to Engineer together with an associated block library list containing the filename (max. 6 characters) and block description. The Contractor shall ensure that the library is regularly updated and circulated to all other users, together with the associated library listing.
- (4) All Blocks of a common type, symbols or details should initially be created within a CAD "Model Space File" specifically utilized for that purpose. These files will be made available on request by Employer's Representative.
- (5) All Blocks created will typically be 2D unless 3D is specifically requested. In both instances they shall have an origin at a logical point located within the extents of each Block's masked area or volume.

### **3.12 CAD Dimensioning**

Automatic CAD Dimensioning will be used at all times. Any dimensional change must involve the necessary revision to the model space file. If the CAD Quality Control Checks find that the revisions have not been correctly carried out, the rejection of the entire CAD submission will result.

### **3.13 CAD Layering**

All CAD elements shall be placed on the layers allocated for each different discipline. The layer naming convention to be adopted by the Contractor shall be submitted for acceptance and inclusion within these standards.

### **3.14 Global origin, Location & Orientation on the Alignment Drawing.**

- (1) Location or Plan information in "Model Space" files shall coincide with the correct location and orientation on the Project grid for each specific contract.
- (2) Location plans shall have at least three setting out points shown on each CAD "Model Space" file. Each setting out point shall be indicated by a simple cross-hair together with related Eastings and Northings co-ordinates. The Civil Contractor(s) will establish the three setting out co-ordinates for their respective works, which will then be used by all other contractors including the Contractor.

### **3.15 Line Thickness and Colour**

To assist plotting by other users, the following colour codes will be assigned to the following line thickness / pen sizes.

Colour	Code No	Line Thickness
Red	10	0.18
White	7	0.25
Yellow	2	0.35
Brown	34	0.5
Blue	130	0.7
Orange	30	1.0
Green	3	1.4
Grey	253	2.0

### **3.16 CAD Utilization of 2D & 3D Files**

Although the project standard is 2D CAD files, certain disciplines and contractors may use 3D CAD files for specific applications or where the isolated use of 3D aids the design and visualization process (i.e. Architecture, Survey and Utilities). In these specific instances 3D CAD data will only be transmitted if all other users can use this data. If this is not the case, 3D to 2D translation shall be processed by the creator prior to issue.

### **3.17 CAD File Numbering**

- (1) Contractors CAD File Numbering shall be described in 2.2 above.
- (2) Employer CAD File numbering unlike most of the contractors, Employer will not be required to produce numerous CAD files. This will follow the numbering system Except that the status of the drawing in 2.1(3) shall be "E".

### **3.18 CAD File Naming Convention – General**

CAD "Model Space" files shall be named in accordance with general drawing conventions.

## EMPLOYER'S REQUIREMENTS

### APPENDIX 8-WORKS AREAS & TEMPORARY POWER SUPPLY

#### 1. INTRODUCTION

The Contractor shall provide Site Accommodation (total area approx. 250 sq.m) for the Engineer Staff according to the following schedule of offices:

Type	No.	Area in sq.m	Total Area sq.m
Chief Engineer/ Execution Expert	2	12.5	25
Track Engineer Office	5	8	40
Site Inspector (Track) Common Office	5	5	25
General Office / Reception Area	1	25	25
Washroom/toilet (separate for gents and ladies)	4	4	16
Kitchen / Pantry	1	9	9
Meeting Room	1	25	25
Circulations/Verandah/Garden	-	85	85
<b>Total</b>			<b>250</b>

- 1) Offices shall be accessible only from a corridor within the building. The corridor and reception area entrances shall be provided with an external double door.
- 2) Materials for the construction shall be new, robust and durable. The building shall be weatherproof, vermin proof, well insulated thermally and acoustically. Internal walls shall be soundproofed. Electrical power and lighting, including all fixtures and fittings, power, telecoms and internet sockets, shall be provided to each room, including air conditioning to maintain the internal temperature within the range of 20 to 24 degrees Celsius at all times. A standby generator shall also be provided and installed with an automatic switchover.
- 3) Internal doors shall be flush, fitted with door closers, mortise locks with keys and lever handles.
- 4) External doors shall be a pair of solid core doors, external quality, hung on heavy duty hinges, one leaf fitted with barrel bolts top and bottom and the other leaf fitted with a Yale or similar lock.
- 5) Windows, of area not less than 10% of the floor area, shall be provided to all rooms, securely barred, fitted with blinds and having opening sections fitted with locks and mosquito screens.
- 6) The building shall be provided with a continuous water supply and drainage to Kitchen, Washroom and Toilets. The Toilets shall be equipped with low level suites and be adequately ventilated through the ceiling.
- 7) The Kitchen/Pantry shall be fitted out with a 2-drainer stainless steel double sink unit, hot water heater, work top with cupboards under, tiling above the sink and worktop and wall mounted



