ROURKELA
SMART CITY LTD.

DRAFT CONTRACT AGREEMENT & SCHEDULES

FOR

REDEVELOPMENT OF ROAD FROM PANPOSH CHOWK TO AMBEDKAR CHOWK INCLUDING STREETSCAPE, BEAUTIFICATION,LANDSCAPING, INTERSECTION REDESIGN, UTILITY DUCTING AND UNDER GROUND CABLING IN ROURKELA SMART CITY LIMITED (ABD AREA) UNDER SMART CITIES MISSION

REQUEST FOR PROPOSAL(RFP)
BID DOCUMENT
VOLUME -II &III
August-2018
BY

ROURKLA SMARTCITY LTD
UDIT NAGAR ROURKELA - 764012

CONTENTS

PART III
Construction and Maintenance

Part I

Preliminary

ENGINEERING, PROCUREMENT AND CONSTRUCTION AGREEMENT

THIS AGREEMENT is entered into on this the …….. day of ……, 20…..

BETWEEN

The Rourkela Smart City Ltd. (RSCL) represented by Chief Executive Officer , Rourkela Municipal Corporation Udit Nagar Rourkela 764012 (hereinafter referred to as the **"Authority"** which expression shall, unless repugnant to the context or meaning thereof, include its administrators, successors and assigns) of One Part;

AND

{----------,} means the selected bidder having its registered office at ……, (hereinafter referred to as the "**Contractor**" which expression shall, unless repugnant to the context or meaning thereof, include its successors and permitted assigns) of the Other Part.

WHEREAS:

(A) The Authority is engaged in the development of Rourkela Area based development (ABD) Area under the implementation of Smart City Proposal of Rourkela and as part of this endeavour, it has been decided to undertake "Redevelopment of Road including Streetscape Design, Beautification, Landscaping, Intersection Redesign, and Infrastructure Upgrades, the Road No. MRO9 section from km 0.00 Panposh Chowk to km 3.62 Ambedakar Chowk (approx. 3.62 km) of Rourkela" through an Engineering, Procurement and Construction (EPC) Contract. .

(B) The Authority had resolved to redevelop the existing road from km 0.00 Panposh Chowk to km 3.62(Ambedkar Chowk (approximately 3.62km) on the section of Road No.MRO9- (hereinafter called the "Smart Road") in Rourkela by Four Laning on Engineering, Procurement, Construction ("**EPC**") basis in accordance with the terms and conditions to be set forth in an agreement to be entered into.

(C) Deleted

(D) The Authority had prescribed the technical and commercial terms and conditions, and invited bids (the "**Request for Proposals**" or "**RFP**") from the prospective bidders qualifying the minimum eligibility criteria for undertaking the Project.

(E) After evaluation of the bids received, the Authority had accepted the bid of the selected bidder and issued its Letter of Acceptance No. …….. Dated …….. ……. (hereinafter called the "**LOA**") to the selected bidder for "Redevelopment of road From Panposh Chowk to Ambedkar Chowk from 0.00 km to 3.62 km Section of MR09 Road including streetscape, beautification, landscaping, intersection redesign, utility ducting and underground cabling in Rourkela Smart City Limited (ABD) under Smart Cities Mission through on EPC Mode" at the contract price

specified hereinafter, requiring the selected bidder to inter alia:

(i) deliver to the Authority a legal opinion from the legal counsel of the selected bidder with respect to the authority of the selected bidder to enter into this Agreement and the enforceability of the provisions thereof, within 10 (ten) days of the date of issue of LOA; and

(ii) execute this Agreement within 15 (fifteen) days of the date of issue of LOA.

(F) The Contractor has fulfilled the requirements specified in Recital (E) above;

NOW THEREFORE in consideration of the foregoing and the respective covenants and agreements set forth in this Agreement, the sufficiency and adequacy of which is hereby acknowledged, the Authority hereby covenants to pay the Contractor, in consideration of the obligations specified herein, the Contract Price or such other sum as may become payable under the provisions of the Agreement at the times and in the manner specified by the Agreement and intending to be legally bound hereby, the Parties agree as follows:

The following documents attached hereto shall be deemed to form an integral part of this Contract:

(a) Volume-I :
The Agreement;
Corrigendum to the Agreement;
Addendum, if any, to RFP;
Letter comprising the financial Bid;
Letter of Acceptance;
Power of Attorney;
, if any;
Legal opinion;
Any other document to be specified

(b) Volume-II: Technical Bid

ARTICLE 1

DEFINITIONS AND INTERPRETATION

1.1 Definitions

The words and expressions beginning with capital letters and defined in this Agreement (including those in Article 28) shall, unless the context otherwise requires, have the meaning ascribed thereto herein, and the words and expressions defined in the Schedules and used therein shall have the meaning ascribed thereto in the Schedules.

1.2 Interpretation

1.2.1 In this Agreement, unless the context otherwise requires,

(a) references to any legislation or any provision thereof shall include amendment or re-enactment or consolidation of such legislation or any provision thereof so far as such amendment or re-enactment or consolidation applies or is capable of applying to any transaction entered into hereunder;

(b) references to laws of India or Indian law or regulation having the force of law shall include the laws, acts, ordinances, rules, regulations, bye laws or notifications which have the force of law in the territory of India and as from time to time may be amended, modified, supplemented, extended or re-enacted;

(c) references to a "person" and words denoting a natural person shall be construed as a reference to any individual, firm, company, corporation, society, trust, government, state or agency of a state or any association or partnership (whether or not having separate legal personality) of two or more of the above and shall include successors and assigns;

(d) the table of contents, headings or sub-headings in this Agreement are for convenience of reference only and shall not be used in, and shall not affect, the construction or interpretation of this Agreement;

(e) the words "include" and "including" are to be construed without limitation and shall be deemed to be followed by "without limitation" or "but not limited to" whether or not they are followed by such phrases;

(f) references to "construction" or "building" include, unless the context otherwise requires, survey and investigation, design, developing, engineering, procurement, supply of plant, materials, equipment, labour, delivery, transportation, installation, processing, fabrication, testing, and commissioning of the Project, including maintenance during the Construction Period, removing of defects, if any, and other activities incidental to the construction and "construct" or "build" shall be

construed accordingly;

(g) references to "development" include, unless the context otherwise requires, construction, renovation, refurbishing, augmentation, up-gradation and other activities incidental thereto during the Construction Period, and "develop" shall be construed accordingly;

(h) any reference to any period of time shall mean a reference to that according to Indian standard time;

(i) any reference to day shall mean a reference to a calendar day;

(j) references to a "business day" shall be construed as a reference to a day (other than a Sunday) on which banks in Rourkela are generally open for business;

(k) any reference to month shall mean a reference to a calendar month as per the Gregorian calendar;

(l) references to any date, period or Project Milestone shall mean and include such date, period or Project Milestone as may be extended pursuant to this Agreement;

(m) any reference to any period commencing "from" a specified day or date and "till" or "until" a specified day or date shall include both such days or dates; provided that if the last day of any period computed under this Agreement is not a business day, then the period shall run until the end of the next business day;

(n) the words importing singular shall include plural and vice versa;

(o) references to any gender shall include the other and the neutral gender;

(p) "lakh" means a hundred thousand (100,000) and "crore" means ten million (10,000,000);

(q) "indebtedness" shall be construed so as to include any obligation (whether incurred as principal or surety) for the payment or repayment of money, whether present or future, actual or contingent;

(r) references to the "winding-up", "dissolution", "insolvency", or "reorganisation" of a company or corporation shall be construed so as to include any equivalent or analogous proceedings under the law of the jurisdiction in which such company or corporation is incorporated or any jurisdiction in which such company or corporation carries on business including the seeking of liquidation, winding-up, reorganisation, dissolution, arrangement, protection or relief of debtors;

(s) save and except as otherwise provided in this Agreement, any reference, at any time, to any agreement, deed, instrument, licence or document of any description shall be construed as reference to that agreement, deed, instrument, licence or

other document as amended, varied, supplemented, modified or suspended at the time of such reference; provided that this Clause shall not operate so as to increase liabilities or obligations of the Authority hereunder or pursuant hereto in any manner whatsoever;

(t) any agreement, consent, approval, authorisation, notice, communication, information or report required under or pursuant to this Agreement from or by any Party or the Authority's Engineer shall be valid and effective only if it is in writing under the hand of a duly authorised representative of such Party or the Authority's Engineer, as the case may be, in this behalf and not otherwise;

(u) the Schedules and Recitals to this Agreement form an integral part of this Agreement and will be in full force and effect as though they were expressly set out in the body of this Agreement;

(v) references to Recitals, Articles, Clauses, Sub-clauses or Schedules in this Agreement shall, except where the context otherwise requires, mean references to Recitals, Articles, Clauses, Sub-clauses and Schedules of or to this Agreement, and references to a Paragraph shall, subject to any contrary indication, be construed as a reference to a Paragraph of this Agreement or of the Schedule in which such reference appears;

(w) the damages payable by either Party to the other of them, as set forth in this Agreement, whether on per diem basis or otherwise, are mutually agreed genuine pre-estimated loss and damage likely to be suffered and incurred by the Party entitled to receive the same and are not by way of penalty (the "**Damages**"); and

(x) time shall be of the essence in the performance of the Parties' respective obligations. If any time period specified herein is extended for the reasons specified in the Agreement, such extended time shall also be of the essence.

1.2.2 Unless expressly provided otherwise in this Agreement, any Documentation required to be provided or furnished by the Contractor to the Authority shall be provided free of cost and in three copies, and if the Authority is required to return any such Documentation with its comments and/or approval, it shall be entitled to retain two copies thereof.

1.2.3 The rule of construction, if any, that a contract should be interpreted against the parties responsible for the drafting and preparation thereof, shall not apply.

1.2.4 Any word or expression used in this Agreement shall, unless otherwise defined or construed in this Agreement, bear its ordinary English meaning and, for these purposes, the General Clauses Act, 1897 shall not apply.

1.3 Measurements and arithmetic conventions

All measurements and calculations shall be in the metric system and calculations done to 2 (two) decimal places, with the third digit of 5 (five) or above being rounded up and

below 5 (five) being rounded down.

1.4 Priority of agreements and errors/discrepancies

1.4.1 This Agreement, and all other agreements and documents forming part of or referred to in this Agreement are to be taken as mutually explanatory and, unless otherwise expressly provided elsewhere in this Agreement, the priority of this Agreement and other documents and agreements forming part hereof or referred to herein shall, in the event of any conflict between them, be in the following order:

(a) this Agreement; and
(b) all other agreements and documents forming part hereof or referred to herein; i.e. this Agreement at (a) above shall prevail over the agreements and documents at (b).

1.4.2 Subject to the provisions of Clause 1.4.1, in case of ambiguities or discrepancies within this Agreement, the following shall apply:

(a) between two or more Clauses of this Agreement, the provisions of a specific Clause relevant to the issue under consideration shall prevail over those in other Clauses;

(b) between the Clauses of this Agreement and the Schedules, the Clauses shall prevail and between Schedules and Annexes, the Schedules shall prevail;

(c) between any two Schedules, the Schedule relevant to the issue shall prevail;

(d) between the written description on the Drawings and the Specifications and Standards, the latter shall prevail;

(e) between the dimension scaled from the Drawing and its specific written dimension, the latter shall prevail; and

(f) between any value written in numerals and that in words, the latter shall prevail.

1.5 Deleted

{Project is less than 100 Cr.so JV is not allowed}

Part II

Scope of Project

ARTICLE 2

SCOPE OF THE PROJECT

2.1 Scope of the Project

Under this Agreement, the scope of the Project (the "**Scope of the Project**") shall mean and include:

(a) construction of the Project on the Site set forth in Schedule-A and as specified in Schedule-B together with provision of Project Facilities as specified in Schedule-C, and in conformity with the Specifications and Standards set forth in Schedule-D;

(b) maintenance of the Project in accordance with the provisions of this Agreement and in conformity with the requirements set forth in Schedule-E; and

(c) performance and fulfilment of all other obligations of the Contractor in accordance with the provisions of this Agreement and matters incidental thereto or necessary for the performance of any or all of the obligations of the Contractor under this Agreement.

ARTICLE 3

OBLIGATIONS OF THE CONTRACTOR

3.1 Obligations of the Contractor

3.1.1 Subject to and on the terms and conditions of this Agreement, the Contractor shall undertake the survey, investigation, design, engineering, procurement, construction, and maintenance of the Project and observe, fulfil, comply with and perform all its obligations set out in this Agreement or arising hereunder.

3.1.2 The Contractor shall comply with all Applicable Laws and Applicable Permits (including renewals as required) in the performance of its obligations under this Agreement.

3.1.3 Subject to the provisions of Clauses 3.1.1 and 3.1.2, the Contractor shall discharge its obligations in accordance with Good Industry Practice and as a reasonable and prudent person.

3.1.4 The Contractor shall remedy any and all loss or damage to the Project from the Appointed Date until the end of the Construction Period at the Contractor's cost, save and except to the extent that any such loss or damage shall have arisen from any default or neglect of the Authority.

3.1.5 The Contractor shall remedy any and all loss or damage to the Project during the Defects Liability Period at the Contractor's cost to the extent that such loss or damage shall have arisen out of the reasons specified in Clause 17.3.

3.1.6 The Contractor shall remedy any and all loss or damage to the Project during the Maintenance Period at the Contractor's cost, including those stated in Clause 14.1.2, save and except to the extent that any such loss or damage shall have arisen on account of any default or neglect of the Authority or on account of a Force Majeure Event.

3.1.7 The Contractor shall, at its own cost and expense, in addition to and not in derogation of its obligations elsewhere set out in this Agreement:

(a) make, or cause to be made, necessary applications to the relevant Government Instrumentalities with such particulars and details as may be required for obtaining Applicable Permits set forth in Schedule-F and obtain and keep in force and effect such Applicable Permits in conformity with the Applicable Laws;

(b) procure, as required, the appropriate proprietary rights, licences, agreements and permissions for Materials, methods, processes and systems used or incorporated into the Project ;

(c) make reasonable efforts to maintain harmony and good industrial relations among the personnel employed by it or its Sub-contractors in connection with the performance of its obligations under this Agreement;

(d) ensure and procure that its Sub-contractors comply with all Applicable Permits and Applicable Laws in the performance by them of any of the Contractor's obligations under this Agreement;

(e) not do or omit to do any act, deed or thing which may in any manner be violative of any of the provisions of this Agreement;

(f) support, cooperate with and facilitate the Authority in the implementation and operation of the Project in accordance with the provisions of this Agreement;

(g) ensure that the Contractor and its Sub-contractors comply with the safety and welfare measures for labour in accordance with the Applicable Laws and Good Industry Practice;

(h) keep, on the Site, a copy of this Agreement, publications named in this Agreement, the Drawings, Documents relating to the Project, and Change of Scope Orders and other communications given under this Agreement. The Authority's Engineer and its authorised personnel shall have the right of access to all these documents at all reasonable times;

(i) cooperate with other contractors employed by the Authority and personnel of any public authority; and

(j) not interfere unnecessarily or improperly with the convenience of the public, or the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Authority or of others.

3.1.8 The Contractor shall undertake all necessary superintendence to plan, arrange, direct, manage, inspect and test the Works.

3.2 Obligations relating to sub-contracts and any other agreements

3.2.1 The Contractor shall not sub-contract any Works in more than **49% (forty nine per cent)** of the total length of the Project and shall carry out Works directly under its own supervision and through its own personnel and equipment in **at least 51% (fifty one per cent)** of the total length of the Project Provided, however, that in respect of the Works carried out directly by the Contractor, it may enter into contracts for the supply and installation of Materials, Plant, equipment, road furniture, safety devices and labour, as the case may be, for such Works. For the avoidance of doubt, the Parties agree that the Contractor may sub-divide the aforesaid length of **51% (fifty one per cent)** in no more than 5 (five) sections of the Project. The Parties further agree that all obligations and liabilities under this Agreement for the entire project shall at all times remain with the Contractor.

3.2.2. In the event any sub-contract for Works, or the aggregate of such sub-contracts with any Sub-contractor, exceeds 5% (five percent) of the Contract Price, the Contractor shall communicate the name and particulars, including the relevant experience of the sub-

contractor, to the Authority prior to entering into any such sub-contract. The Authority shall examine the particulars of the sub-contractor from the national security and public interest perspective and may require the Contractor, no later than 15 (fifteen) business days from the date of receiving the communication from the Contractor, not to proceed with the sub-contract, and the Contractor shall comply therewith.

3.2.3 In the event any sub-contract referred to in Clause 3.2.2 relates to a sub-contractor who has, over the preceding 3 (three) years, not undertaken at least one work of a similar nature with a contract value exceeding 40% (forty per cent) of the value of the sub-contract to be awarded hereunder and received payments in respect thereof for an amount equal to at least such 40% (forty per cent), the Authority may, no later than 15 (fifteen) business days from the date of receiving the communication from the Contractor, require the Contractor not to proceed with such sub-contract, and the Contractor shall comply therewith.

3.2.4 It is expressly agreed that the Contractor shall, at all times, be responsible and liable for all its obligations under this Agreement notwithstanding anything contained in the agreements with its Sub-contractors or any other agreement that may be entered into by the Contractor, and no default under any such agreement shall excuse the Contractor from its obligations or liability hereunder.

3.3 Employment of foreign nationals

The Contractor acknowledges, agrees and undertakes that employment of foreign personnel by the Contractor and/or its Sub-contractors and their sub-contractors shall be subject to grant of requisite regulatory permits and approvals including employment/residential visas and work permits, if any required, and the obligation to apply for and obtain the same shall and will always be of the Contractor. Notwithstanding anything to the contrary contained in this Agreement, refusal of or inability to obtain any such permits and approvals by the Contractor or any of its Sub-contractors or their sub-contractors shall not constitute Force Majeure Event, and shall not in any manner excuse the Contractor from the performance and discharge of its obligations and liabilities under this Agreement.

3.4 Contractor's personnel

3.4.1 The Contractor shall ensure that the personnel engaged by it or by its Sub-contractors in the performance of its obligations under this Agreement are at all times appropriately qualified, skilled and experienced in their respective functions in conformity with Good Industry Practice. The Contractor will try to hire at least 10% trained workmen as per NSQF. If necessary the requisite workmen may be got trained through authorized training centres of Directorate General of Training (DGT). The Contractor will organize training at project site/sites for the trainees as and when required as per the training schedule finalized in consultation with the training centres, and the Project Director. The trainees are to be paid stipend (subject to maximum limit of Rs. 15,000/- per person) on the basis of minimum wages to compensate for loss of income during the training period. The

expenditure on training and stipend to be paid to the trainees shall be borne by Authority.

3.4.2 The Authority's Engineer may, for reasons to be specified in writing, direct the Contractor to remove any member of the Contractor's or Sub-contractor's personnel. Provided that any such direction issued by the Authority's Engineer shall specify the reasons for the removal of such person.

3.4.3 The Contractor shall on receiving such a direction from the Authority's Engineer order for the removal of such person or persons with immediate effect. It shall be the duty of the Contractor to ensure that such persons are evicted from the Site within 10 (ten) days of any such direction being issued in pursuance of Clause 3.4.2. The Contractor shall further ensure that such persons have no further connection with the Works or Maintenance under this Agreement. The Contractor shall then appoint (or cause to be appointed) a replacement.

3.5 Advertisement on Project

The Project or any part thereof shall not be used in any manner to advertise any commercial product or services.

3.6 Contractor's care of the Works

The Contractor shall bear full risk in and take full responsibility for the care of the Works, and of the Materials, goods and equipment for incorporation therein, from the Appointed Date until the date of Provisional Certificate (with respect to the Works completed prior to the issuance of the Provisional Certificate) and/or Completion Certificate (with respect to the Works referred to in the Punch List), save and except to the extent that any such loss or damage shall have arisen from any default or neglect of the Authority.

3.7 Electricity, water and other services

The Contractor shall be responsible for procuring of all power, water and other services that it may require.

3.8 Unforeseeable difficulties

Except as otherwise stated in the Agreement:

(a) the Contractor accepts complete responsibility for having foreseen all difficulties and costs of successfully completing the Works;

(b) the Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs; and

(c) the Scheduled Completion Date shall not be adjusted to take account of any unforeseen difficulties or costs.

ARTICLE 4

OBLIGATIONS OF THE AUTHORITY

4.1 Obligations of the Authority

4.1.1 The Authority shall, at its own cost and expense, undertake, comply with and perform all its obligations set out in this Agreement or arising hereunder.

4.1.2 The Authority shall be responsible for the correctness of the Scope of the Project, Project Facilities, Specifications and Standards and the criteria for testing of the completed Works.

4.1.3 The Authority shall provide to the Contractor:

(a) upon receiving the Performance Security under Clause 7.1.1, the Right of Way in accordance with the provisions of Clauses 8.2 and 8.3, within a period of 30 (thirty) days from the date of this Agreement, on no less than 90% (ninety per cent) of the total length of the Project ;

(b) Deleted

(c) all environmental clearances as required under Clause 4.3.

4.1.4 Delay in providing the Right of Way or approval of GAD by railway authorities, as the case may be, in accordance with the provisions of Clause 4.1.3 shall entitle the Contractor to Damages in a sum calculated in accordance with the provisions of Clause 8.3 of this Agreement and Time Extension in accordance with the provisions of Clause 10.5 of this Agreement. For the avoidance of doubt, the Parties agree that the Damages for delay in approval of GAD by the railway authorities for a particular road over-bridge/under-bridge shall be deemed to be equal to the Damages payable under the provisions of Clause 8.3 for delay in providing Right of Way for a length of 2 (two) kilometre for each such road over-bridge/under-bridge.