- cupboards. Fire and Safety regulations shall be complied with and firefighting equipment shall be provided in accordance with the recommendations of the Maharashtra Fire Services.
- 8) The Contractor shall provide, erect and maintain appropriate name boards as specified, for each of the offices. The wording shall be agreed with the Engineer.
  - 9) The Contractor shall provide protective clothing and safety equipment for 12 persons, comprising, as a minimum – Safety Helmets, Safety Harness, Steel-toed construction shoes/boots(sizes to be notified), Day-Glow waist coat, Industrial safety goggles, Industrial gloves, Breathing Masks and Filters, Ear protectors, Heavy weight suits (sizes to be notified), Lamps (with batteries), etc., as required by the Engineer.
  - 10) The Contractor shall provide an adjacent shaded hard standing parking area.
  - 11) The Contractor shall arrange for upkeep, service and security of the offices and compound. These to be thoroughly cleaned and rubbish and waste to be removed at least once per day.
  - 12) The Contractor shall provide 03 nos. of 07-seater capacity vehicles with driver facility free of for the Employer for the transportation to sites and offices during entire commissioning period.
  - 13) The Contractor shall submit a detailed office layout plan showing all relevant details of these site offices, not limited to that described above, which will require a notice from the Engineer.
  - 14) Furniture will be provided by contractor including storages for record.
  - 15) 02 Desktops, 01 Laptop, One Printer + Scanner, Internet Connectivity, and Stationery Item as required will be provided by contractor. Meeting rooms will be Air-conditioned at Site locations.
  - 16) The Contractor shall provide within the designated principal Works Areas, at locations agreed with the Engineer, the compounds and facilities for the Engineer and other contractors of the Employer defined under Clause 2 of this Appendix.
  - 17) The standard conditions applying to the use of any Works Area by the Contractor for its site facilities are given under Clause 2 of this Appendix.
  - 18) The contractor shall also provide a temporary built-up area of about 250sq.m for office accommodation for Employer and Engineer staff at suitable location along the alignment with toilet and electricity facility including services for office upkeep, consumable, Furniture, security, Air Conditioning, Ventilation etc as directed by the Engineer.
  - 19) The Conditions for supply of electricity by the Contractor to Designated Contractors are given under Clause 3 of this Appendix.

## **2. STANDARD ENGINEERING CONDITIONS**

The following standard engineering conditions apply to all Works Areas:

### **Formation**

- (a) The Works Areas shall be formed to the levels that the Engineer has given his consent. No such levels shall be amended without prior consent of the Engineer.
- (b) The Works Areas shall be surfaced in a manner agreed with the Engineer, compatible with their intended use, and, in particular, footpaths and roadways connecting facilities shall be clearly defined. Measures shall be taken to the satisfaction of the Engineer to ensure all areas are properly drained and kept free of static water.

- (c) The removal, diversion or reinstatement elsewhere as may be required of any existing works or installation whatsoever within the Works Areas shall be carried out to the satisfaction of the Engineer.

#### **Roads & Parking**

- (d) Space shall be provided within the Works Areas for parking, loading/unloading and maneuvering of motor vehicles.
- (e) Any damage done to the adjoining public roads and fixtures and properties (public or private) shall be made good to the satisfaction of the Engineer.

#### **Drainage & Sewerage**

- (f) All storm or rainwater from the Work Areas including any access roads thereto shall be conveyed to the nearest stream course, catch-pit, channel or storm water drain as required by the Engineer. All temporary and permanent works shall be carried out in such a manner that no damage or nuisance are caused by storm water or rain water to the adjacent property.
- (g) No drain or watercourse shall be used without consent of the Engineer.
- (h) Damages or obstructions caused to any water course, drain, water- main or other installations within or adjoining the Works Areas shall be made good to the satisfaction of the Engineer.
- (i) Treatment and disposal of sewage and wastewater from the Works Area shall be provided to the satisfaction of the Engineer.

#### **Buildings**

- (j) No permanent structures other than those required for the Permanent Works shall be Temporary permitted on the Works Areas.
- (k) Electricity, water, telephone and sewerage shall be provided by the Contractor, as required, for all temporary buildings.
- (l) No potable water from the MCGM / TMC/ Local authority shall be used for heating, cooling and humidification purposes, or vehicle washing without the written consent of the Engineer.

#### **Pedestrian Access**

Every existing pedestrian access throughout the Works Areas shall be maintained in a usable condition at all times to the satisfaction of the Engineer including lighting, signing and guarding.

#### **Fencing**

The Works Areas shall be secured against unauthorized access at all times. In particular, fencing or the like shall be maintained, removed and re-erected in the new location wherever and whenever a Works Area is relinquished in stages.

#### **Temporary Water & Power Supply to Designated Contractors**

Designated Contractors, during construction phase, shall use power & water supply provided by the Civil Contractor. Facilities provided shall be:

- (a) at the ends of each station, at concourse level, a mains water supply of 25 mm diameter complete with stopcock; and
- (b) at the ends and at the midpoint of each station, at both the concourse and platform levels and at agreed locations along the viaduct (at a maximum distance of 150 m), 415V three phase / 230 V single phase power supply, suitably earthed and each with sockets capable of receiving three

- (3) electric plugs of the size and type used for hand-held construction equipment.