4.1.5 Notwithstanding anything to the contrary contained in this Agreement, the Parties expressly agree that the aggregate Damages payable under Clauses 4.1.4, 8.3 and 9.2 shall not exceed 1% (one per cent) of the Contract Price. For the avoidance of doubt, the Damages payable by the Authority under the aforesaid Clauses shall not be additive if they arise concurrently from more than one cause but relate to the same part of the Project .

Both the parties agree that payment of these Damages shall be full and final settlement of all claims of the Contractor and such compensation shall be the sole remedy against delays of the Authority and both parties further agree this as final cure against delays of the Authority.

4.1.6 The Authority agrees to provide support to the Contractor and undertakes to observe, comply with and perform, subject to and in accordance with the provisions of this Agreement and the Applicable Laws, the following:

(a) upon written request from the Contractor, and subject to the Contractor complying with Applicable Laws, provide reasonable support to the Contractor in procuring Applicable Permits required from any Government Instrumentality for implementation of the Project;

(b) upon written request from the Contractor, provide reasonable assistance to the Contractor in obtaining access to all necessary infrastructure facilities and utilities, including water and electricity at rates and on terms no less favourable than those generally available to commercial customers receiving substantially equivalent services;

(c) procure that no barriers that would have a material adverse effect on the works are erected or placed on or about the Project by any Government Instrumentality or persons claiming through or under it, except for reasons of Emergency, national security, law and order or collection of inter-state taxes;

(d) not do or omit to do any act, deed or thing which may in any manner be violative of any of the provisions of this Agreement;

(e) support, cooperate with and facilitate the Contractor in the implementation of the Project in accordance with the provisions of this Agreement; and

(f) upon written request from the Contractor and subject to the provisions of Clause 3.3, provide reasonable assistance to the Contractor and any expatriate personnel of the Contractor or its Sub-contractors to obtain applicable visas and work permits for the purposes of discharge by the Contractor or its Sub-contractors of their obligations under this Agreement and the agreements with the Sub-contractors.

4.2 Maintenance obligations prior to the Appointed Date

The Authority shall, prior to the Appointed Date, maintain the Project , at its own cost and expense, so that its traffic worthiness and safety are at no time materially inferior as compared to its condition 10 (ten) days prior to the last date for submission of the Bid, and in the event of any material deterioration or damage other than normal wear and tear, undertake repair thereof. For the avoidance of doubt, the Authority shall undertake only routine maintenance prior to the Appointed Date, and it shall undertake special repairs only in the event of excessive deterioration or damage caused due to unforeseen events such as floods or earthquake.

4.3 Environmental Clearances

The Authority represents and warrants that the environmental clearances required for

construction of the Project shall be procured by the Authority prior to the date of issue of LOA. For the avoidance of doubt, the present status of environmental clearances is specified in Schedule-A.

ARTICLE 5
REPRESENTATIONS AND WARRANTIES

5.1 Representations and warranties of the Contractor

The Contractor represents and warrants to the Authority that:

(a) it is duly organised and validly existing under the laws of India, and has full power and authority to execute and perform its obligations under this Agreement and to carry out the transactions contemplated hereby;

(b) it has taken all necessary corporate and/or other actions under Applicable Laws to authorise the execution and delivery of this Agreement and to validly exercise its rights and perform its obligations under this Agreement;

(c) this Agreement constitutes its legal, valid and binding obligation, enforceable against it in accordance with the terms hereof, and its obligations under this Agreement will be legally valid, binding and enforceable obligations against it in accordance with the terms hereof;

(d) it is subject to the laws of India, and hereby expressly and irrevocably waives any immunity in any jurisdiction in respect of this Agreement or matters arising thereunder including any obligation, liability or responsibility hereunder;

(e) the information furnished in the Bid and as updated on or before the date of this Agreement is true and accurate in all respects as on the date of this Agreement;

(f) the execution, delivery and performance of this Agreement will not conflict with, result in the breach of, constitute a default under, or accelerate performance required by any of the terms of its memorandum and articles of association or any Applicable Laws or any covenant, contract, agreement, arrangement, understanding, decree or order to which it is a party or by which it or any of its properties or assets is bound or affected;

(g) there are no actions, suits, proceedings, or investigations pending or, to its knowledge, threatened against it at law or in equity before any court or before any other judicial, quasi-judicial or other authority, the outcome of which may result in the breach of this Agreement or which individually or in the aggregate may result in any material impairment of its ability to perform any of its obligations under this Agreement;

(h) it has no knowledge of any violation or default with respect to any order, writ, injunction or decree of any court or any legally binding order of any Government Instrumentality which may result in any material adverse effect on its ability to perform its obligations under this Agreement and no fact or circumstance exists

which may give rise to such proceedings that would adversely affect the performance of its obligations under this Agreement;

(i) it has complied with Applicable Laws in all material respects and has not been subject to any fines, penalties, injunctive relief or any other civil or criminal liabilities which in the aggregate have or may have a material adverse effect on its ability to perform its obligations under this Agreement;

(j) no representation or warranty by it contained herein or in any other document furnished by it to the Authority or to any Government Instrumentality in relation to Applicable Permits contains or will contain any untrue or misleading statement of material fact or omits or will omit to state a material fact necessary to make such representation or warranty not misleading;

(k) no sums, in cash or kind, have been paid or will be paid, by it or on its behalf, to any person by way of fees, commission or otherwise for securing the contract or entering into this Agreement or for influencing or attempting to influence any officer or employee of the Authority in connection therewith;

(l) all information provided by the {selected bidder} in response to the Request for Qualification and Request for Proposals or otherwise, is to the best of its knowledge and belief, true and accurate in all material respects; and

(m) nothing contained in this Agreement shall create any contractual relationship or obligation between the Authority and any Sub-contractors, designers, consultants or agents of the Contractor.

5.2 Representations and warranties of the Authority

The Authority represents and warrants to the Contractor that:

(a) it has full power and authority to execute, deliver and perform its obligations under this Agreement and to carry out the transactions contemplated herein and that it has taken all actions necessary to execute this Agreement, exercise its rights and perform its obligations, under this Agreement;

(b) it has taken all necessary actions under the Applicable Laws to authorise the execution, delivery and performance of this Agreement;

(c) it has the financial standing and capacity to perform its obligations under this Agreement;

(d) this Agreement constitutes a legal, valid and binding obligation enforceable against it in accordance with the terms hereof;

(e) it has no knowledge of any violation or default with respect to any order, writ, injunction or any decree of any court or any legally binding order of any Government Instrumentality which may result in any material adverse effect on the Authority's ability to perform its obligations under this Agreement;

(f) it has complied with Applicable Laws in all material respects;

(g) it has good and valid right to the Site and has the power and authority to grant the Right of Way in respect thereof to the Contractor; and

(h) it has procured Right of Way and environment clearances such that the Contractor can commence construction forthwith on 90% (ninety per cent) of the total length of the Project.

5.3 Disclosure

In the event that any occurrence or circumstance comes to the attention of either Party that renders any of its aforesaid representations or warranties untrue or incorrect, such Party shall immediately notify the other Party of the same. Such notification shall not have the effect of remedying any breach of the representation or warranty that has been found to be untrue or incorrect nor shall it adversely affect or waive any obligation of either Party under this Agreement.

ARTICLE 6

DISCLAIMER

6.1 Disclaimer

6.1.1 The Contractor acknowledges that prior to the execution of this Agreement, the Contractor has, after a complete and careful examination, made an independent evaluation of the Request for Proposal, Scope of the Project, Specifications and Standards of design, construction and maintenance, Site, local conditions, physical qualities of ground, subsoil and geology, traffic volumes, suitability and availability of access routes to the Site and all information provided by the Authority or obtained, procured or gathered otherwise, and has determined to its satisfaction the accuracy or otherwise thereof and the nature and extent of difficulties, risks and hazards as are likely to arise or may be faced by it in the course of performance of its obligations hereunder. Save as provided in Clause 4.1.2 and Clause 5.2, the Authority makes no representation whatsoever, express, implicit or otherwise, regarding the accuracy, adequacy, correctness, reliability and/or completeness of any assessment, assumptions, statement or information provided by it and the Contractor confirms that it shall have no claim whatsoever against the Authority in this regard.

6.1.2 The Contractor acknowledges and hereby accepts to have satisfied itself as to the correctness and sufficiency of the Contract Price.

6.1.3 The Contractor acknowledges and hereby accepts the risk of inadequacy, mistake or error in or relating to any of the matters set forth in Clause 6.1.1 above and hereby acknowledges and agrees that the Authority shall not be liable for the same in any manner whatsoever to the Contractor, or any person claiming through or under any of them, and shall not lead to any adjustment of Contract Price or Scheduled Completion Date.

6.1.4 The Parties agree that any mistake or error in or relating to any of the matters set forth in Clause 6.1.1 above shall not vitiate this Agreement, or render it voidable.

6.1.5 In the event that either Party becomes aware of any mistake or error relating to any of the matters set forth in Clause 6.1.1 above, that Party shall immediately notify the other Party, specifying the mistake or error.

6.1.6 Except as otherwise provided in this Agreement, all risks relating to the Project shall be borne by the Contractor; and the Authority shall not be liable in any manner for such risks or the consequences thereof.

Part III

Construction and Maintenance

ARTICLE 7

PERFORMANCE SECURITY

7.1 Performance Security

7.1.1 The Contractor shall, for the performance of its obligations hereunder during the Construction Period, provide to the Authority, within 10 (ten) days of the date of this Agreement, an irrevocable and unconditional guarantee from a Bank in the form set forth in Schedule-G (the "Performance Security") for an amount equal to 5% (five percent) of the Contract Price. The Performance Security shall be valid until 60 (sixty) days after the Defects Liability Period. Until such time the Performance Security is provided by the Contractor pursuant hereto and the same comes into effect, the Bid Security shall remain in force and effect, and upon such provision of the Performance Security, the Authority shall release the Bid Security to the Contractor.

The Contractor shall alongwith the Performance Security provide to the Authority an irrevocable and unconditional guarantee from a Bank for a sum equivalent to Rs. 1.08 crore (Rupees one crore and eight lakhs) in the form set forth in Schedule-G (the "Additional Performance Security"), to be modified, mutatis mutandis, for this purpose as security to the Authority if the Bid Price offered by the Contractor is lower by more than 10% with respect to the Estimated Project Cost. Additional Performance Security shall be calculated as under:

(i) If the bid price offered by the Contractor is lower than 10% but upto 20% of the Estimated Project Cost, then the Additional Performance Security shall be calculated @20% of the difference in the (a) Estimated Project Cost (as mentioned in RFP)-10% of the Estimated Project Cost and (b) the Bid Price offered by the selected Bidder.

(ii) If the bid price offered by the Contractor is lower than 20% of the Estimated Project Cost, then the Additional Performance Security shall be calculated @30% of the difference in the (a) Estimated Project Cost (as mentioned in RFP)-10% of the Estimated Project Cost and (b) the Bid Price offered by the selected Bidder.

(iii) The Additional Performance Security shall be valid until 28 (twenty eight) days after the issue of Completion Certificate under Article 12 of this Agreement.

(iv) The Additional Performance Security shall not be treated as part of Performance Security.

7.1.2 Notwithstanding anything to the contrary contained in this Agreement, the Parties agree that in the event of failure of the Contractor to provide the Performance Security in accordance with the provisions of Clause 7.1.1 and within the time specified therein or such extended period as may be provided by the Authority, in accordance with the provisions of Clause 7.1.3, the Authority may encash the Bid Security and appropriate the proceeds thereof as Damages, and thereupon all rights, privileges, claims and entitlements of the Contractor under or arising out of this Agreement shall be deemed to have been waived by, and to have ceased with the concurrence of the Contractor, and this

Agreement shall be deemed to have been terminated by mutual agreement of the Parties.

7.1.3 In the event the Contractor fails to provide the Performance Security within 10 (ten) days of this Agreement, it may seek extension of time for a period not exceeding 30 (Thirty) days on payment of Damages for such extended period in a sum calculated at the rate of 0.01% (zero point zero one per cent) of the Contract Price for each day until the Performance Security is provided. For the avoidance of doubt the agreement shall be deemed to be terminated on expiry of additional 30 days time period and Bid security shall be encashed by the Authority.

7.2 Extension of Performance Security

The Contractor may initially provide the Performance Security for a period of 2 (two) years; provided that it shall procure the extension of the validity of the Performance Security, as necessary, at least 2 (two) months prior to the date of expiry thereof. Upon the Contractor providing an extended Performance Security, the previous Performance Security shall be deemed to be released and the Authority shall return the same to the Contractor within a period of 7 (seven) business days from the date of submission of the extended Performance Security.

7.3 Appropriation of Performance Security

7.3.1 Upon occurrence of a Contractor's Default, the Authority shall, without prejudice to its other rights and remedies hereunder or in law, be entitled to encash and appropriate the relevant amounts from the Performance Security as Damages for such Contractor's Default.

7.3.2 Upon such encashment and appropriation from the Performance Security, the Contractor shall, within 30 (thirty) days thereof, replenish, in case of partial appropriation, to its original level the Performance Security, and in case of appropriation of the entire Performance Security provide a fresh Performance Security, as the case may be, and the Contractor shall, within the time so granted, replenish or furnish fresh Performance Security as aforesaid failing which the Authority shall be entitled to terminate the Agreement in accordance with Article 23. Upon replenishment or furnishing of a fresh Performance Security, as the case may be, as aforesaid, the Contractor shall be entitled to an additional Cure Period of 30 (thirty) days for remedying the Contractor's Default, and in the event of the Contractor not curing its default within such Cure Period, the Authority shall be entitled to encash and appropriate such Performance Security as Damages, and to terminate this Agreement in accordance with Article 23.

7.3.3 The Additional Performance Security shall be encashed, in case the Contractor cannot achieve the Milestones –II/III/IV … within the prescribed period as per this Agreement due to the fault of the Contractor.

7.4 Release of Performance Security

7.4.1 The Authority shall return the Performance Security to the Contractor within 60 (sixty)

days of the later of the expiry of the Maintenance Period or the Defects Liability Period under this Agreement. Notwithstanding the aforesaid, the Parties agree that the Authority shall not be obliged to release the Performance Security until all Defects identified during the Defects Liability Period have been rectified.

7.4.2 The Authority shall return the Additional Performance Security to the Contractor within 28 (twenty eight) days from the date of issue of Completion Certificate under Article 12 of this Agreement.

7.5 Retention Money

7.5.1 From every payment for Works due to the Contractor in accordance with the provisions of Clause 19.5, the Authority shall deduct 6% (six per cent) thereof as guarantee money for performance of the obligations of the Contractor during the Construction Period (the "**Retention Money**") subject to the condition that the maximum amount of Retention Money shall not exceed 5% (five per cent) of the Contract Price.

7.5.2 Upon occurrence of a Contractor's Default, the Authority shall, without prejudice to its other rights and remedies hereunder or in law, be entitled to appropriate the relevant amounts from the Retention Money as Damages for such Contractor's Default.

7.5.3 The Contractor may, upon furnishing an irrevocable and unconditional bank guarantee substantially in the form provided at Annex-II of Schedule-G, require the Authority to refund the Retention Money deducted by the Authority under the provisions of Clause 7.5.1. Provided that the refund hereunder shall be made in tranches of not less than 1% (one per cent) of the Contract Price.

7.5.4 Within 15 (fifteen) days of the date of issue of the Completion Certificate, the Authority shall discharge the bank guarantees furnished by the Contractor under the provisions of Clause 7.5.3 and refund the balance of Retention Money remaining with the Authority after adjusting the amounts appropriated under the provisions of Clause 7.5.2 and the amounts refunded under the provisions of Clause 7.5.3.

7.5.5 The Parties agree that in the event of Termination of this Agreement, the Retention Money and the bank guarantees specified in this Clause 7.5 shall be treated as if they are Performance Security and shall be reckoned as such for the purposes of Termination Payment under Clause 23.6.

ARTICLE 8
RIGHT OF WAY

8.1 The Site

The site of the Project (the "**Site**") shall comprise the site described in Schedule-A in respect of which the Right of Way shall be provided by the Authority to the Contractor. The Authority shall be responsible for:

(a) acquiring and providing Right of Way on the Site in accordance with the alignment finalised by the Authority, free from all encroachments and encumbrances, and free access thereto for the execution of this Agreement; and

(b) obtaining licences and permits for environment clearance for the Project .

8.2 Procurement of the Site

8.2.1 The Authority Representative and the Contractor shall, within 30 (thirty) days of the date of this Agreement, inspect the Site and prepare a memorandum containing an inventory of the Site including the vacant and unencumbered land, buildings, structures, road works, trees and any other immovable property on or attached to the Site. Subject to the provisions of Clause 8.2.3, such memorandum shall have appended thereto an appendix (the "**Appendix**") specifying in reasonable detail those parts of the Site to which vacant access and Right of Way has not been given to the Contractor. Signing of the memorandum, in two counterparts (each of which shall constitute an original), by the authorised representatives of the Parties shall be deemed to constitute a valid evidence of giving the Right of Way to the Contractor for discharging its obligations under and in accordance with the provisions of this Agreement and for no other purpose whatsoever.

Whenever the Authority is ready to hand over any part or parts of the Site included in the Appendix, it shall inform the Contractor, by notice, the proposed date and time such of handing over. The Authority Representative and the Contractor shall, on the date so notified, inspect the specified parts of the Site, and prepare a memorandum containing an inventory of the vacant and unencumbered land, buildings, structures, road works, trees and any other immovable property on or attached to the Site so handed over. Signing of the memorandum, in two counterparts (each of which shall constitute an original), by the authorised representatives of the Parties shall be deemed to constitute a valid evidence of giving the relevant Right of Way to the Contractor.

8.2.2 The Authority shall provide the Right of Way to the Contractor in respect of all land included in the Appendix by the date specified in Schedule-A for those parts of the Site referred to therein, or no later than 90 (ninety) days of the Appointed Date for those parts of the Site which have not been specified in Schedule-A, and in the event of delay for any reason other than Force Majeure or breach of this Agreement by the Contractor, it shall pay to the Contractor, Damages in a sum calculated in accordance with Clause 8.3.

8.2.3 Notwithstanding anything to the contrary contained in this Clause 8.2, the Authority shall specify the parts of the Site, if any, for which Right of Way shall be provided to the Contractor on the dates specified in Schedule-A. Such parts shall also be included in the Appendix prepared in pursuance of Clause 8.2.1. For the avoidance of doubt, the Parties expressly agree that the Appendix shall in no event contain sections of the Project the cumulative length of which exceeds 10% (ten per cent) of the total length of the Project.

8.3 Damages for delay in handing over the Site

8.3.1 In the event the Right of Way to any part of the Site is not provided by the Authority on or before the date(s) specified in Clause 8.2 for any reason other than Force Majeure or breach of this Agreement by the Contractor, the Authority shall pay Damages to the Contractor in a sum calculated in accordance with the following formula for and in respect of those parts of the Site to which the Right of Way has not been provided:

Amount of Damages in Rs. per day per metre = 0.05 x C x 1/L x 1/N

Where

C = the Contract Price; L = length of the Project in metres; and

N = Completion period in days (Appointed Date to Scheduled Completion Date)

In the event that any Damages are due and payable to the Contractor under the provisions of this Clause 8.3.1 for delay in providing the Right of Way, the Contractor shall, subject to the provisions of Clause 10.5, be entitled to Time Extension equal to the period for which the Damages have become due and payable under this Clause 8.3.1, save and except that:

(a) if any delays involve time overlaps, the overlaps shall not be additive; and

(b) such Time Extension shall be restricted only to the Works which are affected by the delay in providing the Right of Way.

For the avoidance of doubt, the Parties expressly agree that the Damages specified hereunder and the Time Extension specified in Clause 10.5 shall be restricted only to failure of the Authority to provide the Right of Way for and in respect of the width of the roadway, its embankment and a parallel working strip at least 3 (three) metres wide.

8.3.2 Notwithstanding anything to the contrary contained in this Agreement, the Contractor expressly agrees that Works on all parts of the Site for which Right of Way is granted within 90 (ninety) days of the Appointed Date, or with respect to the parts of the Site provided in Schedule-A, no later than the date(s) specified therein, as the case may be, shall be completed before the Scheduled Completion Date and shall not qualify for any Time Extension under the provisions of Clause 8.3.1.

8.3.3 Notwithstanding anything to the contrary contained in this Agreement, the Authority may at any time withdraw any Works forming part of this Agreement, subject to such Works not exceeding an aggregate value, such value to be determined in accordance with Schedule-H, equal to 10(ten) percent of the Contract Price.

Provided that if any Works cannot be undertaken within the municipal limits of a town or within any area falling in a reserved forest or wildlife sanctuary, as the case may be, because the requisite clearances or approvals for commencing construction of Works therein have not been given within 240 (two hundred and forty) days of the Appointed date, the affected Works shall be deemed to be withdrawn under the provisions of this Clause 8.3.3 unless the Parties agree to the contrary, and such Works shall not be computed for the purposes of the aforesaid ceiling of 10% (ten per cent) hereunder.

8.3.4 In the event of withdrawal of Works under Clause 8.3.3, the Contract Price shall be reduced by an amount equal to 90 (ninety) per cent of the value of the Works withdrawn and the Contractor shall not be entitled to any other compensation or Damages for the withdrawal of Works.

Provided that if any Works are withdrawn after commencement of the Construction of such works, the Authority shall pay to the Contractor 110% (one hundred and ten per cent) of the fair value of the work done, as assessed by the Authority's Engineer:

8.4 Site to be free from Encumbrances

Subject to the provisions of Clause 8.2, the Site shall be made available by the Authority to the Contractor pursuant hereto free from all Encumbrances and occupations and without the Contractor being required to make any payment to the Authority on account of any costs, compensation, expenses and charges for the acquisition and use of such Site for the duration of the Project Completion Schedule. For the avoidance of doubt, it is agreed that the existing rights of way, easements, privileges, liberties and appurtenances to the Site shall not be deemed to be Encumbrances. It is further agreed that, unless otherwise specified in this Agreement, the Contractor accepts and undertakes to bear any and all risks arising out of the inadequacy or physical condition of the Site.