Such provisions shall be available to the Designated Contractors from the commencement of the first Installation Interfacing and Co-ordination Period until the Permanent water and power supplies are connected and commissioned within the respective stations. The Designated Contractors shall be responsible for reimbursement to the Civil contractor of the utility charges for consumption of mains water and electricity by the Designated Contractors, supplies shall be individually metred for each Designated contractor. The Contractor shall charge the Designated Contractors for consumption of mains water and electricity at the unit rates as billed to the Contractor by the water and electricity authorities for such utilities.

#### **Applicability**

- (1) Where the Civil Contractor is required to provide temporary electrical supplies, or to use, extend or expand on temporary supplies installed by others, all such activity shall be executed in accordance with Paragraphs of this Appendix.
- (2) When the Civil Contractor makes use of temporary electrical supplies provided by others he will observe and comply with the requirements of this Appendix.

#### **Work on Site**

- (1) The Contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Engineer for review not later than 4 weeks before the appointment and who shall be solely responsible for ensuring the safety of all temporary electrical equipment on Site. The Contractor shall not install or operate any temporary Site electrical systems until this representative is appointed and has commenced duties.
- (2) The name and contact telephone number of the representative having been reviewed without objection by the Engineer shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.
- (3) Schematic diagrams and the details of the equipment for all temporary electrical installations shall be submitted by the Contractor, and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for his consent.
- (4) All electrical installation work on Site shall be carried out in accordance with the requirements laid down in BS 7375 and the Specification. All work shall be supervised or executed by qualified and suitably categorised electricians, who are registered as such under the Electricity Ordinance 1990/Electricity (Registration) Regulations 1990.

#### **Electrical General**

Temporary electrical Site installations and distribution systems shall be in accordance with: -

- (1) Indian Electricity Rules
- (2) The Power Companies' Supply Rules;
- (3) Electricity and its subsidiary Regulations;
- (4) IEE Wiring Regulations (16<sup>th</sup> Edition);
- (5) BS 7375 Distribution of Electricity on Construction and Building Sites;
- (6) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites;
- (7) BS 6164 Safety in Tunneling in the Construction Industry.
- (8) Any other applicable national standards

## **Materials, Appliances and Components**

All materials, appliances and components used within the distribution system shall comply with BS 4363 and BS 7375 Appendix A.

### **Design Considerations**

- (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.
- (2) All cabling shall be run at high level whenever possible and firmly secured to ensure they do not present a hazard or obstruction to people and equipment.
- (3) The installation on Site shall allow convenient access to authorised and competent operators to work on the apparatus contained within.

### **Mains Voltage**

- (1) The Site mains voltage shall be as per the Electricity Authority, 415V/ 3 phase 4 wire system.
  - (a) Single phase voltage shall be as per the Electricity Authority, 230V supply.
  - (b) Reduced voltages shall conform to BS 7375.
- (2) Types of Distribution Supply

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 - 230V /1 phase;
  - (d) fixed flood lighting - 230V/ 1 phase;
  - (e) portable and hand-held tools - 115V /1 phase;
  - (f) Site lighting (other than flood lighting) - 115V /1 phase; and
  - (g) Portable hand-lamps (general use) - 115V /1 phase.
- (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 / 230V. 1 phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.
- (4) Protection of Circuits
  - (a) Protection shall be provided for all main and sub-circuits against excess current, under and over voltage, 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.
  - (b) Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with: -

- (i) BS 88;
- (ii) BS EN 60898; and
- (iii) BS 7375;
- (iii) Any other appropriate Indian Standards.

### **Earthing**

- (1) 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.
- (2) Earthing systems shall conform to the following standards: -
  - (a) IEE Wiring Regulations (16th Edition);
  - (b) BS 7430;
  - (c) BS 7375; and
  - (d) IEEE Standard 80 Guide for Safety in AC Substation Grounding.

### **Plugs, Socket Outlets and Couplers**

Low voltage plugs, sockets and couplers shall be colour coded in accordance with BS 7375, and constructed to conform to BS EN 60309. High voltage couplers and 'T' connections shall be in accordance with BS 3905.

### **Cables**

- (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. Supply cables up to 3.3KV shall be in accordance with BS 6346.
- (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.
- (3) Where low voltage cables are to be used, reference shall be made to BS 7375. The following specifications shall also be referred to particularly for underground cables: -
  - (a) BS 6346 for armoured PVC insulated cables; and
  - (b) BS 6708 Flexible cables for use at mines and quarries.
- (4) All cables which have a voltage to earth exceeding 65 V (except for supplies from welding transformers to welding electrodes) shall be of a type having a metal sheath and/or armour which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.
- (5) 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.
- (6) For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.

- (7) Cables which have applied to them a voltage to earth exceeding 12 V but not normally exceeding 65 V shall be of a type insulated and sheathed with a general purpose or heat resisting elastomer.
- (8) All cables which are likely to be frequently moved in normal use shall be flexible cables. Flexible cables shall be in accordance with BS 6500 and BS 7375.

### **Lighting Installation**

- (1) Where Site inspection of the Works is required during the nights, the Lighting circuits shall be run separate from other sub-circuits and shall be in accordance with BS 7375 and BS 4363.
- (2) Voltage shall not exceed 55 V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.
- (3) Luminaries shall have a degree of protection not less than IP 54. In particularly bad environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.
- (4) The Contractor shall upgrade the lighting level to a minimum of 200 lux by localised lighting in all areas where required by the Engineer.
- (5) Mechanical protection of luminaries against damage by impact shall be provided by use of wire guards or other such devices whenever risk of damage occurs.

### **Electrical Motors**

- (1) Totally enclosed fan cooled motors to BS 4999: Part 105 shall be used.
- (2) Motor control and protection circuits shall be as stipulated in BS 6164. Emergency stops for machinery shall be provided.

### **Inspection and Testing**

Electrical installations on Site shall be inspected and tested in accordance with the requirements of the IEE Wiring Regulations (16<sup>th</sup> Edition).

### **Identification**

Identification labels of a type reviewed without objection by the Engineer shall be affixed to all electrical switches, circuit breakers and motors to specify their purpose.

### **Maintenance:**

- (9) Strict maintenance and regular checks of control apparatus and wiring distribution systems shall be carried out by an electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems. The Contractor shall submit for review by the Engineer details of his maintenance schedule and maintenance works record.
- (10) 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.

### **Metering**

The Contractor shall install a separately metered and invoiced supply or supplies of electricity for: -

- (a) Site fabrication facilities;
- (b) Site workshops and work yards; and
- (c) Site offices and stores.

## EMPLOYER'S REQUIREMENTS

### APPENDIX 9-RAILWAY ENVELOPE ACCESS AND TAKING OVER

#### 1. RAILWAY ENVELOPE TAKING OVER

- (1) The Railway Envelope is defined in the Employer's Requirements - General.
- (2) The conditions for Taking Over of the Railway Envelope are as follows:
  - (a) From Railway Envelope completion date any access to the Railway Envelope by the Contractor shall be in accordance with any procedures, requirements and conditions as defined under Clause 1(3) of this Appendix.
  - (b) At the time of Taking Over, the Contractor shall have executed all necessary works on the structure and all other work within the Railway Envelope, the installation of all equipment fixings defined under Clauses 2(1) and 2(2) of this Appendix, and shall ensure that the Envelope is complete, secure, safe for the operation of trains, and has the Employer's and Engineer's approval for effective Taking Over.
- (3) The conditions for access to the Railway Envelope after Taking Over are as follows:
  - (a) Access to the Railway Envelope after Taking Over will be controlled by the Employer and priority will be given to the testing and trial running of rolling stock and other operating components associated with the railway. Access will be given to the Contractor and to other contractors by the Employer for inspecting, maintaining, adjusting and repairing, by prior arrangement and for limited periods.
  - (b) At the time of Taking Over, the Contractor shall provide the Employer with the name of, and twenty-four (24) hour contact procedure for, the individual charged in liaison with the Employer. The Contractor shall give two weeks' notice of his desired track possessions, and this appointed liaison officer shall attend, when requested, the appropriate meetings where track possession allocations will be made by the Employer. It may be necessary for the Contractor's work to be carried out intermittently or at night if suitable possessions cannot be given during its preferred hours. During all such operations the Contractor will be fully responsible for safety of men, equipment and works.
  - (c) After the Taking Over, and prior to the completion of the Project, the Designated Contractors will be undertaking the following activities:
    - (i) Not Used
    - (ii) testing traction and signaling equipment together with other equipment and facilities required for operation of the railway:

- (iii) undertaking acceptance tests, Integrated System Tests and test running:
- (iv) undertaking trial running: which will increase as the trials proceed until full operating frequencies are reached.

The Contractor shall take into account the Designated Contractors' activities and train operations in planning and programming its Works.

- (4) Prior to the substantial completion of the Project, the Contractor will be given extended possessions of the Railway Envelope for the purposes of final adjustment, tightening, touching up or cleaning up prior to the final inspection of the Works. Such possessions shall be agreed with the Employer in accordance with the procedure set out under Clause 1(3)(b) of this Appendix.

## **2. RAILWAY EQUIPMENT**

- (1) Non-structural items

Architectural finishes shall be supplied and installed by the Designated Contractors.

- (2) Electrical and Mechanical Equipment Fixings

- (a) The Contractor shall be responsible for all co-ordination with the Employer and for determining his detailed requirements for equipment fixing provisions in accordance with the requirements of the Designated Contractors' Works Programme.
- (b) The Contractor shall provide record of agreement with the Designated Contractors on the designed and subsequently revised locations for additional/ revised holes or welding to structural members.

- (3) Electrical and Mechanical Equipment

- (a) Unless expressly specified in the Contract, all railway electrical and mechanical equipment and services within the Railway Envelope, including MV & HV power supplies, traction power equipment, emergency lighting and LV supplies by signaling, communications and platform screen doors, if any, will be supplied and installed by the Designated Contractors.