8.5 Protection of Site from encroachments

On and after signing the memorandum and/or subsequent memorandum referred to in Clause 8.2.1, and until the issue of the Completion Certificate, the Contractor shall maintain a round-the-clock vigil over the Site and shall ensure and procure that no encroachment thereon takes place. During the Construction Period, the Contractor shall protect the Site from any and all occupations, encroachments or Encumbrances, and shall not place or create nor permit any Sub-contractor or other person claiming through or under the Agreement to place or create any Encumbrance or security threat over all or any part of the Site or the Project Assets, or on any rights of the Contractor therein or under this Agreement, save and except as otherwise expressly set forth in this Agreement.

In the event of any encroachment or occupation on any part of the Site, the Contractor shall report such encroachment or occupation forthwith to the Authority and undertake its removal at its own cost and expenses.

8.6 Special/temporary Right of Way

The Contractor shall bear all costs and charges for any special or temporary right of way required by it in connection with access to the Site. The Contractor shall obtain at its cost such facilities on or outside the Site as may be required by it for the purposes of the Project and the performance of its obligations under this Agreement.

8.7 Access to the Authority and the Authority's Engineer

8.7.1 The Right of Way given to the Contractor hereunder shall always be subject to the right of access of the Authority and the Authority's Engineer and their employees and agents for inspection, viewing and exercise of their rights and performance of their obligations under this Agreement.

8.7.2 The Contractor shall ensure, subject to all relevant safety procedures, that the Authority has un-restricted access to the Site during any emergency situation, as decided by the Authority's Engineer.

8.8 Geological and archaeological finds

It is expressly agreed that mining, geological or archaeological rights do not form part of this Agreement with the Contractor for the Works, and the Contractor hereby acknowledges that it shall not have any mining rights or interest in the underlying minerals, fossils, antiquities, structures or other remnants or things either of particular geological or archaeological interest and that such rights, interest and property on or under the Site shall vest in and belong to the Authority or the concerned Government Instrumentality. The Contractor shall take all reasonable precautions to prevent its workmen or any other person from removing or damaging such interest or property and shall inform the Authority forthwith of the discovery thereof and comply with such instructions as the concerned Government Instrumentality may reasonably give for the removal of such property. For the avoidance of doubt, it is agreed that any reasonable expenses incurred by the Contractor hereunder shall be reimbursed by the Authority. It is also agreed that the Authority shall procure that the instructions hereunder are issued by the concerned Government Instrumentality within a reasonable period.

ARTICLE 9

UTILITIES AND TREES

9.1 Existing utilities and roads

Notwithstanding anything to the contrary contained herein, the Contractor shall ensure that the respective entities owning the existing roads, right of way, level crossings, structures, or utilities on, under or above the Site are enabled by it to keep them in continuous satisfactory use, if necessary, by providing suitable temporary diversions with the authority of the controlling body of that road, right of way or utility.

9.2 Shifting of obstructing utilities

The Contractor shall, in accordance with Applicable Laws and with assistance of the Authority, cause shifting of any utility (including electric lines, water pipes and telephone cables) to an appropriate location or alignment, if such utility or obstruction adversely affects the execution of Works or Maintenance of the Project in accordance with this Agreement. The actual cost of such shifting, as approved and communicated by the entity owning the utility, shall be paid by the Contractor. In the event of any delay in such shifting by the entity owning the utility beyond a period of 180 (one hundred and eighty) days from the date of notice by the Contractor to the entity owning the utility and to the Authority, the Contractor shall be entitled to Damages in a sum calculated in accordance with the formula specified in Clause 8.3.1 for the period of delay, and to Time Extension in accordance with Clause 10.5 for and in respect of the part(s) of the Works affected by such delay; provided that if the delays involve any time overlaps, the overlaps shall not be additive.

9.3 New utilities

9.3.1 The Contractor shall allow, subject to such conditions as the Authority may specify, access to, and use of the Site for laying telephone lines, water pipes, electric cables or other public utilities. Where such access or use causes any financial loss to the Contractor, it may require the user of the Site to pay compensation or damages as per Applicable Laws. For the avoidance of doubt, it is agreed that use of the Site under this Clause 9.3 shall not in any manner relieve the Contractor of its obligation to construct and maintain the Project in accordance with this Agreement and any damage caused by such use shall be restored forthwith at the cost of the Authority.

9.3.2 The Authority may, by notice, require the Contractor to connect any adjoining road to the Project, and the connecting portion thereof falling within the Site shall be constructed by the Contractor at the Authority's cost in accordance with Article 10.

9.3.3 The Authority may by notice require the Contractor to connect, through a paved road, any adjoining service station, hotel, motel or any other public facility or amenity to the Project, whereupon the connecting portion thereof that falls within the Site shall be

constructed by the Contractor on payment of the cost. The cost to be paid by the Authority to the Contractor shall be determined by the Authority's Engineer. For the avoidance of doubt, in the event such road is to be constructed for the benefit of any entity, the Authority may require such entity to make an advance deposit with the Contractor or the Authority, as the case may be, of an amount equal to the estimated cost as determined by the Authority's Engineer and such advance shall be adjusted against the cost of construction as determined by the Authority's Engineer hereunder.

9.3.4 In the event the construction of any Works is affected by a new utility or works undertaken in accordance with this Clause 9.3, the Contractor shall be entitled to a reasonable Time Extension as determined by the Authority's Engineer.

9.4 Felling of trees

The Authority shall assist the Contractor in obtaining the Applicable Permits for felling of trees to be identified by the Authority for this purpose if and only if such trees cause a Material Adverse Effect on the construction or maintenance of the Project. The cost of such felling shall not be borne by the Authority and in the event of any delay in felling thereof for reasons beyond the control of the Contractor; it shall be excused for failure to perform any of its obligations hereunder if such failure is a direct consequence of delay in the felling of trees. The Parties hereto agree that the felled trees shall be deemed to be owned by the Authority and shall be disposed in such manner and subject to such conditions as the Authority may in its sole discretion deem appropriate. For the avoidance of doubt, the Parties agree that if any felling of trees hereunder is in a forest area, the Applicable Permit thereof shall be procured by the Authority within the time specified in the Agreement.

ARTICLE 10

DESIGN AND CONSTRUCTION OF THE PROJECT

10.1 Obligations prior to commencement of Works

10.1.1 Within 20 (twenty) days of the Appointed Date, the Contractor shall:

(a) appoint its representative, duly authorised to deal with the Authority in respect of all matters under or arising out of or relating to this Agreement;

(b) appoint a design director (the "**Design Director**") who will head the Contractor's design unit and shall be responsible for surveys, investigations, collection of data, and preparation of preliminary and detailed designs;

(c) undertake and perform all such acts, deeds and things as may be necessary or required before commencement of Works under and in accordance with this Agreement, the Applicable Laws and Applicable Permits; and

(d) make its own arrangements for quarrying of materials needed for the Project under and in accordance with the Applicable Laws and Applicable Permits.

10.1.2 The Authority shall, within 30 (thirty) days of the date of this Agreement, appoint an engineer (the "**Authority's Engineer**") to discharge the functions and duties specified in this Agreement, and shall notify to the Contractor the name, address and the date of appointment of the Authority's Engineer forthwith.

10.1.3 Within 30 (thirty) days of the Appointed Date, the Contractor shall submit to the Authority and the Authority's Engineer a programme (the **"Programme")** for the Works, developed using networking techniques giving the following details:

Part I Contractor's organisation for the Project, the general methods and arrangements for design and construction, environmental management plan, Quality Assurance Plan including design quality plan, traffic management and safety plan covering safety of users and workers during construction, Contractor's key personnel and equipment.

Part II Programme for completion of all stages of construction given in Schedule-H and Project Milestones of the Works as specified in Project Completion Schedule set forth in Schedule-J. The Programme shall include:

(a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of design and stages of Works;

(b) the periods for reviews under Clause 10.2;

(c) the sequence and timing of inspections and tests specified in this Agreement.

The Contractor shall submit a revised programme whenever the previous programme is inconsistent with the actual progress or with the Contractor's obligations.

Part III Monthly cash flow forecast.

10.1.4 The Contractor shall compute, on the basis of the Drawings prepared in accordance with Clause 10.2.4, and provide to the Authority's Engineer, the length, area and numbers, as the case may be, in respect of the various items of work specified in Schedule-H and comprising the Scope of the Project. The Parties expressly agree that these details shall form the basis for estimating the interim payments for the Works in accordance with the provisions of Clause 19.3. For the avoidance of doubt, the sum of payments to be computed in respect of all the items of work shall not exceed the Contract Price, as may be adjusted in accordance with the provisions of this Agreement.

10.1.5 The Contractor shall appoint a safety consultant (the "**Safety Consultant**") to carry out safety audit at the design stage of the Project in accordance with the Applicable Laws and Good Industry Practice. The Safety Consultant shall be appointed after proposing to the Authority a panel of three names of qualified and experienced firms from whom the Authority may choose one to be the Safety Consultant. Provided, however, that if the panel is not acceptable to the Authority and the reasons for the same are furnished to the Contractor, the Contactor shall propose to the Authority a revised panel of three names from the firms empanelled as safety consultants by the Ministry of Road Transport and Highways for obtaining the consent of the Authority. The Contractor shall also obtain the consent of the Authority for the key personnel of the Safety Consultant who shall have adequate experience and qualifications in safety audit of the projects. The Authority shall, within 15 (fifteen) days of receiving a proposal from the Contractor hereunder, convey its decision, with reasons, to the Contractor, and if no such decision is conveyed within the said period, the Contractor may proceed with engaging of the Safety Consultant.

10.1.6 The safety audit pursuant to Clause 10.1.5 shall be carried out by the Safety Consultant in respect of all such design details that have a bearing on safety of Users as well as pedestrians and animals involved in or associated with accidents. The recommendations of the Safety Consultant shall be incorporated in the design of the Project and the Contractor shall forward to the Authority's Engineer a certificate to this effect together with the recommendations of the Safety Consultant. In the event that any works required by the Safety Consultant shall fall beyond the scope of Schedule-B, Schedule-C or Schedule-D, the Contractor shall make a report thereon and seek the instructions of the Authority for Change in Scope. For the avoidance of doubt, the Safety Consultant to be engaged by the Contractor shall be independent of the design and implementation team of the Contractor.

10.2 Design and Drawings

10.2.1 Design and Drawings shall be developed in conformity with the Specifications and Standards set forth in Schedule-D. In the event, the Contractor requires any relaxation in design standards due to restricted Right of Way in any section, the alternative design

criteria for such section shall be provided for review of the Authority's Engineer.

10.2.2 The Contractor shall appoint a proof check consultant (the "**Proof Consultant**") after proposing to the Authority a panel of three names of qualified and experienced firms from whom the Authority may choose one to be the Proof Consultant. Provided, however, that if the panel is not acceptable to the Authority and the reasons for the same are furnished to the Contractor, the Contactor shall propose to the Authority a revised panel of three names from the firms empanelled as proof consultants by the Ministry of Road Transport and Highways] for obtaining the consent of the Authority. The Contractor shall also obtain the consent of the Authority for two key personnel of the Proof Consultant who shall have adequate experience and qualifications in and bridges respectively. The Authority shall, within 15 (fifteen) days of receiving a proposal from the Contractor hereunder, convey its decision, with reasons, to the Contractor, and if no such decision is conveyed within the said period, the Contractor may proceed with engaging of the Proof Consultant.

10.2.3 The Proof Consultant shall:

(a) evolve a systems approach with the Design Director so as to minimise the time required for final designs and construction drawings; and

(b) proof check the detailed calculations, drawings and designs, which have been approved by the Design Director.

10.2.4 In respect of the Contractor's obligations with respect to the design and Drawings of the Project as set forth in Schedule-I, the following shall apply:

(a) The Contractor shall prepare and submit, with reasonable promptness and in such sequence as is consistent with the Project Completion Schedule, three copies each of the design and Drawings, duly certified by the Proof Consultant, to the Authority's Engineer for review. Provided, however, that in respect of Major Bridges and Structures, the Authority's Engineer may require additional drawings for its review in accordance with Good Industry Practice.

(b) by submitting the Drawings for review to the Authority's Engineer, the Contractor shall be deemed to have represented that it has determined and verified that the design and engineering, including field construction criteria related thereto, are in conformity with the Scope of the Project, the Specifications and Standards and the Applicable Laws;

(c) within 15 (fifteen) days of the receipt of the Drawings, the Authority's Engineer shall review the same and convey its observations to the Contractor with particular reference to their conformity or otherwise with the Scope of the Project and the Specifications and Standards. The Contractor shall not be obliged to await the observations of the Authority's Engineer on the Drawings submitted pursuant hereto beyond the said period of 15 (fifteen) days and may begin or continue

Works at its own discretion and risk; Provided, however that in case of a Major Bridge or Structure, the aforesaid period of 15 (fifteen) days may be extended upto 30 (thirty) days;

(d) if the aforesaid observations of the Authority's Engineer indicate that the Drawings are not in conformity with the Scope of the Project or the Specifications and Standards, such Drawings shall be revised by the Contractor in conformity with the provisions of this Agreement and resubmitted to the Authority's Engineer for review. The Authority's Engineer shall give its observations, if any, within 10 (ten) days of receipt of the revised Drawings. In the event the Contractor fails to revise and resubmit such Drawings to the Authority's Engineer for review as aforesaid, the Authority's Engineer may withhold the payment for the affected works in accordance with the provisions of Clause 19.5.4. If the Contractor disputes any decision, direction or determination of the Authority's Engineer hereunder, the Dispute shall be resolved in accordance with the Dispute Resolution Procedure;

(e) no review and/or observation of the Authority's Engineer and/or its failure to review and/or convey its observations on any Drawings shall relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Authority's Engineer or the Authority be liable for the same in any manner; and if errors, omissions, ambiguities, inconsistencies, inadequacies or other Defects are found in the Drawings, they and the construction works shall be corrected at the Contractor's cost, notwithstanding any review under this Article 10;

(f) the Contractor shall be responsible for delays in submitting the Drawing as set forth in Schedule-I caused by reason of delays in surveys and field investigations, and shall not be entitled to seek any relief in that regard from the Authority; and

(g) the Contractor warrants that its designers, including any third parties engaged by it, shall have the required experience and capability in accordance with Good Industry Practice and it shall indemnify the Authority against any damage, expense, liability, loss or claim, which the Authority might incur, sustain or be subject to arising from any breach of the Contractor's design responsibility and/or warranty set out in this Clause.

10.2.5 Any cost or delay in construction arising from review by the Authority's Engineer shall be borne by the Contractor.

10.2.6 Works shall be executed in accordance with the Drawings provided by the Contractor in accordance with the provisions of this Clause 10.2 and the observations of the Authority's Engineer thereon as communicated pursuant to the provisions of Clause 10.2.4 (d). Such Drawings shall not be amended or altered without prior written notice to the Authority's Engineer. If a Party becomes aware of an error or defect of a technical nature in the design or Drawings, that Party shall promptly give notice to the other Party

of such error or defect.

10.2.7 Within 90 (ninety) days of the Project Completion Date, the Contractor shall furnish to the Authority and the Authority's Engineer a complete set of as-built Drawings, in 2 (two) hard copies and in micro film form or in such other medium as may be acceptable to the Authority, reflecting the Project as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Project and setback lines, if any, of the buildings and structures forming part of Project Facilities.

10.3 Construction of the Project

10.3.1 The Contractor shall construct the Project as specified in Schedule-B and Schedule-C, and in conformity with the Specifications and Standards set forth in Schedule-D. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the Works. The 365th (three hundred and sixty five day from the Appointed Date shall be the scheduled completion date (the "**Scheduled Completion Date**") and the Contractor agrees and undertakes that the construction shall be completed on or before the Scheduled Completion Date, including any extension thereof.

10.3.2 The Contractor shall construct the Project in accordance with the Project Completion Schedule set forth in Schedule-J. In the event that the Contractor fails to achieve any Project Milestone or the Scheduled Completion Date within a period of 30 (thirty) days from the date set forth in Schedule-J, unless such failure has occurred due to Force Majeure or for reasons solely attributable to the Authority, it shall pay Damages to the Authority of a sum calculated at the rate of 0.05% (zero point zero five percent) of the Contract Price for delay of each day reckoned from the date specified in Schedule –J and until such Project Milestone is achieved or the Works are completed; provided that if the period for any or all Project Milestones or the Scheduled Completion Date is extended in accordance with the provisions of this Agreement, the dates set forth in Schedule-J shall be deemed to be modified accordingly and the provisions of this Agreement shall apply as if Schedule-J has been amended as above; provided further that in the event the Works are completed within or before the Scheduled Completion Date including any Time Extension, applicable for that work or section, the Damages paid under this Clause 10.3.2 shall be refunded by the Authority to the Contractor, but without any interest thereon. For the avoidance of doubt, it is agreed that recovery of Damages under this Clause 10.3.2 shall be without prejudice to the rights of the Authority under this Agreement including the right of Termination thereof. The Parties further agree that Time Extension hereunder shall only be reckoned for and in respect of the affected works as specified in Clause 10.5.2.

10.3.3 The Authority shall notify the Contractor of its decision to impose Damages in pursuance with the provisions of this Clause 10.3. Provided that no deduction on account of Damages shall be effected by the Authority without notifying the Contractor of its decision to impose the Damages, and taking into consideration the representation, if any, made by the Contractor within 20 (twenty) days of such notice. The Parties expressly

agree that the total amount of Damages under Clause 10.3.2 shall not exceed 10% (ten percent) of the Contract Price.

10.4 Maintenance during Construction Period

10.4.1 During the Construction Period, the Contractor shall maintain, at its cost, the existing lane(s) of the Project so that the traffic worthiness and safety thereof are at no time materially inferior as compared to their condition 10 (ten) days prior to the date of this Agreement, and shall undertake the necessary repair and maintenance works for this purpose; provided that the Contractor may, at its cost, interrupt and divert the flow of traffic if such interruption and diversion is necessary for the efficient progress of Works and conforms to Good Industry Practice; provided further that such interruption and diversion shall be undertaken by the Contractor only with the prior written approval of the Authority's Engineer which approval shall not be unreasonably withheld. For the avoidance of doubt, it is agreed that the Contractor shall at all times be responsible for ensuring safe operation of the Project. It is further agreed that in the event the Project includes construction of a bypass or tunnel and realignment of the existing carriageway, the Contractor shall maintain the existing project in such sections until the new Works are open to traffic.

10.4.2 Notwithstanding anything to the contrary contained in this Agreement, in the event of default by the Contractor in discharging the obligations specified in Clause 10.4.1 above, the Authority shall get these maintenance works done as recommended by the Authority's Engineer to avoid public inconvenience at the risk and cost of the Contractor in order to keep the road in traffic worthy condition.

10.5 Extension of time for completion

10.5.1 Without prejudice to any other provision of this Agreement for and in respect of extension of time, the Contractor shall be entitled to extension of time in the Project Completion Schedule (the **"Time Extension")** to the extent that completion of any Project Milestone is or will be delayed by any of the following, namely:

(a) delay in providing the Right of Way, environmental clearances or approval of railway authorities, specified in Clause 4.1.4;

(b) Change of Scope (unless an adjustment to the Scheduled Completion Date has been agreed under Article 13);

(c) occurrence of a Force Majeure Event;

(d) any delay, impediment or prevention caused by or attributable to the Authority, the Authority's personnel or the Authority's other contractors on the Site; and

(e) any other cause or delay which entitles the Contractor to Time Extension in accordance with the provisions of this Agreement.

10.5.2 The Contractor shall, no later than 15 (fifteen) business days from the occurrence of an event or circumstance specified in Clause 10.5.1, inform the Authority's Engineer by notice in writing, with a copy to the Authority, stating in reasonable detail with supporting particulars, the event or circumstances giving rise to the claim for Time Extension in accordance with the provisions of this Agreement. Provided that the period of 15 (fifteen) business days shall be calculated from the date on which the Contractor became aware, or should have become aware, of the occurrence of such an event or circumstance.

Provided further that notwithstanding anything to the contrary contained in this Agreement, Time Extension shall be due and applicable only for the Works which are affected by the aforesaid events or circumstances and shall not in any manner affect the Project Completion Schedule for and in respect of the Works which are not affected hereunder.

10.5.3 In the event of the failure of the Contractor to issue to the Authority's Engineer a notice in accordance with the provisions of Clause 10.5.2 within the time specified therein, the Contractor shall not be entitled to any Time Extension and shall forfeit its right for any such claims in future. For the avoidance of doubt, in the event of failure of the Contractor to issue notice as specified in this clause 10.5.3, the Authority shall be discharged from all liability in connection with the claim.

10.5.4 The Authority's Engineer shall, on receipt of the claim in accordance with the provisions of Clause 10.5.2, examine the claim expeditiously within the time frame specified herein. In the event the Authority's Engineer requires any clarifications to examine the claim, the Authority's Engineer shall seek the same within 15 (fifteen) days from the date of receiving the claim. The Contractor shall, on receipt of the communication of the Authority's Engineer requesting for clarification, furnish the same to the Authority's Engineer within 10 (ten) days thereof. The Authority's Engineer shall, within a period of 60 (sixty) days from the date of receipt of such clarifications, forward in writing to the Contractor its determination of Time Extension.

Provided that when determining each extension of time under this Clause 10.5, the Authority's Engineer shall review previous determinations and may increase, but shall not decrease, the total Time Extension.

10.5.5 If the event or circumstance giving rise to the notice has a continuing effect:

(a) a fully detailed claim shall be considered as interim;

(b) the Contractor shall, no later than 10 (ten) days after the close of each month, send further interim claims specifying the accumulated delay, the extension of time claimed, and such further particulars as the Authority's Engineer may reasonably require; and

(c) the Contractor shall send a final claim within 30 (thirty) days after the effect of the

event or the circumstance ceases.

Upon receipt of the claim hereunder, the Authority's Engineer shall examine the same in accordance with the provisions of Clause 10.5.4 within a period of 60 (sixty) days of the receipt thereof.

10.6 Incomplete Works

In the event the Contractor fails to complete the Works in accordance with the Project Completion Schedule, including any Time Extension granted under this Agreement, the Contractor shall endeavour to complete the balance work expeditiously and shall pay Damages to the Authority in accordance with the provisions of Clause 10.3.2 for delay of each day until the Works are completed in accordance with the provisions of this Agreement. Recovery of Damages under this Clause shall be without prejudice to the rights of the Authority under this Agreement including the right to termination under Clause 23.1.

10.7 Maintenance Manual

No later than 60 (sixty) days prior to the Project Completion Date, the Contractor shall, in consultation with the Authority's Engineer, evolve a maintenance manual (the **"Maintenance Manual"**) for the regular and preventive maintenance of the Project in conformity with the Specifications and Standards, safety requirements and Good Industry Practice, and shall provide 5 (five) copies thereof to the Authority's Engineer. The Authority's Engineer shall review the Maintenance Manual within 15 (fifteen) days of its receipt and communicate its comments to the Contractor for necessary modifications, if any.

ARTICLE 11

QUALITY ASSURANCE, MONITORING AND SUPERVISION

11.1 Quality of Materials and workmanship

The Contractor shall ensure that the Construction, Materials and workmanship are in accordance with the requirements specified in this Agreement, Specifications and Standards and Good Industry Practice.

11.2 Quality control system

11.2.1 The Contractor shall establish a quality control mechanism to ensure compliance with the provisions of this Agreement (the **"Quality Assurance Plan"** or **"QAP"**).

11.2.2 The Contractor shall, within 30 (thirty) days of the Appointed Date, submit to the Authority's Engineer its Quality Assurance Plan which shall include the following:

(a) organisation, duties and responsibilities, procedures, inspections and documentation;

(b) quality control mechanism including sampling and testing of Materials, test frequencies, standards, acceptance criteria, testing facilities, reporting, recording and interpretation of test results, approvals, check list for site activities, and proforma for testing and calibration in accordance with the Specifications for Road and Bridge Works issued by MORTH, relevant IRC specifications and Good Industry Practice; and

(c) internal quality audit system.

The Authority's Engineer shall convey its comments to the Contractor within a period of 21 (twenty-one) days of receipt of the QAP stating the modifications, if any, required, and the Contractor shall incorporate those in the QAP to the extent required for conforming with the provisions of this Clause 11.2.

11.2.3 The Contractor shall procure all documents, apparatus and instruments, fuel, consumables, water, electricity, labour, Materials, samples, and qualified personnel as are necessary for examining and testing the Project Assets and workmanship in accordance with the Quality Assurance Plan.

11.2.4 The cost of testing of Construction, Materials and workmanship under this Article 11 shall be borne by the Contractor.

11.3. Methodology

The Contractor shall, at least 15 (fifteen) days prior to the commencement of the

construction, submit to the Authority's Engineer for review the methodology proposed to be adopted for executing the Works, giving details of equipment to be deployed, traffic management and measures for ensuring safety. The Authority's Engineer shall complete the review and convey its comments to the Contractor within a period of 10 (ten) days from the date of receipt of the proposed methodology from the Contractor.

11.4. Inspection and technical audit by the Authority

The Authority or any representative authorised by the Authority in this behalf may inspect and review the progress and quality of the construction of Project and issue appropriate directions to the Authority's Engineer and the Contractor for taking remedial action in the event the Works are not in accordance with the provisions of this Agreement.

11.5 External technical audit

At any time during construction, the Authority may appoint an external technical auditor to conduct an audit of the quality of the Works. The findings of the audit, to the extent accepted by the Authority, shall be notified to the Contractor and the Authority's Engineer for taking remedial action in accordance with this Agreement. The Contractor shall provide all assistance as may be required by the auditor in the conduct of its audit hereunder. Notwithstanding anything contained in this Clause 11.5, the external technical audit shall not affect any obligations of the Contractor or the Authority's Engineer under this Agreement.

11.6 Inspection of construction records

The Authority shall have the right to inspect the records of the Contractor relating to the Works.

11.7 Monthly progress reports

During the Construction Period, the Contractor shall, no later than 10 (ten) days after the close of each month, furnish to the Authority and the Authority's Engineer a monthly report on progress of the Works and shall promptly give such other relevant information as may be required by the Authority's Engineer.

11.8 Inspection

11.8.1 The Authority's Engineer and its authorised representative shall at all reasonable times:

(a) have full access to all parts of the Site and to all places from which natural Materials are being obtained for use in the Works; and

(b) during production, manufacture and construction at the Site and at the place of production, be entitled to examine, inspect, measure and test the Materials and workmanship, and to check the progress of manufacture of Materials.

11.8.2 The Contractor shall give the Authority's Engineer and its authorised agents access, facilities and safety equipment for carrying out their obligations under this Agreement.

11.8.3 The Authority's Engineer shall submit a monthly inspection report (the "**Inspection Report**") to the Authority and the Contractor bringing out the results of inspections and the remedial action taken by the Contractor in respect of Defects or deficiencies. For the avoidance of doubt, such inspection or submission of Inspection Report by the Authority's Engineer shall not relieve or absolve the Contractor of its obligations and liabilities under this Agreement in any manner whatsoever.

11.9 Samples

The Contractor shall submit the following samples of Materials and relevant information to the Authority's Engineer for pre-construction review:

(a) manufacturer's test reports and standard samples of manufactured Materials; and

(b) samples of such other Materials as the Authority's Engineer may require.

11.10 Tests

11.10.1 For determining that the Works conform to the Specifications and Standards, the Authority's Engineer shall require the Contractor to carry out or cause to be carried out tests, at such time and frequency and in such manner as specified in this Agreement, and in accordance with Good Industry Practice for quality assurance. The test checks by the Authority's Engineer shall comprise at least 20 (twenty) percent of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.

11.10.2 In the event that results of any tests conducted under this Clause 11.10 establish any Defects or deficiencies in the Works, the Contractor shall carry out remedial measures and furnish a report to the Authority's Engineer in this behalf. The Authority's Engineer shall require the Contractor to carry out or cause to be carried out tests to determine that such remedial measures have brought the Works into compliance with the Specifications and Standards, and the procedure shall be repeated until such Works conform to the Specifications and Standards. For the avoidance of doubt, the cost of such tests and remedial measures in pursuance thereof shall be solely borne by the Contractor.

11.11 Examination of work before covering up

In respect of the work which the Authority's Engineer is entitled to examine, inspect, measure and/or test before it is covered up or put out of view or any part of the work is placed thereon, the Contractor shall give notice to the Authority's Engineer whenever any such work is ready and before it is covered up. The Authority's Engineer shall then either carry out the examination, inspection or testing without unreasonable delay, or promptly give notice to the Contractor that the Authority's Engineer does not require to do so. Provided, however, that if any work is of a continuous nature where it is not possible or

prudent to keep it uncovered or incomplete, the Contractor shall notify the schedule of carrying out such work to give sufficient opportunity, not being less than 3 (three) business days' notice, to the Authority's Engineer to conduct its inspection, measurement or test while the work is continuing. Provided further that in the event the Contractor receives no response from the Authority's Engineer within a period of 3 (three) business days from the date on which the Contractor's notice hereunder is delivered to the Authority's Engineer, the Contractor shall be entitled to assume that the Authority's Engineer would not undertake the said inspection.

11.12 Rejection

If, as a result of an examination, inspection, measurement or testing, any Plant, Materials, design or workmanship is found to be defective or otherwise not in accordance with the provisions of this Agreement, the Authority's Engineer shall reject the Plant, Materials, design or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the Defect and ensure that the rejected item complies with the requirements of this Agreement.

If the Authority's Engineer requires the Plant, Materials, design or workmanship to be retested, the tests shall be repeated under the same terms and conditions, as applicable in each case. If the rejection and retesting cause the Authority to incur any additional costs, such cost shall be recoverable by the Authority from the Contractor; and may be deducted by the Authority from any monies due to be paid to the Contractor.

11.13 Remedial work

11.13.1 Notwithstanding any previous test or certification, the Authority's Engineer may instruct the Contractor to:

(a) remove from the Site and replace any Plant or Materials which are not in accordance with the provisions of this Agreement;

(b) remove and re-execute any work which is not in accordance with the provisions of this Agreement and the Specification and Standards; and

(c) execute any work which is urgently required for the safety of the Project , whether because of an accident, unforeseeable event or otherwise; provided that in case of any work required on account of a Force Majeure Event, the provisions of Clause 21.6 shall apply.

11.13.2 If the Contractor fails to comply with the instructions issued by the Authority's Engineer under Clause 11.13.1, within the time specified in the Authority's Engineer's notice or as mutually agreed, the Authority's Engineer may advise the Authority to have the work executed by another agency. The cost so incurred by the Authority for undertaking such work shall, without prejudice to the rights of the Authority to recover Damages in accordance with the provisions of this Agreement, be recoverable from the Contractor and may be deducted by the Authority from any monies due to be paid to the Contractor.

11.14 Delays during construction

Without prejudice to the provisions of Clause 10.3.2, in the event the Contractor does not achieve any of the Project Milestones or the Authority's Engineer shall have reasonably determined that the rate of progress of Works is such that Completion of the Project is not likely to be achieved by the end of the Scheduled Completion Date, it shall notify the same to the Contractor, and the Contractor shall, within 15 (fifteen) days of such notice, by a communication inform the Authority's Engineer in reasonable detail about the steps it proposes to take to expedite progress and the period within which it shall achieve the Project Completion Date.

11.15 Quality control records and Documents

The Contractor shall hand over to the Authority's Engineer a copy of all its quality control records and documents before the Completion Certificate is issued pursuant to Clause 12.2.

11.16 Video recording

During the Construction Period, the Contractor shall provide to the Authority for every calendar quarter, a video recording, which will be compiled into a 3 (three)-hour compact disc or digital video disc, as the case may be, covering the status and progress of Works in that quarter. The video recording shall be provided to the Authority no later than 15 (fifteen) days after the close of each quarter after the Appointed Date.

11.17 Suspension of unsafe Construction Works

11.17.1 Upon recommendation of the Authority's Engineer to this effect, the Authority may by notice require the Contractor to suspend forthwith the whole or any part of the Works if, in the reasonable opinion of the Authority's Engineer, such work threatens the safety of the Users and pedestrians.

11.17.2 The Contractor shall, pursuant to the notice under Clause 11.17.1, suspend the Works or any part thereof for such time and in such manner as may be specified by the Authority and thereupon carry out remedial measures to secure the safety of suspended works, the Users and pedestrians. The Contractor may by notice require the Authority's Engineer to inspect such remedial measures forthwith and make a report to the Authority recommending whether or not the suspension hereunder may be revoked. Upon receiving the recommendations of the Authority's Engineer, the Authority shall either revoke such suspension or instruct the Contractor to carry out such other and further remedial measures as may be necessary in the reasonable opinion of the Authority, and the procedure set forth in this Clause 11.17 shall be repeated until the suspension hereunder is revoked.

11.17.3 Subject to the provisions of Clause 21.6, all reasonable costs incurred for maintaining and protecting the Works or part thereof during the period of suspension (the "**Preservation Costs**"), shall be borne by the Contractor; provided that if the

suspension has occurred as a result of any breach of this Agreement by the Authority, the Preservation Costs shall be borne by the Authority.

11.17.4 If suspension of Works is for reasons not attributable to the Contractor, the Authority's Engineer shall determine any Time Extension to which the Contractor is reasonably entitled.

ARTICLE 12
COMPLETION CERTIFICATE

12.1 Tests on completion

12.1.1 At least 30 (thirty) days prior to the likely completion of the Project, or a Section thereof, the Contractor shall notify the Authority's Engineer of its intent to subject the Project or a Section thereof, to Tests. The date and time of each of the Tests shall be determined by the Authority's Engineer in consultation with the Contractor, and notified to the Authority who may designate its representative to witness the Tests. The Contractor shall either conduct the Tests as directed by the Authority's Engineer or provide such assistance as the Authority's Engineer may reasonably require for conducting the Tests. In the event of the Contractor and the Authority's Engineer failing to mutually agree on the dates for conducting the Tests, the Contractor shall fix the dates by giving not less than 10 (ten) days notice to the Authority's Engineer.

12.1.2 All Tests shall be conducted in accordance with Schedule-K. The Authority's Engineer shall either conduct or observe, monitor and review the Tests conducted by the Contractor, as the case may be, and review the results of the Tests to determine compliance of the Project or a Section thereof, with Specifications and Standards and if it is reasonably anticipated or determined by the Authority's Engineer during the course of any Test that the performance of the Project or Section or any part thereof, does not meet the Specifications and Standards, it shall have the right to suspend or delay such Test and require the Contractor to remedy and rectify the Defect or deficiencies. Upon completion of each Test, the Authority's Engineer shall provide to the Contractor and the Authority copies of all Test data including detailed Test results. For the avoidance of doubt, it is expressly agreed that the Authority's Engineer may require the Contractor to carry out or cause to be carried out additional Tests, in accordance with Good Industry Practice, for determining the compliance of the Project or Section thereof with the Specifications and Standards.

12.2 Provisional Certificate

12.2.1 Subject to the provisions of Clause 12.2.5, upon completion of all Works forming part of the Project, save and except the Works for which Time Extension has been granted under Clause 10.5, the Authority's Engineer shall, at the request of the Contractor, issue a provisional certificate of completion substantially in the form set forth in Schedule-L (the "**Provisional Certificate**") if the Tests for and in respect of the completed Works are successful. The Provisional Certificate shall have appended thereto a list of outstanding items of work (the "**Punch List**") that need to be completed in accordance with the provisions of this Agreement. The Contractor undertakes to complete the minor outstanding items of works in respect of those Sections of the Project for which the Provisional Certificate has been issued, within a period of 30 (thirty) days of the date of Provisional Certificate, and those parts of the Works in respect of which Time Extension has been granted, within the extended period thereof. For the avoidance of doubt, the

Parties agree that the Punch List shall include all Works for which Time Extension has been granted and shall also include any minor outstanding items of work forming part of the completed Sections if such works do not materially affect the use of the completed Sections for their intended purpose. The Parties further agree that Provisional Certificate shall not be issued if the completed Works cannot be safely and reliably placed in service of the Users thereof.

12.2.2 Upon issue of Provisional Certificate, the provisions of Articles 14 and 17 shall apply to the completed parts of the Project and the property and ownership of all such completed Works shall vest in the Authority.

12.2.3 If the Authority's Engineer determines that the Project or any completed part thereof does not conform to the provisions of this Agreement and cannot be safely and reliably placed in operation, it shall forthwith make a report in this behalf and send copies thereof to the Authority and the Contractor and withhold issuance of the Provisional Certificate until the Defects or deficiencies are rectified by the Contractor and Tests are successful in accordance with this Article 12.

12.2.4 Notwithstanding anything to the contrary contained in Clause 12.2.3, the Authority may, at any time after receiving a report from the Authority's Engineer under that Clause, direct the Authority's Engineer to issue a Provisional Certificate under Clause 12.2.1 and such direction shall be complied forthwith.

12.2.5 No Provisional Certificate shall be issued under the provisions of this Clause 12.2 until the Contractor has submitted valid claims for payment of at least 80% (eighty per cent) of the amount arrived at after reducing the lump sum price specified in Clause 19.1.1 by the amount attributable to works which have been withdrawn under the provisions of Clause 8.3.3. For the avoidance of doubt and by way of illustration, the Parties agree that if the Contract Price specified in Clause 19.1.1 is Rs. 105 cr. (Rs.one hundred and five crore) and the works withdrawn under Clause 8.3.3 have a value of Rs. 5 cr. (Rs.five crore), a Provisional Certificate shall not be issued until valid claims for payment of an amount of Rs. 80 cr. (Rs. eighty crore) have been submitted by the Contractor in accordance with the provisions of this Agreement. It is further agreed that all price adjustments made in pursuance of Clause 19.10 shall not be reckoned for computation of the claims for payments referred to in this Clause 12.2.5.

12.3 Completion of remaining Works

All items in the Punch List shall be completed by the Contractor in accordance with the provisions of this Agreement. For any delay in their completion other than for the reasons solely attributable to the Authority or due to Force Majeure, the Authority shall be entitled to recover Damages from the Contractor in accordance with the provisions of Clause 10.3.2 of this Agreement.

12.4 Completion Certificate

12.4.1 Upon completion of all Works, including the items specified in the Punch List, and the Authority's Engineer determining the Tests to be successful, it shall forthwith issue to the Contractor and the Authority a certificate substantially in the form set forth in Schedule-L (the "**Completion Certificate**").

12.4.2 Upon receiving the Completion Certificate, the Contractor shall remove its equipment, materials, debris and temporary works from the Site within a period of 30 (thirty) days thereof, failing which the Authority may remove or cause to be removed, such equipment, materials, debris and temporary works and recover from the Contractor an amount equal to 120% (one hundred and twenty per cent) of the actual cost of removal incurred by the Authority.

12.4.3 Without prejudice to the obligations of the Contractor specified in Articles 14 and 17, the property and ownership of all the completed Works forming part of the Project shall vest in the Authority.

12.5 Rescheduling of Tests

If the Authority's Engineer certifies to the Authority and the Contractor that it is unable to issue the Completion Certificate or Provisional Certificate, as the case may be, because of events or circumstances on account of which the Tests could not be held or had to be suspended, the Contractor shall be entitled to re-schedule the Tests and hold the same as soon as reasonably practicable.

ARTICLE 13
CHANGE OF SCOPE

13.1 Change of Scope

13.1.1 The Authority may, notwithstanding anything to the contrary contained in this Agreement, require the Contractor to make modifications/alterations to the Works ("**Change of Scope**") before the issue of the Completion Certificate either by giving an instruction or by requesting the Contractor to submit a proposal for Change of Scope involving additional cost or reduction in cost. Any such Change of Scope shall be made and valued in accordance with the provisions of this Article 13.

13.1.2 Change of Scope shall mean:

(a) change in specifications of any item of Works;

(b) omission of any work from the Scope of the Project except under Clause 8.3.3; provided that, subject to Clause 13.5, the Authority shall not omit any work under this Clause in order to get it executed by any other authority; and / or

(c) any additional work, Plant, Materials or services which are not included in the Scope of the Project, including any associated Tests on completion of construction.

13.1.3 If the Contractor determines at any time that a Change of Scope will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Authority of executing, maintaining or operating the Project , (iii) improve the efficiency or value to the Authority of the completed Project , or (iv) otherwise be of benefit to the Authority, it shall prepare a proposal with relevant details at its own cost. The Contractor shall submit such proposal, supported with the relevant details and the amount of reduction in the Contract Price to the Authority to consider such Change of Scope. The Authority shall, within 15 (fifteen) days of receipt of such proposal, either accept such Change of Scope with modifications, if any, and initiate proceedings therefor in accordance with this Article 13 or reject the proposal and inform the Contractor of its decision. For the avoidance of doubt, the Parties agree that the Contractor shall not undertake any Change of Scope without the express consent of the Authority, save and except any Works necessary for meeting any Emergency.

13.2 Procedure for Change of Scope

13.2.1 In the event of the Authority determining that a Change of Scope is necessary, it may direct the Authority's Engineer to issue to the Contractor a notice specifying in reasonable detail the works and services contemplated thereunder (the "**Change of Scope Notice**").

13.2.2 Upon receipt of a Change of Scope Notice, the Contractor shall, with due diligence, provide to the Authority and the Authority's Engineer such information as is necessary, together with preliminary documentation in support of:

(a) the impact, if any, which the Change of Scope is likely to have on the Project Completion Schedule if the works or services are required to be carried out during the Construction Period; and

(b) the options for implementing the proposed Change of Scope and the effect, if any, each such option would have on the costs and time thereof, including the following details:

(i) break down of the quantities, unit rates and cost for different items of work;

(ii) proposed design for the Change of Scope; and

(iii) proposed modifications, if any, to the Project Completion Schedule of the Project

For the avoidance of doubt, the Parties expressly agree that, subject to the provisions of Clause 13.4.2, the Contract Price shall be increased or decreased, as the case may be, on account of Change of Scope.

13.2.3 The Contractor's quotation of costs for the Change of Scope shall be determined on the following principles:

(a) For works where Schedule of Rates (SOR) of concerned circle of State's Public Works Department are available shall be applicable for determination of costs. In case of non-availability of current SOR, the available Schedule of Rates shall be applied by updating the same based on WPI.

(b) For works not similar in nature to the Works being executed, the cost of work shall be derived on the basis of MORTH Standard Data Book and the applicable schedule of rates for the relevant circle, as published by the respective State Government, and such rates shall be indexed with reference to the WPI once every year, with the base being the month and year of the publication of the said schedule of rates; provided, however, that for any item not included in the schedule of rates, the prevailing market rates as determined by the Authority's Engineer shall apply, and for any item in respect of which MORTH Standard Data Book does not provide the requisite details, the Authority's Engineer shall determine the rate in accordance with Good Industry Practice.

13.2.4 Upon reaching an agreement, the Authority shall issue an order (the "**Change of Scope Order**") requiring the Contractor to proceed with the performance thereof. In the event that the Parties are unable to agree, the Authority may:

(a) issue a Change of Scope Order requiring the Contractor to proceed with the performance thereof at the rates and conditions approved by the Authority till the matter is resolved in accordance with Article 26; or

(b) proceed in accordance with Clause 13.5.

13.2.5 The provisions of this Agreement, insofar as they relate to Works and Tests, shall apply *mutatis mutandis* to the works undertaken by the Contractor under this Article 13.