## EMPLOYER'S REQUIREMENTS

### APPENDIX 10- LIST OF APPROVED MANUFACTURERS/SUPPLIERS

S.No.	Details of Materials /Products	Manufacturer's Name
1	Cement	ACC, Ultratech, Ambuja, Grasim, JSW, JK Lakshmi
2	Reinforcement Bars	SAIL, Rashtriya Ispat Nigam Ltd. (Vizag Steel Plant), Tata Steel, JSW Steel, JSP and any other manufacturer approved by MMRDA.
3	Epoxy	FOSROC, SIKALCRETE, BASF, ARALDITE
4	Expansion Joints	Prequalified Manufacturers as per RDSO's latest approved list or as approved by MMRDA.
5	Admixtures	FOSROC, MBT, Sika, BASF, Asian Lab, TP Buildtech, Pinnacle, Fairmate, Asian Paints Ltd.
6	Pile Integrity Testing Agency	CBRI, FUGRO- KND, Pile Dynamic, AIMIL, Geo dynamic, CEG Test House, EMC India, Mythcon, ATL AVANTECH, Soil Engineering Consultants, Knack Engineering
7	Anchor Fastener	HILTI, FISHER, AXEL Industries, Pioneer Nuts and Bolts (TUFF Brand), MUNGO, LPSEJOT, Ripple, M/s Times Engineering, DADU Precision Fasteners, USHA Precision Fasteners Pvt Ltd.
8	Structural Steel	TATA, SAIL, ESSAR, Jindal Steel & Power Ltd., JSW, RINL
9	Stainless Steel	Jindal, SAIL, or approved equivalent by MMRDA
10	Pre-stressing Strand (LRPC)	TATA SSL Ltd, USHA Martin.
11	Pot/Elastomeric Bearings	Prequalified Manufactures as per RDSO's latest approved list or as approved by MMRDA.
12	Horizontal Tie Bars/Shear Bars	BB Bars System, BBV Systems, Macalloy or approved equivalent
13	HDPE Sheathing	Rex Polyextrusion, M/s Dynamic Prestress, Gwalior polypipes Ltd.
14	Formwork Release Agent	FOSROC, MBT, Choksey, BASF, SIKAL, CHRYSO, Fair mate, Pinnacle
15	Prestressing System	Freyssinet, BBR, VSL, Dynamic, Killick Nixon, Tensacciai (India Ltd.), Usha Martin, VSIL, Posten, Wartex Systems, Tech 9
16	Reinforcement Couplers	Dextra, Moment, Sanfield

S.No.	Details of Materials /Products	Manufacturer's Name
17	Hollow Sections, Pipes	Surya Pipes, Hi-Tech Pipes, JSW, JSPL, Tata, Garg Ispat Udyog, Navratan, Bihar, Ravindra Tubes
18	Drainage Pipes	Tirupati Plastomatics, Duraline, REX, STIPL, Kriti, Vishal, Eonn
19	Acrylic Textured Coatings	Spectrum, Renova, Wallz, Surfa Nova, Jotun, Asian Paints, Nerolac, Nippon Paint.
20	Non shrink Grout	FOSROC Chemical (India), SIKA, BASF, ELCHEM, MBT, CHRYSO, Fair mate, Pinnacle
21	Bonding Coat	FOSROC, Sunanda specialty coating Pvt. Ltd., BASF, CHRYSO
22	Polysuphide Sealant	Pidilite, BASF, FOSROC, CHRYSO, STP, SIKA, Fairmate
23	Steel Structural Fasteners	Sundra Fasteners, Unbrako, LPSEJOT, Nelson, Panchsheel, M/s Times Engineering, DADU Precision Fasteners Pvt Ltd
24	Corrosion Protection Paints	Berger, Johnson Nicholson, Nerolac, Asian, Shalimar, Fosroc, SIKA, Nippon paint
25	Micro Silica	Sika, Elkem, FOSROC, Corniche, CALIPAR
26	FBEC	EUROCOUSTIC PRODUCTS LIMITED (PSL), Electrotherm (India) Ltd or any other equivalent manufacturer approved by MMRDA.
27	CPCC	As per the latest approved and Registered vendors of CECRI
28	Fire Resistant Paints	Berger, Nerolac, Nippom Paint
29	External Acrylic Emulsion	Berger, Apex, Asian, Nerolac, Jenson & Nicklson, Nippon paint
30	Integral Crystalline Waterproofing Method	Kryton Buildmat Co. (Pvt.) Ltd., Penetron, Vandex International Ltd., BASF, CHRYSO, XYPEX, Normet India, DON, MYK Schomburg, SIKA
31	Water stopper/Bar	Kanta Rubber, Greenstreak, Maruti, Duron, Deep- Jyoti Rubber
32	Liquid polymer membrane waterproofing	INTEGRITANK, BASF, MAPEI, PIDILITE, CICO, Normet India, DON, MYK Schomburg, SIKA
33	Bentonite/ Polymer	Laviosa Trimax, Shri Hari, Shivam Minerals, Geo Polymers, Vidhya Enterprises
34	Curing Compound	SINAK, FOSROC, SIKA, BASF, CHRYSO, Pinnacle, Fairmate
35	Polycarbonate Sheets	M/s Gallina Acroplus, Coxwell, Poly U, Fabic, Lexan, (SABIC Innovative Plastics), DANPALON, GE Plastics
36	Fly Ash	Thermal Plants, Ashcrete, Ultra Pozz, Star Pozz (the Fly Ash shall be as per our specifications)