13.3 Payment for Change of Scope

Payment for Change of Scope shall be made in accordance with the payment schedule specified in the Change of Scope Order.

13.4 Restrictions on Change of Scope

13.4.1 No Change of Scope shall be executed unless the Authority has issued the Change of Scope Order save and except any Works necessary for meeting any Emergency.

13.4.2 Unless the Parties mutually agree to the contrary, the total value of all Change of Scope Orders shall not exceed 10 (ten) per cent of the Contract Price.

13.4.3 Notwithstanding anything to the contrary in this Article 13, no change made necessary because of any default of the Contractor in the performance of its obligations under this Agreement shall be deemed to be Change of Scope, and shall not result in any adjustment of the Contract Price or the Project Completion Schedule.

13.5 Power of the Authority to undertake works

13.5.1 In the event the Parties are unable to agree to the proposed Change of Scope Orders in accordance with Clause 13.2, the Authority may, after giving notice to the Contractor and considering its reply thereto, award such works or services to any person on the basis of open competitive bidding from amongst bidders who are pre-qualified for undertaking the additional work; provided that the Contractor shall have the option of matching the first ranked bid in terms of the selection criteria, subject to payment of 2% (two per cent) of the bid amount to the Authority[$], and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Contractor shall be entitled to exercise such option only if it has participated in the bidding process and its bid does not exceed the first ranked bid by more than 10% (ten percent) thereof. It is also agreed that the Contractor shall provide assistance and cooperation to the person who undertakes the works or services hereunder, but shall not be responsible for rectification of any Defects and/ or maintenance of works carried out by other agencies.

[$] The Authority shall transfer 75% (seventy five percent) of the amount so received to the first ranked bidder whose bid shall have been matched by the Contractor.

13.5.2 The works undertaken in accordance with this Clause 13.5 shall conform to the Specifications and Standards and shall be carried out in a manner that minimises the disruption in operation of the Project. The provisions of this Agreement, insofar as they relate to Works and Tests, shall apply *mutatis mutandis* to the works carried out under this Clause 13.5.

ARTICLE 14
MAINTENANCE

14.1 Maintenance obligations of the Contractor

14.1.1 The Contractor shall maintain the Project for a period of 4 (four) years commencing from the date of the Provisional Certificate (the "**Maintenance Period**"). For the performance of its Maintenance obligations, the contractor shall be paid 0.5% of the Contract Price for the first year and 1%, 1.5%, 2% of the Contract Price for the second, third and fourth year respectively in case of road projects. But in case of standalone Bridge / structure work, the contractor shall be paid 0.25%, 0.5%, 0.5% and 0.5% of the Contract Price for the first, second, third and fourth year respectively. Amount shall be, inclusive of all taxes. The amount payable for maintenance shall be adjusted to reflect any increase or decrease arising out of variation in WPI to be determined in accordance with the provisions of Clause 19.12. For the avoidance of doubt, it is agreed that in the event no Provisional Certificate is issued, the Maintenance Period shall commence from the date of the Completion Certificate. It is further agreed that the Contract Price hereunder shall be reckoned with reference to the amount specified in Clause 19.1.1, which shall be adjusted to the extent of Change of Scope and the works withdrawn under the provisions of Clause 8.3.3, but shall not include any price adjustments in pursuance of Clause 19.10.

14.1.2 During the Maintenance Period, the Authority shall provide to the Contractor access to the Site for Maintenance in accordance with this Agreement. The obligations of the Contractor hereunder shall include:

(a) permitting safe, smooth and uninterrupted flow of traffic on the Project ;

(b) undertaking routine maintenance including prompt repairs of potholes, cracks, joints, drains, embankments, structures, pavement markings, lighting, road signs and other traffic control devices;

(c) undertaking repairs to structures;

(d) informing the Authority of any unauthorised use of the Project ;

(e) informing the Authority of any encroachments on the Project and

(f) operation and maintenance of all communication, patrolling, and administrative systems necessary for the efficient maintenance of the Project in accordance with the provisions of this Agreement.

14.1.3 In respect of any Defect or deficiency not specified in Schedule-E, the Contractor shall, at its own cost, undertake repair or rectification in accordance with Good Industry Practice, save and except to the extent that such Defect or deficiency shall have arisen on account of any default or neglect of the Authority or a Force Majeure Event.

14.1.4 The Contractor shall remove promptly from the Project any waste materials (including hazardous materials and waste water), rubbish and other debris (including, without limitation, accident debris) and keep the Project in a clean, tidy and orderly condition, and in conformity with the Applicable Laws, Applicable Permits and Good Industry Practice.

14.2 Maintenance Requirements

The Contractor shall ensure and procure that at all times during the Maintenance Period, the Project conforms to the maintenance requirements set forth in Schedule-E (the "**Maintenance Requirements**").

14.3 Maintenance Programme

14.3.1 The Contractor shall prepare a monthly maintenance programme (the **Maintenance Programme**") in consultation with the Authority's Engineer and submit the same to the Authority's Engineer not later than 10 (ten) days prior to the commencement of the month in which the Maintenance is to be carried out. For this purpose a joint monthly inspection by the Contractor and the Authority's Engineer shall be undertaken. The Maintenance Programme shall contain the following:

(a) The condition of the road in the format prescribed by the Authority's Engineer;

(b) the proposed maintenance works; and

(c) deployment of resources for maintenance works.

14.4 Safety, vehicle breakdowns and accidents

14.4.1 The Contractor shall ensure safe conditions for the Users, and in the event of unsafe conditions, lane closures, diversions, vehicle breakdowns and accidents, it shall follow the relevant operating procedures for removal of obstruction and debris without delay. Such procedures shall conform to the provisions of this Agreement, Applicable Laws, Applicable Permits and Good Industry Practice.

14.4.2 The Contractor shall maintain and operate a round-the-clock vehicle rescue post with one mobile crane having the capacity to lift a truck with a Gross Vehicle Weight of 30,000 (thirty thousand) kilograms; and such post shall be located as per opinion of Authority's Engineer. The Contractor shall promptly remove any damaged vehicles and debris from the Project to enable safe movement of traffic and shall report all accidents to the police forthwith.

14.5 Lane closure

14.5.1The Contractor shall not close any lane of the Project for undertaking maintenance works except with the prior written approval of the Authority's Engineer. Such approval shall be sought by the Contractor through a written request to be made at least 10 (ten) days before the proposed closure of lane and shall be accompanied by particulars thereof.

Within 5 (five) business days of receiving such request, the Authority's Engineer shall grant permission with such modifications as it may deem necessary and a copy of such permission shall be sent to the Authority.

14.5.2 Upon receiving the permission pursuant to Clause 14.5.1, the Contractor shall be entitled to close the designated lane for the period specified therein, and in the event of any delay in re-opening such lane, the Contractor shall, for every stretch of 250 (two hundred and fifty) metres, or part thereof, pay Damages to the Authority calculated at the rate of 0.1% (zero point one per cent) of the monthly maintenance payment for each day of delay until the lane has been re-opened for traffic.

14.6 Reduction of payment for non-performance of Maintenance obligations

14.6.1 In the event that the Contractor fails to repair or rectify any Defect or deficiency set forth in Schedule-E within the period specified therein, it shall be deemed as failure of performance of Maintenance obligations by the Contractor and the Authority shall be entitled to effect reduction in monthly lump sum payment for maintenance in accordance with Clause 19.7 and Schedule-M, without prejudice to the rights of the Authority under this Agreement, including Termination thereof.

14.6.2 If the nature and extent of any Defect justifies more time for its repair or rectification than the time specified in Schedule-E, the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Authority's Engineer and conveyed to the Contractor and the Authority with reasons thereof.

14.7 Authority's right to take remedial measures

In the event the Contractor does not maintain and/or repair the Project or any part thereof in conformity with the Maintenance Requirements, the Maintenance Manual or the Maintenance Programme, as the case may be, and fails to commence remedial works within 15 (fifteen) days of receipt of the Maintenance Inspection Report under Clause 15.2 or a notice in this behalf from the Authority or the Authority's Engineer, as the case may be, the Authority shall, without prejudice to its rights under this Agreement including Termination thereof, be entitled to undertake such remedial measures at the cost of the Contractor, and to recover its cost from the Contractor. In addition to recovery of the aforesaid cost, a sum equal to 20% (twenty per cent) of such cost shall be paid by the Contractor to the Authority as Damages.

14.8 Restoration of loss or damage to Project

Save and except as otherwise expressly provided in this Agreement, in the event that the Project or any part thereof suffers any loss or damage during the Maintenance from any cause attributable to the Contractor, the Contractor shall, at its cost and expense, rectify and remedy such loss or damage forthwith so that the Project conforms to the provisions of this Agreement.

14.9 Overriding powers of the Authority

14.9.1 If in the reasonable opinion of the Authority, the Contractor is in material breach of its obligations under this Agreement and, in particular, the Maintenance Requirements, and such breach is causing or likely to cause material hardship or danger to the Users and pedestrians, the Authority may, without prejudice to any of its rights under this Agreement including Termination thereof, by notice require the Contractor to take reasonable measures immediately for rectifying or removing such hardship or danger, as the case may be.

14.9.2 In the event that the Contractor, upon notice under Clause 14.9.1, fails to rectify or remove any hardship or danger within a reasonable period, the Authority may exercise overriding powers under this Clause 14.9.2 and take over the performance of any or all the obligations of the Contractor to the extent deemed necessary by it for rectifying or removing such hardship or danger; provided that the exercise of such overriding powers by the Authority shall be of no greater scope and of no longer duration than is reasonably required hereunder; provided further that any costs and expenses incurred by the Authority in discharge of its obligations hereunder shall be recovered by the Authority from the Contractor, and the Authority shall be entitled to deduct any such costs and expenses incurred from the payments due to the Contractor under Clause 19.7 for the performance of its Maintenance obligations.

14.9.3 In the event of a national emergency, civil commotion or any other circumstances specified in Clause 21.3, the Authority may take over the performance of any or all the obligations of the Contractor to the extent deemed necessary by it, and exercise such control over the Project or give such directions to the Contractor as may be deemed necessary; provided that the exercise of such overriding powers by the Authority shall be of no greater scope and of no longer duration than is reasonably required in the circumstances which caused the exercise of such overriding power by the Authority. For the avoidance of doubt, it is agreed that the consequences of such action shall be dealt in accordance with the provisions of Article 21. It is also agreed that the Contractor shall comply with such instructions as the Authority may issue in pursuance of the provisions of this Clause 14.9.3, and shall provide assistance and cooperation to the Authority, on a best effort basis, for performance of its obligations hereunder.

ARTICLE 15

SUPERVISION AND MONITORING DURING MAINTENANCE

15.1 Inspection by the Contractor

15.1.1 The Authority's Engineer shall undertake regular inspections to evaluate continuously the compliance with the Maintenance Requirements.

15.1.2 The Contractor shall carry out a detailed pre-monsoon inspection of all bridges, culverts and drainage system in accordance with the guidelines contained in IRC: SP35. Report of this inspection together with details of proposed maintenance works as required shall be conveyed to the Authority's Engineer forthwith. The Contractor shall complete the proposed maintenance works before the onset of the monsoon and send a compliance report to the Authority's Engineer. Post monsoon inspection shall be undertaken by the Contractor and the inspection report together with details of any damages observed and proposed action to remedy the same shall be conveyed to the Authority's Engineer forthwith.

15.2 Inspection and payments

15.2.1 The Authority's Engineer may inspect the Project at any time, but at least once every month, to ensure compliance with the Maintenance Requirements. It shall make a report of such inspection (**"Maintenance Inspection Report"**) stating in reasonable detail the Defects or deficiencies, if any, with particular reference to the Maintenance Requirements, the Maintenance Manual, and the Maintenance Programme, and send a copy thereof to the Authority and the Contractor within 10 (ten) days of such inspection.

15.2.2 After the Contractor submits to the Authority's Engineer the Monthly Maintenance Statement for the Project pursuant to Clause 19.6, the Authority's Engineer shall carry out an inspection within 10 (ten) days to certify the amount payable to the Contractor. The Authority's Engineer shall inform the Contractor of its intention to carry out the inspection at least 3 (three) business days in advance of such inspection. The Contractor shall assist the Authority's Engineer in verifying compliance with the Maintenance Requirements.

15.2.3 For each case of non-compliance of Maintenance Requirements as specified in the inspection report of the Authority's Engineer, the Authority's Engineer shall calculate the amount of reduction in payment in accordance with the formula specified in Schedule-M.

15.2.4 Any deduction made on account of non-compliance will not be paid subsequently even after establishing the compliance thereof. Such deductions will continue to be made every month until the compliance is procured.

15.3 Tests

For determining that the Project conforms to the Maintenance Requirements, the Authority's Engineer shall require the Contractor to carry out, or cause to be carried out,

tests specified by it in accordance with Good Industry Practice. The Contractor shall, with due diligence, carry out or cause to be carried out all such tests in accordance with the instructions of the Authority's Engineer and furnish the results of such tests forthwith to the Authority's Engineer.

15.4 Reports of unusual occurrence

The Contractor shall, during the Maintenance Period, prior to the close of each day, send to the Authority and the Authority's Engineer, by facsimile or e-mail, a report stating accidents and unusual occurrences on the Project relating to the safety and security of the Users and Project. A monthly summary of such reports shall also be sent within 3 (three) business days of the closing of month. For the purposes of this Clause 15.4, accidents and unusual occurrences on the Project shall include:

(a) accident, death or severe injury to any person;

(b) damaged or dislodged fixed equipment;

(c) flooding of Project ; and

(d) any other unusual occurrence.

ARTICLE 16
TRAFFIC REGULATION

16.1 Traffic regulation by the Contractor

16.1.1 The Contractor shall take all the required measures and make arrangements for the safety of Users during the construction and maintenance of the Project or a Section thereof in accordance with the provisions of MORTH Specifications. It shall provide, erect and maintain all such barricades, signs, markings, flags, and lights as may be required by Good Industry Practice for the safety of the traffic passing through the Section under construction or maintenance.

16.1.2 All works shall be carried out in a manner creating least interference to traffic passing through the Project or a Section thereof. In stretches where construction or maintenance works on the carriageway are taken up, the Contractor shall ensure that proper passage is provided for the traffic. Where it is not possible or safe to allow traffic on part width of the carriageway, a temporary diversion of proper specifications shall be constructed by the Contractor at its own cost. The Contractor shall take prior approval of the Authority's Engineer for any proposed arrangement for traffic regulation during Construction and Maintenance, which approval shall not be unreasonably withheld.

ARTICLE 17

DEFECTS LIABILITY

17.1 Defects Liability Period

17.1.1 The Contractor shall be responsible for all the Defects and deficiencies, except usual wear and tear in the Project or any Section thereof, till the expiry of a period of 4 (four) years commencing from the date of Provisional Certificate (the "**Defects Liability Period**"). Provided that the Defects Liability Period shall in no case be less than **42 (forty two)** months from the date of Completion. Certificate for and in respect of works for which Time Extension was granted. Provided further that in the event no Provisional Certificate is issued, the Defects Liability Period shall commence from the date of the Completion Certificate. For the avoidance of doubt, any repairs or restoration on account of usual wear or tear in the Project or any Section thereof shall form a part of the Maintenance obligations of the Contractor as specified in Article 14.

17.1.2 Deleted.

17.2 Remedying Defects

Save and except as provided in Clause 14.1.2, the Contractor shall repair or rectify all Defects and deficiencies observed by the Authority's Engineer during the Defects Liability Period within a period of 15 (fifteen) days from the date of notice issued by the Authority's Engineer in this behalf, or within such reasonable period as may be determined by the Authority's Engineer at the request of the Contractor, in accordance with Good Industry Practice.

17.3 Cost of remedying Defects

For the avoidance of doubt, any repair or rectification undertaken in accordance with the provisions of Clause 17.2, including any additional testing, shall be carried out by the Contractor at its own risk and cost, to the extent that such rectification or repair is attributable to:

(a) the design of the Project;

(b) Plant, Materials or workmanship not being in accordance with this Agreement and the Specifications and Standards;

(c) improper maintenance during construction of the Project by the Contractor; and/ or

(d) failure by the Contractor to comply with any other obligation under this Agreement.

17.4 Contractor's failure to rectify Defects

In the event that the Contractor fails to repair or rectify such Defect or deficiency within the period specified in Clause 17.2, the Authority shall be entitled to get the same repaired, rectified or remedied at the Contractor's cost so as to make the Project conform to the Specifications and Standards and the provisions of this Agreement. All costs consequent thereon shall, after due consultation with the Authority and the Contractor, be determined by the Authority's Engineer. The cost so determined and an amount equal to twenty percent of the cost as Damages shall be recoverable by the Authority from the Contractor and may be deducted by the Authority from any monies due to the Contractor.

17.5 Contractor to search cause

17.5.1 The Authority's Engineer may instruct the Contractor to examine the cause of any Defect in the Works or part thereof before the expiry of the Defects Liability Period.

17.5.2 In the event any Defect identified under Clause 17.5.1 is attributable to the Contractor, the Contractor shall rectify such Defect within the period specified by the Authority's Engineer, and shall bear the cost of the examination and rectification of such Defect.

17.5.3 In the event such Defect is not attributable to the Contractor, the Authority's Engineer shall, after due consultation with the Authority and the Contractor, determine the costs incurred by the Contractor on such examination and notify the same to the Contractor, with a copy to the Authority, and the Contractor shall be entitled to payment of such costs by the Authority.

17.6. Extension of Defects Liability Period

The Defects Liability Period shall be deemed to be extended till the identified Defects under Clause 17.2 have been remedied.

ARTICLE 18
AUTHORITY'S ENGINEER

18.1 Appointment of the Authority's Engineer

18.1.1 The Authority shall appoint a consulting engineering firm substantially in accordance with the selection criteria set forth in Schedule-N, to be the engineer under this Agreement (the "**Authority's Engineer**").

18.1.2 The Authority's Engineer should be appointed within 30 days from the date of this Agreement or before declaration of Appointed Date. The Authority shall notify the appointment or replacement of the Authority's Engineer to the Contractor.

18.1.3 The staff of the Authority's Engineer shall include suitably qualified engineers and other professionals who are competent to assist the Authority's Engineer to carry out its duties.

18.2 Duties and authority of the Authority's Engineer

18.2.1 The Authority's Engineer shall perform the duties and exercise the authority in accordance with the provisions of this Agreement, and substantially in accordance with the terms of reference ("**Terms of Reference" or "TOR")** set forth in Annex 1 of Schedule N, but subject to obtaining prior written approval of the Authority before determining:

(a) any Time Extension;

(b) any additional cost to be paid by the Authority to the Contractor;

(c) the Termination Payment; or

(d) any other matter which is not specified in (a), (b) or (c) above and which creates an obligation or liability on either Party for a sum exceeding Rs. 5,000,000 (Rs. fifty lakh).

18.2.2 No decision or communication of the Authority's Engineer shall be effective or valid unless it is accompanied by an attested true copy of the approval of the Authority for and in respect of any matter specified in Clause 18.2.1.

18.2.3 The Authority's Engineer shall submit regular periodic reports, at least once every month, to the Authority in respect of its duties and functions under this Agreement. Such reports shall be submitted by the Authority's Engineer within 10 (ten) days of the beginning of every month. For the avoidance of doubt, the Authority's Engineer shall include in its report, compliance of the recommendations of the Safety Consultant.

18.3 Delegation by the Authority's Engineer

18.3.1 The Authority's Engineer may, by order in writing, delegate any of his duties and responsibilities to suitably qualified and experienced personnel who are accountable to Authority's Engineer, or may revoke any such delegation, under intimation to the Authority and the Contractor. Provided, however, that the Authority's Engineer shall be responsible and liable for all actions and omissions of such personnel.

18.3.2 Any failure of the Authority's Engineer to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Authority to reject the work, Plant or Materials, which is not in accordance with the provisions of this Agreement and the Specifications and Standards.

18.3.3 Notwithstanding anything stated in Clause 18.3.1 above, the Authority's Engineer shall not delegate the authority to refer any matter for the Authority's prior approval wherever required in accordance with the provisions of Clause 18.2.

18.4 Instructions of the Authority's Engineer

18.4.1 The Authority's Engineer may issue to the Contractor instructions for remedying any Defect. The Contractor shall take such instructions from the Authority's Engineer, or from an assistant to whom appropriate authority has been delegated under Clause 18.3.

18.4.2 The instructions issued by the Authority's Engineer shall be in writing. However, if the Authority's Engineer issues any oral instructions to the Contractor, it shall confirm in writing the oral instructions within 2 (two) working days of issuing them.

18.4.3 In case the Contractor does not receive the confirmation of the oral instruction within the time specified in Clause 18.4.2, the Contractor shall seek the written confirmation of the oral instructions from the Authority's Engineer. The Contractor shall obtain acknowledgement from the Authority's Engineer of the communication seeking written confirmation. In case of failure of the Authority's Engineer or its delegated assistant to reply to the Contractor within 2 (two) days of the receipt of the communication from the Contractor, the Contractor may not carry out the instruction.

18.4.4 In case of any dispute on any of the instructions issued by the delegated assistant, the Contractor may refer the dispute to the Authority's Engineer, who shall then confirm, reverse or vary the instructions within [3 (three)] business days of the dispute being referred.

18.5 Determination by the Authority's Engineer

18.5.1 The Authority's Engineer shall consult with each Party in an endeavour to reach

agreement wherever this Agreement provides for the determination of any matter by the Authority's Engineer. If such agreement is not achieved, the Authority's Engineer shall make a fair determination in accordance with this Agreement having due regard to all relevant circumstances. The Authority's Engineer shall give notice to both the Parties of each agreement or determination, with supporting particulars.

18.5.2 Each Party shall give effect to each agreement or determination made by the Authority's Engineer in accordance with the provisions of this Agreement. Provided, however, that if any Party disputes any instruction, decision, direction or determination of the Authority's Engineer, the Dispute shall be resolved in accordance with the Dispute Resolution Procedure.