S.No.	Details of Materials /Products	Manufacturer's Name
37	Pre-Coated profiled Metal Sheetings	Blue Scope Steel, Multicolor, Essar Steel, Bhushan Steel, Ispat Profile India
38	Welding Electrodes	Esab India, Advani-Oerlikon, D&H Welding Electrodes, Superon Schweisstechnik India, Maruti Weld, Modi Arc, Modi Hitech, Weld alloy
39	Anticarbonation paint	Berger, Fosroc, Sika, Fairmate, Asian paint, Nerolac, Nippon Paint, BASF.

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 11-GAD : Depot Layout**

**Refer Volume-5: Tender Drawings**

## EMPLOYER'S REQUIREMENTS

### APPENDIX 12- CONTRACTOR'S SITE LABORATORY

#### 1. SITE LABORATORY (AT BATCHING PLANT LOCATION)

- (1) The Site Laboratory shall be approximately 250m<sup>2</sup> in area. It shall consist of the following accommodation:

1 concrete laboratory	60m <sup>2</sup> floor area
1 Soil laboratory	30m <sup>2</sup> floor area
2 office	each 15m <sup>2</sup> floor area
1 storeroom	10m <sup>2</sup> floor area
1 kitchen	10m <sup>2</sup> floor area
male toilets, changing room & shower	sufficient for 6 persons
- (2) The remaining area out of the 250m<sup>2</sup> shall consist of storage area for concrete cube curing tanks. The laboratory, office etc. shall be in one building; the curing tank storage building may be in a separate building, but if so it shall be adjacent to the laboratory building & connected to it by a level, weatherproof passageway. In addition, an area of covered hard standing of 50m<sup>2</sup> for motor vehicles shall be provided adjacent to the laboratory.

#### 2. STANDARD OF CONSTRUCTION

- (1) The laboratory shall be constructed to the best Engineering practice and as approved by the Engineer. Two independent telephone lines with two extensions each shall be provided for the laboratory. Telephones shall be located in areas as agreed with the Engineer.
- (2) A water tank with minimum capacity of 2000 liters shall be installed, as a source of constant water pressure (15 KPa minimum) for each laboratory.
- (3) In the case of sinks used for washing samples, adequate trapping and/or separating devices shall be provided to ensure the proper functioning of the facility.

#### 3. FURNISHINGS AND FIXTURES

The contractor's site laboratory shall be provided with required furnishings and fixtures.

#### 4. LABORATORY EQUIPMENT

- (1) The laboratory equipment, as listed below, shall be approved by the Engineer. The Contractor shall submit for the Engineer's approval within 2 weeks of the order to commence work the name of the supplier it intends to use for each piece of apparatus together with the relevant catalogue number.

- (2) The layout of the equipment in the testing laboratory shall be instructed by the Engineer. The equipment shall be maintained to an accuracy appropriate to the required testing methods with routine calibration by an accredited organization as recommended by the appropriate Authority. Equipment shall also be calibrated after maintenance or relocation.

- (3) The Contractor's site laboratory shall be equipped with the following material testing equipment as a minimum. The nature and quantity of equipment required for testing may be varied by the Engineer depending on the detail of the Contractor's Design and Construction methods or for any other reason which he deems to be valid and necessary for the proper control of quality:

**5. Determining Moisture Content (1 complete set)**

Micro Oven, capacity 35 liters, control temperature up to 200°C	1No.
Balance, capacity 200 gm., sensitivity 0.01gm.	1set
Lab. Tongs	1No.
Moisture cans 75ml. with lid	36No.

**6. Sieve Analysis**

Sieve shaker (portable)	1unit
Coarse sieves In Sizes from 100mm to 10mm	(1set
Fine Sieves #4, #8, #16, #30, #40, #50, #100, #200	each)
Pans & Covers	

**7. Specific Gravity and Absorption of Coarse Aggregate**

Wire basket, 200mm dia.	
Heavy duty suspension balance, 20 kg x 1 gm. with accessory for weight in water	1set
Suitable water container	1No

**8. Testing of Aggregate**

Balance, 100 kg. capacity with 10gm precision	1No.
Tamping rod 16mm diameter x 600mm long	1No.
Measuring containers (3, 10, 15, 30 litres)	1each

**9. Flakiness and Elongation**

Flakiness gauge, elongation index	1 set
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## 10. Soundness Test

Sodium sulphate	25kg
Soaking tank	1No.
Balance, Capacity 3 kg., Sensitivity 0.1gm.	1set
Sieves: Coarse	1set
Fine	1set