18.6 Remuneration of the Authority's Engineer

The remuneration, cost and expenses of the Authority's Engineer shall be paid by the Authority.

18.7 Termination of the Authority's Engineer

18.7.1 The Authority may, in its discretion, replace the Authority's Engineer at any time, but only after appointment of another Authority's Engineer in accordance with Clause 18.1.

18.7.2 If the Contractor has reasons to believe that the Authority's Engineer is not discharging its duties and functions in accordance with the provisions of this Agreement, it may make a written representation to the Authority and seek termination of the appointment of the Authority's Engineer. Upon receipt of such representation, the Authority shall hold a tripartite meeting with the Contractor and Authority's Engineer and make best efforts for an amicable resolution of the representation. In the event that the appointment of the Authority's Engineer is terminated hereunder, the Authority shall appoint forthwith another Authority's Engineer in accordance with Clause 18.1.

Part IV

Financial Covenants

ARTICLE 19

PAYMENTS

19.1 Contract Price

19.1.1 The Authority shall make payments to the Contractor for the Works on the basis of the lump sum price accepted by the Authority in consideration of the obligations specified in this Agreement for an amount of Rs. … … … … (Rs. … … … … … … … …) (the "**Contract Price**"), which shall be subject to adjustments in accordance with the provisions of this Agreement. For the avoidance of doubt, the Parties expressly agree that the Contract Price shall not include the cost of Maintenance which shall be paid separately in accordance with the provisions of Clause 19.7. The Parties further agree that save and except as provided in this Agreement, the Contract Price shall be valid and effective until issue of Completion Certificate.

19.1.2 The Contract Price includes all duties, taxes (except GST), royalty, and fees that may be levied in accordance with the laws and regulations in force as on the Base Date on the Contractor's equipment, Plant, Materials and supplies acquired for the purpose of this Agreement and on the services performed under this Agreement. Nothing in this Agreement shall relieve the Contractor from its responsibility to pay any tax including any tax that may be levied in India on profits made by it in respect of this Agreement.

19.1.3 The Contract Price shall not be adjusted for any change in costs stated in Clause 19.1.2 above, except as stated in Clauses 19.10 and 19.17.

19.1.4 The Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs, unless otherwise provided for in this Agreement.

19.1.5 Unless otherwise stated in this Agreement, the Contract Price covers all the Contractor's obligations for the Works under this Agreement and all things necessary for the Construction and the remedying of any Defects in the Project .

19.1.6 All payments under this Agreement shall be made in Indian Rupees.

19.2 Advance Payment

19.2.1 The Authority shall make an interest-bearing (@ Bank Rate[$]) advance payment (the "Advance Payment"), equal in amount to 10 (ten) percent of the Contract Price, exclusive for mobilisation expenses. The Advance Payment for mobilisation expenses shall be made in two instalments each equal to 5% (five percent) of the Contract Price. The second 5% (five percent) mobilisation advance would be released after submission of utilization certificate by the Contractor for the first 5% advance already released earlier.

[$] Bank Rate shall be as declared by Reserve Bank of India (RBI).

In addition to above, the Authority shall make an additional interest-bearing advance payment against newly purchased key construction equipment required for the works as per agreed construction programme and brought to the site, if so requested by the Contractor subject to the same terms and conditions specified for Advance Payment for mobilisation expenses in this Agreement. The maximum of such advance shall be 5% (five percent) of the Contract Price against Bank Guarantee. This advance shall be further subject to the condition that (i) such new equipment are considered by the Authority's Engineer to be necessary for the works and (ii) these new equipment should be procured in the name of Contractor and is verified by Authority's Engineer to have been brought to site.

The Advance Payment for mobilization expenses and for acquisition of key new construction equipment would be deemed as interest bearing advance at Bank Rate, to be compounded annually. The interest would be recovered along with the recovery of mobilization Advance Payment in equal installments as per provision laid down for the mobilization advance recovery**..**

19.2.2 The Contractor may apply to the Authority for the first instalment of the Advance Payment at any time after the Appointed Date, along with an irrevocable and unconditional guarantee from a Bank for an amount equivalent to 110% (one hundred and ten per cent) of such instalment, substantially in the form provided at Annex-III of Schedule-G, to remain effective till the complete and full repayment thereof.

19.2.3 Deleted.

19.2.4 At any time, after 60 (sixty) days from the Appointed Date, the Contractor may apply to the Authority for the second instalment of the Advance Payment along with an irrevocable and unconditional guarantee from a Bank for an amount equivalent to 110% (one hundred and ten per cent) of such instalment, substantially in the form provided at Annex-III of Schedule-G, to remain effective till the complete and full repayment thereof.

19.2.5 The Advance Payment shall be paid by the Authority to the Contractor within 15 (fifteen) days of the receipt of its respective requests in accordance with the provisions of this Clause 19.2.

19.2.6 Deleted.

19.2.7 The advance payment shall be repaid through percentage deductions from the stage payments determined by the Authority's Engineer in accordance with Sub-Clause 19.5, as follows:

(a) deductions shall commence in the next Stage Payment Statement following that in which the total of all certified stage payments (excluding the advance payment and deductions and repayments of retention) exceeds 20% (twenty percent) of the Contract Price; and

(b) deductions shall be made at the rate of 15% (fifteen percent) of each Stage Payment

Statement until such time as the advance payment has been repaid; provided that the advance payment shall be completely repaid prior to the time when 80% (80 percent) of the Contract Price has been certified for payment.

19.2.8 If the Advance Payment has not been fully repaid prior to Termination under Clause 21.7 or Article 23, as the case may be, the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Authority. Without prejudice to the provisions of Clause 19.2.7, in the event of Termination for Contractor Default, the Advance Payment shall be deemed to carry interest at the rate of 10% (ten per cent) per annum from the date of Advance Payment to the date of recovery by encashment of the Bank Guarantee for the Advance Payment. For the avoidance of doubt, the aforesaid interest shall be payable on each instalment of the Advance Payment, regardless of whether the instalment or any part thereof has been repaid to the Authority prior to Termination.

19.3 Procedure for estimating the payment for the Works

19.3.1 The Authority shall make interim payments to the Contractor as certified by the Authority's Engineer on completion of a stage, in a length, number or area as specified, and valued in accordance with the proportion of the Contract Price assigned to each item and its stage in Schedule-H.

19.3.2 The Contractor shall base its claim for interim payment for the stages completed till the end of the month for which the payment is claimed, valued in accordance with Clause 19.3.1, supported with necessary particulars and documents in accordance with this Agreement.

19.3.3 Any reduction in the Contract Price arising out of Change of Scope or the works withdrawn under Clause 8.3 shall not affect the amounts payable for the items or stage payments thereof which are not affected by such Change of Scope or withdrawal. For avoidance of doubt and by way of illustration, the Parties agree that if the amount assigned to Major Bridges is reduced from Rs. 100 crore to Rs. 80 crore owing to Change of Scope or withdrawal of work, the reduction in payment shall be restricted to relevant payments for Major Bridges only and the payment due in respect of all other stage payments under the item Major Bridges shall not be affected in any manner. The Parties further agree that the adjustments arising out of the aforesaid modifications shall be carried out in a manner that the impact of such modifications is restricted to the said Change of Scope or withdrawal, as the case may be, and does not alter the payments due for and in respect of items or stage payments which do not form part of such Change of Scope or withdrawal.

19.4 Stage Payment Statement for Works

The Contractor shall submit a statement (the **"Stage Payment Statement")**, in 3 copies, by the 7th (seventh) day of the month to the Authority's Engineer in the form set forth in Schedule-O, showing the amount calculated in accordance with Clause 19.3 to which the

Contractor considers himself entitled for completed stage(s) of the Works. The Stage Payment Statement shall be accompanied with the progress reports and any other supporting documents. The Contractor shall not submit any claim for payment of incomplete stages of work.

19.5 Stage Payment for Works

19.5.1 Within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor pursuant to Clause 19.4, the Authority's Engineer shall broadly determine the amount due to the Contractor and recommend the release of 90 (ninety) percent of the amount so determined as part payment against the Stage Payment Statement, pending issue of the Interim Payment Certificate by the Authority's Engineer. Within 10 (ten) days of the receipt of recommendation of the Authority's Engineer, the Authority shall make electronic payment directly to the Contractor's bank account.

19.5.2 Within 15 (fifteen) days of the receipt of the Stage Payment Statement referred to in Clause 19.4, the Authority's Engineer shall determine and shall deliver to the Authority and the Contractor an IPC certifying the amount due and payable to the Contractor, after adjusting the payments already released to the Contractor against the said statement. For the avoidance of doubt, the Parties agree that the IPC shall specify all the amounts that have been deducted from the Stage Payment Statement and the reasons therefor.

19.5.3 In cases where there is a difference of opinion as to the value of any stage, the Authority's Engineer's view shall prevail and interim payments shall be made to the Contractor on this basis; provided that the foregoing shall be without prejudice to the Contractor's right to raise a Dispute.

19.5.4 The Authority's Engineer may, for reasons to be recorded, withhold from payment:

(a) the estimated value of work or obligation that the Contractor has failed to perform in accordance with this Agreement and the Authority's Engineer had notified the Contractor; and

(b) the estimated cost of rectification of work done being not in accordance with this Agreement.

19.5.5 Payment by the Authority shall not be deemed to indicate the Authority's acceptance, approval, consent or satisfaction with the work done.

19.6 Monthly Maintenance Statement of the Project

19.6.1 The Contractor shall submit to the Authority's Engineer a monthly maintenance statement ("**Monthly Maintenance Statement")** in 3 (three) copies by the 7th (seventh) day of each month in the format set forth in Schedule-O for the Maintenance of the Project during the previous month.

19.6.2 The monthly lump sum amount payable for Maintenance shall be 1/12th (one-twelfth) of the annual cost of Maintenance as specified in Clause 14.1.1.

19.7 Payment for Maintenance of the Project

19.7.1 Within 15 (fifteen) days of receipt of the Monthly Maintenance Statement from the Contractor pursuant to Clause 19.6, the Authority's Engineer shall verify the Contractor's monthly maintenance statement and certify the amount to be paid to the Contractor taking into account:

(a) Compliance with the Maintenance Requirements; and

(b) reduction for non-compliance with the Maintenance Requirement in accordance with Clause 19.7.2.

The Authority's Engineer shall deliver to the Authority an IPC approving or amending the monthly maintenance statement to reflect the amount due to the Contractor in accordance with this Agreement.

19.7.2 Maintenance shall be measured in units of one kilometer each; provided, however, that payment thereof shall be made in fixed monthly amounts in accordance with this Agreement. If the Maintenance Requirements set forth in Schedule-E are not met, reduction in payments shall be made in accordance with the provisions of Schedule-M. The reductions for non-compliance with the Maintenance Requirements shall be applied on the basis of monthly inspections by the Authority's Engineer.

19.7.3 The deduction made on account of non-compliance with the Maintenance Requirements shall not be subsequently considered for payment after the compliance is achieved by repair or rectification.

19.7.4 The Authority shall pay to the Contractor every quarter any amount due under any IPC under this Clause 19.7. The payment shall be made no later than 30 (thirty) days from the date of submission of the last IPC for the relevant quarter.

19.8 Payment of Damages

19.8.1 The Contractor may claim Damages due and payable to it in accordance with the provisions of this Agreement.

19.8.2 The Authority's Engineer shall issue the IPC within 15 (fifteen) days of the receipt of the claim under Clause 19.8.1, after making adjustments in accordance with the provisions of this Agreement. The Authority shall pay to the Contractor the amount due under any IPC within a period of 30 (thirty) days from the date of the submission of the claim under this Clause 19.8. In the event of the failure of the Authority to make payment to the Contractor within the specified time, the Authority shall be liable to pay to the Contractor interest thereon and the provisions of Clause 19.9 shall apply *mutatis mutandis* thereto.

19.9 Time of payment and interest

19.9.1 The Authority shall pay to the Contractor any amount due under any payment certificate issued by the Authority's Engineer in accordance with the provisions of this Article 19, or in accordance with any other clause of this Agreement as follows:

(a) payment shall be made no later than 30 (thirty) days from the date of submission of the Stage Payment Statement by the Contractor to the Authority's Engineer for certification in accordance with the provisions of Clause 19.4 for an IPC; provided that, in the event the IPC is not issued by the Authority's Engineer within the aforesaid period of 30 (thirty) days, the Authority shall pay the amount shown in the Contractor's Stage Payment Statement and any discrepancy therein shall be added to, or deducted from, the next payment certificate issued to the Contractor; and

(b) payment shall be made no later than 30 (thirty) days from the date of submission of the Final Payment Certificate for Works along with the discharge submitted to the Authority's Engineer in accordance with the provisions of Clause 19.15 for certification.

19.9.2 In the event of the failure of the Authority to make payment to the Contractor within the time period stated in this Clause 19.9, the Authority shall be liable to pay to the Contractor interest at the Base Rate plus 2% (two percent), calculated at quarterly rests, on all sums remaining unpaid from the date on which the same should have been paid, calculated in accordance with the provisions of Clause 19.9.1(a) and (b) and till the date of actual payment.

19.10. Price adjustment for the Works

19.10.1 The amounts payable to the Contractor for Works shall be adjusted in accordance with the provisions of this Clause 19.10.

19.10.2 Subject to the provisions of Clause 19.10.3, the amounts payable to the Contractor for Works, shall be adjusted in the IPC issued by the Authority's Engineer for the increase or decrease in the index cost of inputs for the Works, by the addition or subtraction of the amounts determined by the formulae prescribed in Clause 19.10.4.

19.10.3 To the extent that full compensation for any increase or decrease in costs to the Contractor is not covered by the provisions of this or other Clauses in this Agreement, the costs and prices payable under this Agreement shall be deemed to include the amounts required to cover the contingency of such other increase or decrease of costs and prices.

19.10.4 The Contract Price shall be adjusted for increase or decrease in rates and price of labour, cement, steel, Plant, machinery and spares, bitumen, fuel and lubricants, and other material inputs in accordance with the principles, procedures and formulae specified below:

(a) Price adjustment shall be applied on completion of the specified stage of the respective item of work in accordance with Schedule-H;

(b) Adjustment for each item of work/stage shall be made separately.

(c) The following expressions and meanings are assigned to the value of the work done:

RW= Value of work done for the completion of a stage under the following items of Schedule-H:

(i) Road works; and

(ii) Other works

BR = Value of work done for the completion of a stage under the items Major Bridges and Structures (Schedule-H)

(d) Price adjustment for changes in cost shall be paid in accordance with the following formulae:

(i) VRW= 0.85 RW x [PL x (LI – LO)/LO + PA x (AI – AO)/AO + PF x (FI –FO)/FO + PB x (BI – BO)/BO + PM x (MI – MO)/MO + PC x (CI – CO)/CO+ PS x (SI – SO)/SO]

(ii) VBR = 0.85 BR x [PL x (LI – LO)/LO + PA x (AI – AO)/AO + PF x (FI – FO)/FO + PM x (MI – MO)/MO+ PC x (CI – CO)/CO + PS x (SI – SO)/SO]

Where

VRW = Increase or decrease in the cost of road works/other works during the period under consideration due to changes in the rates for relevant components as stated in sub-paragraph (e)

VBR = Increase or decrease in the cost of Major Bridges and Structures during the period under consideration due to changes in the rates for relevant components as stated in sub-paragraph (e)

PB, PC, PL, PM, and PS are the percentages of bitumen, cement, labour, other materials, and steel/components (including strands and cables) respectively for the relevant item as stated in sub-paragraph (e)

PA is the percentage of Plant, machinery and spares component for the relevant item as stated in sub-paragraph (e).

PF is the percentage of fuel and lubricants for the relevant items as stated in sub-paragraph (e).

AO = The wholesale price index as published by the Ministry of Commerce & Industry, Government of India (hereinafter called "WPI") for construction machinery for the month of the Base Date.

AI = The WPI for construction machinery for the month three months prior to the month to which the IPC relates.

BO = The official retail price of bitumen at the nearest refinery at Haladia /Paradip on the Base Date.

BI = The official retail price of bitumen at nearest refinery at Haladia /Paradip, on the first day of the month three months prior to the month to which the IPC relates.

CO = The WPI for grey cement for the month of the Base Date..

CI = The WPI for grey cement for the month three months prior to the month to which the IPC relates.

FO = The official retail price of high speed diesel (HSD) oil at the existing consumer pumps of Indian Oil Corporation ("IOC") in the State of Odisha on the Base Date.

FI = The official retail price of HSD at the existing consumer pumps of IOC in the State of Odisha on the first day of the month three months prior to the month to which the IPC relates.

LO = The consumer price index for industrial workers for the circle **** in the State of Odisha , published by Labour Bureau, Ministry of Labour, Government of India, (hereinafter called "CPI") for the month of the Base Date.

LI = The CPI for the month three months prior to the month to which the IPC relates.

MO = The WPI for all commodities for the month of the Base Date.

MI = The WPI for all commodities for the month three months prior to the month to which the IPC relates.

SO = The WPI for steel (re-bars) for the month of the Base Date.

SI = The WPI for steel (re-bars) for the month three months prior to the month to which the IPC relates.

(e) The following percentages shall govern the price adjustment of the Contract Price:

Component	Item				
	Road Works				Major Bridges and Structures
	Earthwork, Granular work, and Other works	Bituminous work	Cement Concrete Pavement	Culverts, minor bridges and other structures	
Labour (PL)	20%	20%	20%	15%	15%
Cement (PC)	5%	Nil	20%	15%	15%
Steel (PS)	Nil	Nil	Nil	15%	20%
Bitumen (PB)	Nil	15%	Nil	Nil	Nil
Fuel and lubricants (PF)	10%	10%	10%	10%	10%
Other Materials (PM)	50%	40%	35%	30%	25%
Plant, machinery and spares. (PA)	15%	15%	15%	15%	15%
Total	100%	100%	100%	100%	100%

(f) In case an IPC relates to a month which is within 3 (three) months from the Base Date, no price adjustment shall be applicable.

19.11 Restrictions on price adjustment

Price adjustment shall be due and payable only in respect of the stages of Works for which the Stage Payment Statement has been submitted by the Contractor no later than 30 (thirty) days from the date of the applicable Project Milestone or the Scheduled Completion Date, as the case may be, including any Time Extension granted therefor in

accordance with the provisions of this Agreement. For the avoidance of doubt, in the event of submission of any Stage Payment Statement after the period specified herein, price adjustment shall be applicable until the date of the respective Project Milestone or the Scheduled Completion Date, as the case may be.

19.12. Price adjustment for Maintenance of Project

Lump sum payment for Maintenance shall be adjusted every quarter for changes in rates and prices of various inputs in accordance with the formula given below:

$V = P \times (W^I - W^O)/W^O$

V = Increase or decrease in the quarterly lump sum payment

P = Quarterly lump sum payment due to the Contractor after adjusting any reduction in payment for non compliance of the Maintenance Requirements

W^O = The wholesale price index (all commodities) for the month of the Base Date.

W^I = The wholesale price index (all commodities) for the first day of the quarter under consideration for determining the price adjustment.

19.13 Final Payment Statement

19.13.1 Within 60 (sixty) days after receiving the Completion Certificate under Clause 12.4, the Contractor shall submit to the Authority's Engineer for consideration six copies of a Final Payment Statement (the "**Final Payment Statement**") for Works, with supporting documents showing in detail, in the form prescribed by the Authority's Engineer:

(a) the summary of Contractor's Stage Payment claims for Works as submitted in accordance with Clause 19.4;

(b) the amounts received from the Authority against each claim; and

(c) any further sums which the Contractor considers due to it from the Authority.

If the Authority's Engineer disagrees with or cannot verify any part of the Final Payment Statement, the Contractor shall submit such further information as the Authority's Engineer may reasonably require. The Authority's Engineer shall deliver to the Authority:

(i) an IPC for those parts of the Final Payment Statement which are not in dispute, along with a list of disputed items which shall then be settled in accordance with the provisions of Article 26; or

(ii) a Final Payment Certificate in accordance with Clause 19.15 if there are no disputed items.

19.13.2 If the Authority's Engineer does not prescribe the form referred to in Clause 19.13.1 within 15 (fifteen) of the date of issue of the Completion Certificate, the Contractor shall submit the statement in such form as it deems fit.

19.14 Discharge

Upon submission of the Final Payment Statement for Works under Clause 19.13, the Contractor shall give to the Authority, with a copy to the Authority's Engineer, a written discharge confirming that the total of the Final Payment Statement represents full and final settlement of all monies due to the Contractor in respect of this Agreement for all the Works arising out of this Agreement, except for any monies due to either Party on account of any Defect. Provided that such discharge shall become effective only after the payment due has been made in accordance with the Final Payment Certificate issued pursuant to Clause 19.15.

19.15 Final Payment Certificate

19.15.1 Within 30 (thirty) days after receipt of the Final Payment Statement for Works under Clause 19.13, and the written discharge under Clause 19.14, and there being no disputed items of claim, the Authority's Engineer shall deliver to the Authority, with a copy to the Contractor, a final payment certificate (the "**Final Payment Certificate")** stating the amount which, in the opinion of the Authority's Engineer, is finally due under this Agreement or otherwise. For the avoidance of doubt, before issuing the Final Payment Certificate, the Authority's Engineer shall ascertain from the Authority all amounts previously paid by the Authority and for all sums to which the Authority is entitled, the balance, if any, due from the Authority to the Contractor or from the Contractor to the Authority, as the case may be.

19.15.2 The Authority shall, in accordance with the provisions of Clause 19.9, pay to the Contractor the amount which is stated as being finally due in the Final Payment Certificate.