### Concrete

Buckets for concrete sampling	12 No.
Slump cone	12 No.
Tamping rod	12No
Baseplate	12No.
Mixing pan for concrete	2No.
Scoop for general purpose	2No.
Concrete thermometer	1No.
Concrete cylinder mould, 150 mm * 300 mm; 100 mm *300mm	10each
Concrete cube mould, 100 mm cube & 150mmcube	10 each
Adjustable spanners for dismantling cube moulds	6No.
Capping set	2No.
Capping compound	
Concrete curing tank with capacity for 270 cubes, temperature controlled, with circulation system drain And lockable cover	5No.
Schmidt test hammer	1No.
Compression testing machine ( <u>Electrically</u> operated)	1 No.
Mould oil	
Temperature chart recorder	1No.
<b>Test For Material</b>	
Aggregate Impact Testing Machine fixed on floor	1No.
Abrasion test fixed on floor	1No.
All testing equipment and machines required for fine and coarse aggregate testing complete set	
All testing equipment and machines required for cement testing complete set	

Mechanical Sieve shaker and sieve set for sand/ fine aggregate

All testing equipment and machines required for water testing complete set

All testing equipment and machines required for admixtures and plasticizer complete set

All measuring equipment digital/non digital equipment required

#### 11. Miscellaneous

Vernier calipers to measure up to 200mm,

With elongated jaws 5No.

Steel rule, 300mm long graduated 2No.

Rubber gloves 10pr.

Cotton working gloves 20pr.

First aid kit 1set

Wire brush 6No.

Steel tape, 3m,5m,30m 3each

Ball peen hammer,1kg 2No.

Paint scraper. Approx.100mmwide 8No.

Float, steel Approx.280 x120mm 8No.

Sackbarrow 1No.

Shovel: Square Mouthed 2No.

Round Mouthed 2No.

24-wheel trolley, heavy duty, approx. 0.7m x 1.0m long

Pneumatic tyred type 1 No.

Wheelbarrow, rubber tyred 1 No.

Comprehensive tool kit. To include screwdrivers, pliers, claw hammer, multi-grips, spanners(adjustable) 1No.

Type NR Schmidt Hammer and tester with recording device 1No.

Testing Anvil for Schmidt Hammer test (SHT) 1No.

Chart recording paper for SHT 10pkts

Cover meter for detecting metal objects to depth of 100mm below the surface of non-magnetic objects 3No.

Noise meter 1No.

RCPT Testing Machine 1No.

Permeability Testing Machine 1No.



## 1. SITE LABORATORY (AT DEPOT LOCATION)

- (1) The Site Laboratory shall be approximately 150m<sup>2</sup> in area. It shall consist of the following accommodation:
 

a) Ballast Testing lab (with all equipment and accessories)	15m <sup>2</sup> floor area
i. Water absorption test	
ii. Ballast impact test	
iii. Abrasion value test	
iv. Sieve analysis	
b) concrete laboratory	10m <sup>2</sup> floor area
c) office	each 10m <sup>2</sup> floor area
d) storeroom	10m <sup>2</sup> floor area
e) kitchen	10m <sup>2</sup> floor area
f) male toilets, changing room & shower	sufficient for 6 persons
- (2) The remaining area out of the 150m<sup>2</sup> shall consist of storage area for concrete cube curing tanks. The laboratory, office etc. shall be in one building; the curing tank storage building may be in a separate building, but if so, it shall be adjacent to the laboratory building & connected to it by a level, weatherproof passageway. In addition, an area of covered hard standing of 50m<sup>2</sup> for motor vehicles shall be provided adjacent to the laboratory.

## 2. STANDARD OF CONSTRUCTION

- (1) The laboratory shall be constructed to the best Engineering practice and as approved by the Engineer. Two independent telephone lines with two extensions each shall be provided for the laboratory. Telephones shall be located in areas as agreed with the Engineer.
- (2) A water tank with minimum capacity of 2000 liters shall be installed, as a source of constant water pressure (15 KPa minimum) for each laboratory.
- (3) In the case of sinks used for washing samples, adequate trapping and/or separating devices shall be provided to ensure the proper functioning of the facility.

## 3. FURNISHINGS AND FIXTURES

The contractor's site laboratory shall be provided with required furnishings and fixtures.

## 4. LABORATORY EQUIPMENT

- (1) The laboratory equipment, as listed below, shall be approved by the Engineer. The Contractor shall submit for the Engineer's approval within 2 weeks of the order to commence work the name of the supplier it intends to use for each piece of apparatus together with the relevant catalogue number.
- (2) The layout of the equipment in the testing laboratory shall be instructed by the Engineer. The equipment shall be maintained to an accuracy appropriate to the required testing methods with routine calibration by an accredited organization as recommended by the appropriate Authority. Equipment shall also be calibrated after maintenance or relocation.

- (3) The Contractor's site laboratory shall be equipped with the following material testing equipment as a minimum. The nature and quantity of equipment required for testing may be varied by the Engineer depending on the detail of the Contractor's Design and Construction methods or for any other reason which he deems to be valid and necessary for the proper control of quality:

**5. Determining Moisture Content (1 complete set)**

Micro Oven, capacity 35 liters, control temperature up to 200°C	1 No.
Balance, capacity 200 gm., sensitivity 0.01 gm.	1 set
Lab. Tongs	1 No.
Moisture cans 75 ml. with lid	36 No.

## **EMPLOYER'S REQUIREMENTS**

### **APPENDIX 13- Refer Volume 6 BOQ**

## **EMPLOYER'S REQUIREMENT**

### **ATTACHMENT A- PROVISION OF LABOUR CAMP**

#### **1. EMPLOYER NOT TO PROVIDE QUARTERS FOR CONTRACTOR'S LABOUR**

The Employer will not provide living accommodation for the use of the Contractor or any of his staff or labour employed on the Works.

#### **PROVISION OF LABOUR CAMP**

The Contractor, shall, at his own expense, make adequate arrangements for the housing, supply of drinking water and provision of bathrooms, latrines and urinals, with adequate water supply, for his staff and workmen directly or through sub-contractors employed on the Works at the location authorized by Engineer.

The Contractor at his own cost shall maintain all campsites in a clean and sanitary condition. The Contractor shall obey all health and sanitary rules and regulations and carry out at his cost all health and sanitary measures that may from time to time be prescribed by the Local/Medical Authorities and permit inspection of all health and sanitary arrangements at all times by the Employer, Engineer and the staff of the local municipality or other authorities concerned. Should the Contractor fail to provide adequate health and sanitary arrangements these shall be provided by the Employer and the cost recovered from the Contractor.

The Contractor shall at his own cost, provide First Aid and Medical facilities at the Labour Camp and at work sites on the advice of the Medical Authority in relation to the strength of the Contractor's staff and workmen, employed directly or through sub-contractors.

The Contractor shall at his own cost, provide the following minimum requirements for fire precautions:

- Portable Fire Extinguishers.
- Manual Fire Alarms.
- Water Supply for use by the Fire Service.

The Contractor at his own cost shall provide necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers. He should also ensure that electrical installations are done by Trained Electricians. These installations shall be maintained, and daily maintenance records must be made available for inspection of the Engineer.

#### **CAMP DISCIPLINE**

The Contractor shall take requisite precautions and use his best endeavours to prevent any riotous or unlawful behavior by or amongst his workmen, and others, employed directly or through sub-contractors. These precautions shall be for the preservation of the peace and protection of the inhabitants and security property in the neighborhood of the Works. In the event of the Employer requiring the maintenance of a Special Police Force at or in the vicinity of the site, during the tenure of the work, the expenses thereof shall be borne by the Contractor and if paid by the Employer, shall be recoverable from the Contractor.

The sale of alcoholic drinks or other intoxicating drugs or beverages upon the work, in any labor camp, or in any of the buildings, encampments or tenements owned or occupied by, or within the control of, the Contractor or any of his employees directly or through sub-contractors employed on the work, shall be forbidden, and the Contractor shall exercise his influence and authority to secure

strict compliance with this condition. The Contractor shall also ensure that no labour or employees are permitted to work at the site in an intoxicated state or under the influence of drugs.

The Contractor shall remove from his camp such labour and their families, as refuse protective inoculation and vaccination when called upon to do so by the Engineer on the advice of the Medical Authority. Should Cholera, Plague or any other infectious disease break out, the Contractor shall at his own cost burn the huts, bedding, clothes and other belongings of or used by the infected parties. The Contractor shall promptly erect new huts on healthy sites as required by the Employer, within the time specified by the Employer, failing which the work may be done by the Employer and the cost recovered from the Contractor.

#### **LABOUR ACCOMMODATION**

The Contractor shall provide living accommodation that is equal to or exceeds the minimum criteria established in the following sub-sections, needed to house his staff, workers employed directly or through sub-contractors. The buildings shall be constructed with cement panels so as to have a minimum life of not less than the length of the Contract.

- a) The roofs shall be watertight and laid with galvalume materials permissible for residential use under local regulations and for which the consent of the Engineer has been obtained.
- b) Each hut shall have suitable ventilation. All doors, windows, and ventilators shall be provided with security leaves and fasteners. Back to back units may be avoided.
- c) The minimum height of each unit shall be 2.10m and shall have separate cooking place.
- d) Suitable no. of common toilet/bath shall be provided.

#### **WATER SUPPLY**

The Contractor shall provide an adequate supply of potable water from MCGM / Local authorities for the use of labourers in the Camp. The provision shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, tanks which be of metal or masonry shall be provided. The Contractor shall also at his expense make arrangements for the provision and laying of water pipe lines from the existing mains wherever available and shall pay for all the fees and charges thereof.

#### **DRAINAGE**

The Contractor shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy. Surface water shall be drained away from paths and roads and shall not be allowed to accumulate into ditches or ponds where mosquitoes can breed.

#### **SANITATION**

The Contractor shall make arrangements for conservancy and sanitation in the labour camps according to the rules and regulations of the Local Public Health and Medical Authorities.

The Contractor shall provide a sewage system that is adequate for the number of residents in the camp, and which meets the requirements of the Municipality Authorities.