19.16 Final payment statement for Maintenance

19.16.1 Within 30 (thirty) days after completion of the Maintenance Period, the Contractor shall submit to the Authority's Engineer six copies of the final payment statement for Maintenance of the Project , with supporting documents showing the details set forth below in the form prescribed by the Authority's Engineer :

(a) the total amount claimed in accordance with the monthly statement for Maintenance of Project ;

(b) the amount paid in accordance with the Interim Payment Certificates; and

(c) any sums which the Contractor considers to be due to it, with supporting documents.

19.16.2 The Authority's Engineer shall certify final payment within 30 (thirty) days of the receipt of the final payment statement of Maintenance under Clause 19.16.1, segregating the items of amount payable from the items of amount disallowed. The Authority shall make payment on the basis of the final payment authorised by the Authority's Engineer within a period of 30 (thirty) days of the receipt of the Final Payment Statement from the Authority's Engineer.

19.16.3 If the Authority's Engineer does not prescribe the form within 15 (fifteen) days of the date of issue of the Completion Certificate, the Contractor shall submit the statement in such form as it deems fit.

19.17 Change in law

19.17.1 If as a result of Change in Law, the Contractor suffers any additional costs in the execution of the Works or in relation to the performance of its other obligations under this Agreement, the Contractor shall, within 15 (fifteen) days from the date it becomes reasonably aware of such addition in cost, notify the Authority with a copy to the Authority's Engineer of such additional cost due to Change in Law.

19.17.2 If as a result of Change in Law, the Contractor benefits from any reduction in costs for the execution of this Agreement or in accordance with the provisions of this Agreement, either Party shall, within 15 (fifteen) days from the date it becomes reasonably aware of such reduction in cost, notify the other Party with a copy to the Authority's Engineer of such reduction in cost due to Change in Law.

19.17.3 The Authority's Engineer shall, within 15 (fifteen) days from the date of receipt of the notice from the Contractor or the Authority, determine any addition or reduction to the Contract Price, as the case may be, due to the Change in Law.

19.18 Correction of Interim Payment Certificates

The Authority's Engineer may by an Interim Payment Certificate make any correction or modification in any previous Interim Payment Certificate issued by the Authority's Engineer.

19.19 Authority's claims

If the Authority considers itself to be entitled to any payment from the Contractor under any Clause of this Agreement, it shall give notice and particulars to the Contractor 20 (twenty) days before making the recovery from any amount due to the Contractor, and shall take into consideration the representation, if any, made by the Contractor in this behalf, before making such recovery.

19.20 Bonus for early completion

In the event that the Project Completion Date occurs prior to the Scheduled Completion

Date, the Contractor shall be entitled to receive a payment of bonus equivalent to 0.03% (zero point zero three per cent) of the Contract Price for each day by which the Project Completion Date precedes the Scheduled Completion Date, but subject to a maximum of 5% (five per cent) of the Contract Price. Provided, however, that the payment of bonus, if any, shall be made only after the issue of the Completion Certificate. For the avoidance of the doubt, the Parties agree that for the purpose of determining the bonus payable hereunder, the Contract Price shall always be deemed to be the amount specified in Clause 19.1.1, and shall exclude any revision thereof for any reason. The Parties also agree that bonus shall be payable only if each work for which Extension of Time has been granted is completed within respective Extended Time.

ARTICLE 20
INSURANCE

20.1 Insurance for Works and Maintenance

20.1.1 The Contractor shall effect and maintain at its own cost the insurances specified in Schedule-P and as per the requirements under the Applicable Laws.

20.1.2 Subject to the provisions of Clause 21.6, the Authority and the Contractor shall, in accordance with its obligations as provided for in this Agreement, be liable to bear the cost of any loss or damage that does not fall within the scope of this Article 20 or cannot be recovered from the insurers.

20.1.3 Subject to the exceptions specified in Clause 20.1.4 below, the Contractor shall, save and except as provided for in this Agreement, fully indemnify, hold harmless and defend the Authority from and against any and all losses, damages, costs, charges and/or claims with respect to:

(a) the death of or injury to any person; or

(b) the loss of or damage to any property (other than the Works);

that may arise out of or in consequence of any breach by the Contractor of this Agreement during the execution of the Works or the remedying of any Defects therein.

20.1.4 Notwithstanding anything stated above in Clause 20.1.3, the Authority shall fully indemnify the Contractor from and against any and all losses, damages, costs, charges, proceedings and/or claims arising out of or with respect to

(a) the use or occupation of land or any part thereof by the Authority;

(b) the right of the Authority to execute the Works, or any part thereof, on, over, under, in or through any land;

(c) the damage to property which is the unavoidable result of the execution and completion of the Works, or the remedying of any Defects therein, in accordance with this Agreement; and

(d) the death of or injury to persons or loss of or damage to property resulting from any act or neglect of the Authority, its agents, servants or other contractors, not being employed by the Contractor.

Provided that, in the event of any injury or damage as a result of the contributory negligence of the Contractor, the Authority shall be liable to indemnify the Contractor from and against any and all losses, damages, costs, charges, proceedings and/or claims to the extent as may be proportionately determined to be the liability of the Authority, its

servants or agents or other contractors not associated with the Contractor in such injury or damage.

20.1.5 Without prejudice to the obligations of the Parties as specified under Clauses 20.1.3 and 20.1.4, the Contractor shall maintain or effect such third party insurances as may be required under the Applicable Laws.

20.1.6 The Contractor shall provide to the Authority, within 30 days of the Appointed Date, evidence of professional liability insurance maintained by its Design Director and/or consultants to cover the risk of professional negligence in the design of Works. The professional liability coverage shall be for a sum of not less than 3% (three per cent) of the Contract Price and shall be maintained until the end of the Defects Liability Period.

20.2 Notice to the Authority

` No later than 15 (fifteen) days after the date of this Agreement, the Contractor shall by notice furnish to the Authority, in reasonable detail, information in respect of the insurances that it proposes to effect and maintain in accordance with this Article 20. Within 15 (fifteen) days of receipt of such notice, the Authority may require the Contractor to effect and maintain such other insurances as may be necessary pursuant hereto, and in the event of any difference or disagreement relating to any such insurance, the Dispute Resolution Procedure shall apply.

20.3 Evidence of Insurance Cover

20.3.1 All insurances obtained by the Contractor in accordance with this Article 20 shall be maintained with insurers on terms consistent with Good Industry Practice. Within 10 (ten) days from the Appointed Date, the Contractor shall furnish to the Authority notarised true copies of the certificate(s) of insurance, copies of insurance policies and premia payment receipts in respect of such insurance, and no such insurance shall be cancelled, modified, or allowed to expire or lapse until the expiration of at least 45 (forty-five) days after notice of such proposed cancellation, modification or non-renewal has been delivered by the Contractor to the Authority. The Contractor shall act in accordance with the directions of the Authority. Provided that the Contractor shall produce to the Authority the insurance policies in force and the receipts for payment of the current premia.

20.3.2 The Contractor shall ensure the adequacy of the insurances at all times in accordance with the provisions of this Agreement.

20.4 Remedy for failure to insure

If the Contractor shall fail to effect and keep in force all insurances for which it is responsible pursuant hereto, the Authority shall have the option to either keep in force any such insurances, and pay such premia and recover the costs thereof from the Contractor, or in the event of computation of a Termination Payment, treat an amount

equal to the Insurance Cover as deemed to have been received by the Contractor.

20.5 Waiver of subrogation

All insurance policies in respect of the insurance obtained by the Contractor pursuant to this Article 20 shall include a waiver of any and all rights of subrogation or recovery of the insurers thereunder against, inter alia, the Authority, and its assigns, successors, undertakings and their subsidiaries, Affiliates, employees, insurers and underwriters, and of any right of the insurers to any set-off or counterclaim or any other deduction, whether by attachment or otherwise, in respect of any liability of any such person insured under any such policy or in any way connected with any loss, liability or obligation covered by such policies of insurance.

20.6 Contractor's waiver

The Contractor hereby further releases, assigns and waives any and all rights of subrogation or recovery against, inter alia, the Authority and its assigns, undertakings and their subsidiaries, Affiliates, employees, successors, insurers and underwriters, which the Contractor may otherwise have or acquire in or from or in any way connected with any loss, liability or obligation covered by policies of insurance maintained or required to be maintained by the Contractor pursuant to this Agreement (other than third party liability insurance policies) or because of deductible clauses in or inadequacy of limits of any such policies of insurance.

20.7 Cross liabilities

Any such insurance maintained or effected in pursuance of this Article 20 shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Authority as separately insured.

20.8 Accident or injury to workmen

Notwithstanding anything stated in this Agreement, it is hereby expressly agreed between the Parties that the Authority shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or Sub-contractor, save and except as for death or injury resulting from any act, omission or default of the Authority, its agents or servants. The Contractor shall indemnify and keep indemnified the Authority from and against all such claims, proceedings, damages, costs, charges, and expenses whatsoever in respect of the above save and except for those acts, omissions or defaults for which the Authority shall be liable.

20.9 Insurance against accident to workmen

The Contractor shall effect and maintain during the Agreement such insurances as may be required to insure the Contractor's personnel and any other persons employed by it on the Project from and against any liability incurred in pursuance of this Article 20.

Provided that for the purposes of this Clause 20.9, the Contractor's personnel/any person employed by the Contractor shall include the Sub-contractor and its personnel. It is further provided that, in respect of any persons employed by any Sub-contractor, the Contractor's obligations to insure as aforesaid under this Clause 20.9 shall be discharged if the Sub-contractor shall have insured against any liability in respect of such persons in such manner that the Authority is indemnified under the policy. The Contractor shall require such Sub-contractor to produce before the Authority, when required, such policy of insurance and the receipt for payment of the current premium within 10 (ten) days of such demand being made by the Authority.

20.10 Application of insurance proceeds

The proceeds from all insurance claims, except for life and injury, shall be applied for any necessary repair, reconstruction, reinstatement, replacement, improvement, delivery or installation of the Project and the provisions of this Agreement in respect of construction of works shall apply *mutatis mutandis* to the works undertaken out of the proceeds of insurance.

20.11 Compliance with policy conditions

Each Party hereby expressly agrees to fully indemnify the other Party from and against all losses and claims arising from its failure to comply with conditions imposed by the insurance policies effected in accordance with this Agreement.

Part V

Force Majeure and Termination

ARTICLE 21

FORCE MAJEURE

21.1 Force Majeure

As used in this Agreement, the expression "Force Majeure" or "Force Majeure Event" shall mean occurrence in India of any or all of Non-Political Event, Indirect Political Event and Political Event, as defined in Clauses 21.2, 21.3 and 21.4 respectively, if it affects the performance by the Party claiming the benefit of Force Majeure (the "**Affected Party**") of its obligations under this Agreement and which act or event (i) is beyond the reasonable control of the Affected Party, and (ii) the Affected Party could not have prevented or overcome by exercise of due diligence and following Good Industry Practice, and (iii) has Material Adverse Effect on the Affected Party.

21.2 Non-Political Event

A Non-Political Event shall mean one or more of the following acts or events:

(a) act of God, epidemic, extremely adverse weather conditions, lightning, earthquake, landslide, cyclone, flood, volcanic eruption, chemical or radioactive contamination or ionising radiation, fire or explosion (to the extent of contamination or radiation or fire or explosion originating from a source external to the Site);

(b) strikes or boycotts (other than those involving the Contractor, Sub-contractors or their respective employees/representatives, or attributable to any act or omission of any of them) interrupting supplies and services to the Project for a continuous period of 24 (twenty-four) hours and an aggregate period exceeding 10 (ten) days in an Accounting Year, and not being an Indirect Political Event set forth in Clause 21.3;

(c) any failure or delay of a Sub-contractor but only to the extent caused by another Non-Political Event;

(d) any judgement or order of any court of competent jurisdiction or statutory authority made against the Contractor in any proceedings for reasons other than (i) failure of the Contractor to comply with any Applicable Law or Applicable Permit, or (ii) on account of breach of any Applicable Law or Applicable Permit or of any contract, or (iii) enforcement of this Agreement, or (iv) exercise of any of its rights under this Agreement by the Authority;

(e) the discovery of geological conditions, toxic contamination or archaeological remains on the Site that could not reasonably have been expected to be discovered through a site inspection; or

(f) any event or circumstances of a nature analogous to any of the foregoing.

21.3 Indirect Political Event

An Indirect Political Event shall mean one or more of the following acts or events:

(a) an act of war (whether declared or undeclared), invasion, armed conflict or act of foreign enemy, blockade, embargo, riot, insurrection, terrorist or military action, civil commotion or politically motivated sabotage;

(b) industry-wide or State-wide strikes or industrial action for a continuous period of 24 (twenty-four) hours and exceeding an aggregate period of 10 (ten) days in an Accounting Year;

(c) any civil commotion, boycott or political agitation which prevents construction of the Project by the Contractor for an aggregate period exceeding 10 (ten) days in an Accounting Year;

(d) any failure or delay of a Sub-contractor to the extent caused by any Indirect Political Event;

(e) any Indirect Political Event that causes a Non-Political Event; or

(f) any event or circumstances of a nature analogous to any of the foregoing.

21.4 Political Event

A Political Event shall mean one or more of the following acts or events by or on account of any Government Instrumentality:

(a) Change in Law, only if consequences thereof cannot be dealt with under and in accordance with the provisions of Clause 19.17;

(b) compulsory acquisition in national interest or expropriation of any Project Assets or rights of the Contractor or of the Sub-Contractors;

(c) unlawful or unauthorised or without jurisdiction revocation of, or refusal to renew or grant without valid cause, any clearance, licence, permit, authorisation, no objection certificate, consent, approval or exemption required by the Contractor or any of the Sub-contractors to perform their respective obligations under this Agreement; provided that such delay, modification, denial, refusal or revocation did not result from the Contractor's or any Sub-contractor's inability or failure to comply with any condition relating to grant, maintenance or renewal of such clearance, licence, authorisation, no objection certificate, exemption, consent, approval or permit;

(d) any failure or delay of a Sub-contractor but only to the extent caused by another Political Event; or

(e) any event or circumstances of a nature analogous to any of the foregoing.

21.5 Duty to report Force Majeure Event

21.5.1 Upon occurrence of a Force Majeure Event, the Affected Party shall by notice report such occurrence to the other Party forthwith. Any notice pursuant hereto shall include full particulars of:

(a) the nature and extent of each Force Majeure Event which is the subject of any claim for relief under this Article 21 with evidence in support thereof;

(b) the estimated duration and the effect or probable effect which such Force Majeure Event is having or will have on the Affected Party's performance of its obligations under this Agreement;

(c) the measures which the Affected Party is taking or proposes to take for alleviating the impact of such Force Majeure Event; and

(d) any other information relevant to the Affected Party's claim.

21.5.2 The Affected Party shall not be entitled to any relief for or in respect of a Force Majeure Event unless it shall have notified the other Party of the occurrence of the Force Majeure Event as soon as reasonably practicable, and in any event no later than 10 (ten) days after the Affected Party knew, or ought reasonably to have known, of its occurrence, and shall have given particulars of the probable material effect that the Force Majeure Event is likely to have on the performance of its obligations under this Agreement.

21.5.3 For so long as the Affected Party continues to claim to be materially affected by such Force Majeure Event, it shall provide the other Party with regular (and not less than weekly) reports containing information as required by Clause 21.5.1, and such other information as the other Party may reasonably request the Affected Party to provide.

21.6 Effect of Force Majeure Event on the Agreement

21.6.1 Upon the occurrence of any Force Majeure after the Appointed Date, the costs incurred and attributable to such event and directly relating to this Agreement (the "**Force Majeure costs**") shall be allocated and paid as follows:

(a) upon occurrence of a Non-Political Event, the Parties shall bear their respective Force Majeure costs and neither Party shall be required to pay to the other Party any costs thereof;

(b) upon occurrence of an Indirect Political Event, all Force Majeure costs attributable to such Indirect Political Event, and not exceeding the Insurance Cover for such Indirect Political Event, shall be borne by the Contractor, and to the extent Force Majeure costs exceed such Insurance Cover, one half of such excess amount shall be reimbursed by the Authority to the Contractor for the

Force Majeure events; and

(c) upon occurrence of a Political Event, all Force Majeure costs attributable to such Political Event shall be reimbursed by the Authority to the Contractor.

For the avoidance of doubt, Force Majeure costs may include costs directly attributable to the Force Majeure Event, but shall not include debt repayment obligations, if any, of the Contractor.

21.6.2 Save and except as expressly provided in this Article 21, neither Party shall be liable in any manner whatsoever to the other Party in respect of any loss, damage, cost, expense, claims, demands and proceedings relating to or arising out of occurrence or existence of any Force Majeure Event or exercise of any right pursuant hereto.

21.6.3 Upon the occurrence of any Force Majeure Event during the Construction Period, the Project Completion Schedule for and in respect of the affected Works shall be extended on a day for day basis for such period as performance of the Contractor's obligations is affected on account of the Force Majeure Event or its subsisting effects.

21.7 Termination Notice for Force Majeure Event

21.7.1 If a Force Majeure Event subsists for a period of 60 (sixty) days or more within a continuous period of 120 (one hundred and twenty) days, either Party may in its discretion terminate this Agreement by issuing a Termination Notice to the other Party without being liable in any manner whatsoever, save as provided in this Article 21, and upon issue of such Termination Notice, this Agreement shall, notwithstanding anything to the contrary contained herein, stand terminated forthwith; provided that before issuing such Termination Notice, the Party intending to issue the Termination Notice shall inform the other Party of such intention and grant 15 (fifteen) days time to make a representation, and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the Termination Notice.

21.8 Termination Payment for Force Majeure Event

21.8.1 In the event of this Agreement being terminated on account of a Non-Political Event, the Termination Payment shall be an amount equal to the sum payable under Clause 23.5.
Provided that in the event Termination occurs during the Maintenance Period, the Authority's Engineer shall only determine the value of Works associated with Maintenance.

21.8.2 If Termination is on account of an Indirect Political Event, the Termination Payment shall include:

(a) any sums due and payable under Clause 23.5; and

(b) the reasonable cost, as determined by the Authority's Engineer, of the Plant and Materials procured by the Contractor and transferred to the Authority for use in Construction or Maintenance, only if such Plant and Materials are in conformity

with the Specifications and Standards;

Provided that in the event Termination occurs during the Maintenance Period, the Authority's Engineer shall only determine the value of Works associated with Maintenance.

21.8.3 If Termination is on account of a Political Event, the Authority shall make a Termination Payment to the Contractor in an amount that would be payable under Clause 23.6.2 as if it were an Authority Default.

21.9 Dispute resolution

In the event that the Parties are unable to agree in good faith about the occurrence or existence of a Force Majeure Event, such Dispute shall be finally settled in accordance with the Dispute Resolution Procedure; provided that the burden of proof as to the occurrence or existence of such Force Majeure Event shall be upon the Party claiming relief and/or excuse on account of such Force Majeure Event.

21.10 Excuse from performance of obligations

If the Affected Party is rendered wholly or partially unable to perform its obligations under this Agreement because of a Force Majeure Event, it shall be excused from performance of such of its obligations to the extent it is unable to perform on account of such Force Majeure Event; provided that:

(a) the suspension of performance shall be of no greater scope and of no longer duration than is reasonably required by the Force Majeure Event;

(b) the Affected Party shall make all reasonable efforts to mitigate or limit damage to the other Party arising out of or as a result of the existence or occurrence of such Force Majeure Event and to cure the same with due diligence; and

(c) when the Affected Party is able to resume performance of its obligations under this Agreement, it shall give to the other Party notice to that effect and shall promptly resume performance of its obligations hereunder.

ARTICLE 22

SUSPENSION OF CONTRACTOR'S RIGHTS

22.1 Suspension upon Contractor Default

Upon occurrence of a Contractor Default, the Authority shall be entitled, without prejudice to its other rights and remedies under this Agreement including its rights of Termination hereunder, to (i) suspend carrying out of the Works or Maintenance or any part thereof, and (ii) carry out such Works or Maintenance itself or authorise any other person to exercise or perform the same on its behalf during such suspension (the "**Suspension**"). Suspension hereunder shall be effective forthwith upon issue of notice by the Authority to the Contractor and may extend up to a period not exceeding 90 (ninety) days from the date of issue of such notice.

22.2 Authority to act on behalf of Contractor

During the period of Suspension hereunder, all rights and liabilities vested in the Contractor in accordance with the provisions of this Agreement shall continue to vest therein and all things done or actions taken, including expenditure incurred by the Authority for discharging the obligations of the Contractor under and in accordance with this Agreement shall be deemed to have been done or taken for and on behalf of the Contractor and the Contractor undertakes to indemnify the Authority for all costs incurred during such period. The Contractor hereby licences and sub-licences respectively, the Authority or any other person authorised by it under Clause 22.1 to use during Suspension, all Intellectual Property belonging to or licenced to the Contractor with respect to the Project and its design, engineering, construction and maintenance, and which is used or created by the Contractor in performing its obligations under the Agreement.

22.3 Revocation of Suspension

22.3.1 In the event that the Authority shall have rectified or removed the cause of Suspension within a period not exceeding 60 (sixty) days from the date of Suspension, it shall revoke the Suspension forthwith and restore all rights of the Contractor under this Agreement. For the avoidance of doubt, the Parties expressly agree that the Authority may, in its discretion, revoke the Suspension at any time, whether or not the cause of Suspension has been rectified or removed hereunder.

22.3.2 Upon the Contractor having cured the Contractor Default within a period not exceeding 60 (sixty) days from the date of Suspension, the Authority shall revoke the Suspension forthwith and restore all rights of the Contractor under this Agreement.

22.4 Termination

22.4.1 At any time during the period of Suspension under this Article 22, the Contractor may by notice require the Authority to revoke the Suspension and issue a Termination Notice.

The Authority shall, within 15 (fifteen) days of receipt of such notice, terminate this Agreement under and in accordance with Article 23.

22.4.2 Notwithstanding anything to the contrary contained in this Agreement, in the event that Suspension is not revoked within 90 (ninety) days from the date of Suspension hereunder, the Agreement shall, upon expiry of the aforesaid period, be deemed to have been terminated by mutual agreement of the Parties and all the provisions of this Agreement shall apply, *mutatis mutandis*, to such Termination as if a Termination Notice had been issued by the Authority upon occurrence of a Contractor Default.

ARTICLE 23

TERMINATION

23.1 Termination for Contractor Default

23.1.1 Save as otherwise provided in this Agreement, in the event that any of the defaults specified below shall have occurred, and the Contractor fails to cure the default within the Cure Period set forth below, or where no Cure Period is specified, then within a Cure Period of 60 (sixty) days, the Contractor shall be deemed to be in default of this Agreement (the "**Contractor Default**"), unless the default has occurred solely as a result of any breach of this Agreement by the Authority or due to Force Majeure. The defaults referred to herein shall include:

(a) the Contractor fails to provide, extend or replenish, as the case may be, the Performance Security in accordance with this Agreement;

(b) subsequent to the replenishment or furnishing of fresh Performance Security in accordance with Clause 7.3, the Contractor fails to cure, within a Cure Period of 30 (thirty) days, the Contractor Default for which the whole or part of the Performance Security was appropriated;

(c) the Contractor does not achieve the latest outstanding Project Milestone due in accordance with the provisions of Schedule-J, subject to any Time Extension, and continues to be in default for 45 (forty five) days;

(d) the Contractor abandons or manifests intention to abandon the construction or Maintenance of the Project without the prior written consent of the Authority;

(e) the Contractor fails to proceed with the Works in accordance with the provisions of Clause 10.1 or stops Works and/or the Maintenance for 30 (thirty) days without reflecting the same in the current programme and such stoppage has not been authorised by the Authority's Engineer;

(f) the Project Completion Date does not occur within the period specified in Schedule-J for the Scheduled Completion Date, or any extension thereof;

(g) failure to complete the Punch List items within the periods stipulated therefor in Clause 12.2.1;

(h) the Contractor fails to rectify any Defect, the non-rectification of which shall have a Material Adverse Effect on the Project, within the time specified in this Agreement or as directed by the Authority's Engineer;

(i) the Contractor subcontracts the Works or any part thereof in violation of this Agreement or assigns any part of the Works or the Maintenance without the prior

approval of the Authority;

(j) the Contractor creates any Encumbrance in breach of this Agreement;

(k) an execution levied on any of the assets of the Contractor has caused a Material Adverse Effect ;

(l) the Contractor is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Contractor or for the whole or material part of its assets that has a material bearing on the Project;

(m) the Contractor has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of the Authority, a Material Adverse Effect;

(n) a resolution for winding up of the Contractor is passed, or any petition for winding up of the Contractor is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Contractor is ordered to be wound up by court except for the purpose of amalgamation or reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Contractor are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Contractor under this Agreement; and provided that:

(i) the amalgamated or reconstructed entity has the capability and experience necessary for the performance of its obligations under this Agreement; and

(ii) the amalgamated or reconstructed entity has the financial standing to perform its obligations under this Agreement and has a credit worthiness at least as good as that of the Contractor as at the Appointed Date;

(o) any representation or warranty of the Contractor herein contained which is, as of the date hereof, found to be materially false or the Contractor is at any time hereafter found to be in breach thereof;

(p) the Contractor submits to the Authority any statement, notice or other document, in written or electronic form, which has a material effect on the Authority's rights, obligations or interests and which is false in material particulars;

(q) the Contractor has failed to fulfil any obligation, for which failure Termination has been specified in this Agreement; or

(r) the Contractor commits a default in complying with any other provision of this Agreement if such a default causes a Material Adverse Effect on the Project or on the Authority.

23.1.2 Without prejudice to any other rights or remedies which the Authority may have under this Agreement, upon occurrence of a Contractor Default, the Authority shall be entitled to terminate this Agreement by issuing a Termination Notice to the Contractor; provided that before issuing the Termination Notice, the Authority shall by a notice inform the Contractor of its intention to issue such Termination Notice and grant 15 (fifteen) days to the Contractor to make a representation, and may after the expiry of such 15 (fifteen) days, whether or not it is in receipt of such representation, issue the Termination Notice.

23.1.3 After termination of this Agreement for Contractor Default, the Authority may complete the Works and/or arrange for any other entities to do so. The Authority and these entities may then use any Materials, Plant and equipment, Contractor's documents and other design documents made by or on behalf of the Contractor.

23.2 Termination for Authority Default

23.2.1 In the event that any of the defaults specified below shall have occurred, and the Authority fails to cure such default within a Cure Period of 90 (ninety) days or such longer period as has been expressly provided in this Agreement, the Authority shall be deemed to be in default of this Agreement (the "**Authority Default**") unless the default has occurred as a result of any breach of this Agreement by the Contractor or due to Force Majeure. The defaults referred to herein shall include:

(a) the Authority commits a material default in complying with any of the provisions of this Agreement and such default has a Material Adverse Effect on the Contractor;

(b) the Authority has failed to make payment of any amount due and payable to the Contractor within the period specified in this Agreement;

(c) the Authority has failed to provide, within a period of 180 (one hundred and eighty) days from the Appointed Date, the environmental clearances required for construction of the Project ;

(d) the Authority repudiates this Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by this

Agreement; or

(e) the Authority's Engineer fails to issue the relevant Interim Payment Certificate within 60 (sixty) days after receiving a statement and supporting documents.

23.2.2 Without prejudice to any other right or remedy which the Contractor may have under this Agreement, upon occurrence of an Authority Default, the Contractor shall be entitled to terminate this Agreement by issuing a Termination Notice to the Authority; provided that before issuing the Termination Notice, the Contractor shall by a notice inform the Authority of its intention to issue the Termination Notice and grant 15 (fifteen) days to the Authority to make a representation, and may after the expiry of such 15 (fifteen) days, whether or not it is in receipt of such representation, issue the Termination Notice.

If on the consideration of the Authority's representation or otherwise, the contractor does not issue the Termination Notice on such 15th day and prefers to continue with the project, it is deemed that the cause of action of the Termination Notice has been condoned by the Contractor. Hence he forfeits his right to any other remedy on that count.

23.3 Termination for Authority's convenience

Notwithstanding anything stated hereinabove, the Authority may terminate this Agreement for convenience. The termination shall take effect 30 (thirty) days from the date of notice hereunder.

23.4 Requirements after Termination

Upon Termination of this Agreement in accordance with the terms of this Article 23, the Contractor shall comply with and conform to the following:

(a) deliver to the Authority all Plant and Materials which shall have become the property of the Authority under this Article 23;

(b) deliver all relevant records, reports, Intellectual Property and other licences pertaining to the Works, Maintenance, other design documents and in case of Termination occurring after the Provisional Certificate has been issued, the "as built' Drawings for the Works;

(c) transfer and/or deliver all Applicable Permits to the extent permissible under Applicable Laws; and

(d) vacate the Site within 15 (fifteen) days.

23.5 Valuation of Unpaid Works

23.5.1 Within a period of 45 (forty-five) days after Termination under Clause 23.1, 23.2 or 23.3, as the case may be, has taken effect, the Authority's Engineer shall proceed in accordance

with Clause 18.5 to determine as follows the valuation of unpaid Works (the "**Valuation of Unpaid Works**"):

(a) value of the completed stage of the Works, less payments already made;

(b) reasonable value of the partially completed stages of works as on the date of Termination, only if such works conform with the Specifications and Standards; and

(c) value of Maintenance, if any, for completed months, less payments already made,

and shall adjust from the sum thereof (i) any other amounts payable or recoverable, as the case may be, in accordance with the provisions of this Agreement; and (ii) all taxes due to be deducted at source.

23.5.2 The Valuation of Unpaid Works shall be communicated to the Authority, with a copy to the Contractor, within a period of 30 (thirty) days from the date of Termination.

23.6 Termination Payment

23.6.1 Upon Termination on account of Contractor's Default under Clause 23.1, the Authority shall:

(a) encash and appropriate the Performance Security and Retention Money, or in the event the Contractor has failed to replenish or extend the Performance Security, claim the amount stipulated in Clause 7.1.1, as agreed pre-determined compensation to the Authority for any losses, delays and cost of completing the Works and Maintenance, if any;

(b) encash and appropriate the bank guarantee, if any, for and in respect of the outstanding Advance Payment and interest thereon; and

(c) pay to the Contractor, by way of Termination Payment, an amount equivalent to the Valuation of Unpaid Works after adjusting any other sums payable or recoverable, as the case may be, in accordance with the provisions of this Agreement.

23.6.2 Upon Termination on account of an Authority Default under Clause 23.2 or for Authority's convenience under Clause 23.3, the Authority shall:

(a) return the Performance Security and Retention Money forthwith;

(b) encash and appropriate the bank guarantee, if any, for and in respect of the outstanding Advance Payment; and

(c) pay to the Contractor, by way of Termination Payment, an amount equal to:

(i) Valuation of Unpaid Works;

(ii) the reasonable cost, as determined by the Authority's Engineer, of the Plant and Materials procured by the Contractor and transferred to the Authority for its use, only if such Plant and Materials are in conformity with the Specifications and Standards;

(iii) the reasonable cost of temporary works, as determined by the Authority's Engineer; and

(iv) 10% (ten per cent) of the cost of the Works and Maintenance that are not commenced or not completed,

and shall adjust from the sum thereof (i) any other amounts payable or recoverable, as the case may be, in accordance with the provisions of this Agreement, and (ii) all taxes due to be deducted at source.

23.6.3 Termination Payment shall become due and payable to the Contractor within 30 (thirty) days of a demand being made by the Contractor to the Authority with the necessary particulars, and in the event of any delay, the Authority shall pay interest at the Base Rate plus 2% (two percent), calculated at quarterly rests, on the amount of Termination Payment remaining unpaid; provided that such delay shall not exceed 90 (ninety) days. For the avoidance of doubt, it is expressly agreed that Termination Payment shall constitute full discharge by the Authority of its payment obligations in respect thereof hereunder.

23.6.4 The Contractor expressly agrees that Termination Payment under this Article 23 shall constitute a full and final settlement of all claims of the Contractor on account of Termination of this Agreement and that it shall not have any further right or claim under any law, treaty, convention, contract or otherwise.

23.7 Other rights and obligations of the Parties

Upon Termination for any reason whatsoever

(a) property and ownership in all Materials, Plant and Works and the Project shall, as between the Contractor and the Authority, vest in the Authority in whole; provided that the foregoing shall be without prejudice to Clause 23.6

(b) risk of loss or damage to any Materials, Plant or Works and the care and custody thereof shall pass from the Contractor to the Authority; and

(c) the Authority shall be entitled to restrain the Contractor and any person claiming through or under the Agreement from entering upon the Site or any part of the Project except for taking possession of materials, stores, implements, construction

plants and equipment of the Contractor, which have not been vested in the Authority in accordance with the provisions of this Agreement.

23.8 Survival of rights

Notwithstanding anything to the contrary contained in this Agreement any Termination pursuant to the provisions of this Agreement shall be without prejudice to the accrued rights of either Party including its right to claim and recover money damages, insurance proceeds, security deposits, and other rights and remedies, which it may have in law or Agreement. All rights and obligations of either Party under this Agreement, including Termination Payments, shall survive the Termination to the extent such survival is necessary for giving effect to such rights and obligations.

Part VI

Other Provisions

ARTICLE 24
ASSIGNMENT AND CHARGES

24.1 Restrictions on assignment and charges

This Agreement shall not be assigned by the Contractor to any person, save and except with the prior consent in writing of the Authority, which consent the Authority shall be entitled to decline without assigning any reason.

24.2 Hypothecation of Materials or Plant

Notwithstanding the provisions of Clause 24.1, the Contractor may pledge or hypothecate to its lenders, any Materials or Plant prior to their incorporation in the Works. Further, the Contractor may, by written notice to the Authority, assign its right to receive payments under this Agreement either absolutely or by way of charge, to any person providing financing to the Contractor in connection with the performance of the Contractor's obligations under this Agreement. The Contractor acknowledges that any such assignment by the Contractor shall not relieve the Contractor from any obligations, duty or responsibility under this Agreement.

ARTICLE 25

LIABILITY AND INDEMNITY

25.1 General indemnity

25.1.1 The Contractor will indemnify, defend, save and hold harmless the Authority and its officers, servants, agents, Government Instrumentalities and Government owned and/or controlled entities/enterprises, (the "**Authority Indemnified Persons**") against any and all suits, proceedings, actions, demands and third party claims for any loss, damage, cost and expense of whatever kind and nature, whether arising out of any breach by the Contractor of any of its obligations under this Agreement or from any negligence under the Agreement, including any errors or deficiencies in the design documents, or tort or on any other ground whatsoever, except to the extent that any such suits, proceedings, actions, demands and claims have arisen due to any negligent act or omission, or breach or default of this Agreement on the part of the Authority Indemnified Persons.

25.2 Indemnity by the Contractor

25.2.1 Without limiting the generality of Clause 25.1, the Contractor shall fully indemnify, hold harmless and defend the Authority and the Authority Indemnified Persons from and against any and all loss and/or damages arising out of or with respect to:

(a) failure of the Contractor to comply with Applicable Laws and Applicable Permits;

(b) payment of taxes required to be made by the Contractor in respect of the income or other taxes of the Sub-contractors, suppliers and representatives; or

(c) non-payment of amounts due as a result of Materials or services furnished to the Contractor or any of its Sub-contractors which are payable by the Contractor or any of its Sub-contractors.

25.2.2 Without limiting the generality of the provisions of this Article 25, the Contractor shall fully indemnify, hold harmless and defend the Authority Indemnified Persons from and against any and all suits, proceedings, actions, claims, demands, liabilities and damages which the Authority Indemnified Persons may hereafter suffer, or pay by reason of any demands, claims, suits or proceedings arising out of claims of infringement of any domestic or foreign patent rights, copyrights or other intellectual property, proprietary or confidentiality rights with respect to any materials, information, design or process used by the Contractor or by the Sub-contractors in performing the Contractor's obligations or in any way incorporated in or related to the Project. If in any such suit, action, claim or proceedings, a temporary restraint order or preliminary injunction is granted, the Contractor shall make every reasonable effort, by giving a satisfactory bond or otherwise, to secure the revocation or suspension of the injunction or restraint order. If, in any such suit, action, claim or proceedings, the Project , or any part thereof or comprised therein, is held to constitute an infringement and its use is permanently enjoined, the Contractor shall promptly make every reasonable effort to secure for the Authority a licence, at no

cost to the Authority, authorising continued use of the infringing work. If the Contractor is unable to secure such licence within a reasonable time, the Contractor shall, at its own expense, and without impairing the Specifications and Standards, either replace the affected work, or part, or process thereof with non-infringing work or part or process, or modify the same so that it becomes non-infringing.

25.3 Notice and contest of claims

In the event that either Party receives a claim or demand from a third party in respect of which it is entitled to the benefit of an indemnity under this Article 25 (the "**Indemnified Party**") it shall notify the other Party (the "**Indemnifying Party**") within 15 (fifteen) days of receipt of the claim or demand and shall not settle or pay the claim without the prior approval of the Indemnifying Party, which approval shall not be unreasonably withheld or delayed. In the event that the Indemnifying Party wishes to contest or dispute the claim or demand, it may conduct the proceedings in the name of the Indemnified Party, subject to the Indemnified Party being secured against any costs involved, to its reasonable satisfaction.

25.4 Defence of claims

25.4.1 The Indemnified Party shall have the right, but not the obligation, to contest, defend and litigate any claim, action, suit or proceeding by any third party alleged or asserted against such Party in respect of, resulting from, related to or arising out of any matter for which it is entitled to be indemnified hereunder, and reasonable costs and expenses thereof shall be indemnified by the Indemnifying Party. If the Indemnifying Party acknowledges in writing its obligation to indemnify the Indemnified Party in respect of loss to the full extent provided by this Article 25, the Indemnifying Party shall be entitled, at its option, to assume and control the defence of such claim, action, suit or proceeding, liabilities, payments and obligations at its expense and through the counsel of its choice; provided it gives prompt notice of its intention to do so to the Indemnified Party and reimburses the Indemnified Party for the reasonable cost and expenses incurred by the Indemnified Party prior to the assumption by the Indemnifying Party of such defence. The Indemnifying Party shall not be entitled to settle or compromise any claim, demand, action, suit or proceeding without the prior written consent of the Indemnified Party, unless the Indemnifying Party provides such security to the Indemnified Party as shall be reasonably required by the Indemnified Party to secure the loss to be indemnified hereunder to the extent so compromised or settled.

25.4.2 If the Indemnifying Party has exercised its rights under Clause 25.3, the Indemnified Party shall not be entitled to settle or compromise any claim, action, suit or proceeding without the prior written consent of the Indemnifying Party (which consent shall not be unreasonably withheld or delayed).

25.4.3 If the Indemnifying Party exercises its rights under Clause 25.3, the Indemnified Party shall nevertheless have the right to employ its own counsel, and such counsel may participate in such action, but the fees and expenses of such counsel shall be at the

expense of the Indemnified Party, when and as incurred, unless:

(a) the employment of counsel by such party has been authorised in writing by the Indemnifying Party; or

(b) the Indemnified Party shall have reasonably concluded that there may be a conflict of interest between the Indemnifying Party and the Indemnified Party in the conduct of the defence of such action; or

(c) the Indemnifying Party shall not, in fact, have employed independent counsel reasonably satisfactory to the Indemnified Party, to assume the defence of such action and shall have been so notified by the Indemnified Party; or

(d) the Indemnified Party shall have reasonably concluded and specifically notified the Indemnifying Party either:

(i) that there may be specific defences available to it which are different from or additional to those available to the Indemnifying Party; or

(ii) that such claim, action, suit or proceeding involves or could have a material adverse effect upon it beyond the scope of this Agreement:

Provided that if Sub-clauses (b), (c) or (d) of this Clause 25.4.3 shall be applicable, the counsel for the Indemnified Party shall have the right to direct the defence of such claim, demand, action, suit or proceeding on behalf of the Indemnified Party, and the reasonable fees and disbursements of such counsel shall constitute legal or other expenses hereunder.

25.5 No consequential claims

Notwithstanding anything to the contrary contained in this Article 25, the indemnities herein provided shall not include any claim or recovery in respect of any cost, expense, loss or damage of an indirect, incidental or consequential nature, including loss of profit, except as expressly provided in this Agreement.

25.6 Survival on Termination

The provisions of this Article 25 shall survive Termination.

ARTICLE 26

DISPUTE RESOLUTION

26.1 Dispute Resolution

26.1.1 Any dispute, difference or controversy of whatever nature howsoever arising under or out of or in relation to this Agreement (including its interpretation) between the Parties, and so notified in writing by either Party to the other Party (the "**Dispute**") shall, in the first instance, be attempted to be resolved amicably in accordance with the conciliation procedure set forth in Clause 26.2.

26.1.2 The Parties agree to use their best efforts for resolving all Disputes arising under or in respect of this Agreement promptly, equitably and in good faith, and further agree to provide each other with reasonable access during normal business hours to all non-privileged records, information and data pertaining to any Dispute.

26.2 Conciliation

In the event of any Dispute between the Parties, either Party may call upon the Authority's Engineer, or such other person as the Parties may mutually agree upon (the "**Conciliator**") to mediate and assist the Parties in arriving at an amicable settlement thereof. Failing mediation by the Conciliator or without the intervention of the Conciliator, either Party may require such Dispute to be referred to the Chairman of the Authority and the Chairman of the Board of Directors of the Contractor for amicable settlement, and upon such reference, the said persons shall meet no later than 7 (seven) business days from the date of reference to discuss and attempt to amicably resolve the Dispute. If such meeting does not take place within the 7 (seven) business day period or the Dispute is not amicably settled within 15 (fifteen) days of the meeting or the Dispute is not resolved as evidenced by the signing of written terms of settlement within 30 (thirty) days of the notice in writing referred to in Clause 26.1.1 or such longer period as may be mutually agreed by the Parties, either Party may refer the Dispute to arbitration in accordance with the provisions of Clause 26.3.

26.3 Arbitration

26.3.1 Any Dispute which is not resolved amicably by conciliation, as provided in Clause 26.2, shall be finally decided by reference to arbitration by a Board of Arbitrators appointed in accordance with Clause 26.3.2. Such arbitration shall be held in accordance with the Rules of Arbitration of the International Centre for Alternative Dispute Resolution, New Delhi (the "Rules"), or such other rules as may be mutually agreed by the Parties, and shall be subject to the provisions of the Arbitration Act. The venue of such arbitration shall be [Rourkela], and the language of arbitration proceedings shall be English

26.3.2 There shall be a Board of three arbitrators, of whom each Party shall select one, and the third arbitrator shall be appointed by the two arbitrators so selected and in the event of

disagreement between the two arbitrators, the appointment shall be made in accordance with the Rules..

26.3.3 The arbitrators shall make a reasoned award (the "**Award**"). Any Award made in any arbitration held pursuant to this Article 26 shall be final and binding on the Parties as from the date it is made, and the Contractor and the Authority agree and undertake to carry out such Award without delay.

26.3.4 The Contractor and the Authority agree that an Award may be enforced against the Contractor and/or the Authority, as the case may be, and their respective assets wherever situated.

26.3.5 This Agreement and the rights and obligations of the Parties shall remain in full force and effect, pending the Award in any arbitration proceedings hereunder.

26.3.6 In the event the Party against whom the Award has been granted challenges the Award for any reason in a court of law, it shall make an interim payment to the other Party for an amount equal to 75% (seventy five per cent) of the Award, pending final settlement of the Dispute. The aforesaid amount shall be paid forthwith upon furnishing an irrevocable Bank Guarantee for a sum equal to 120 % (one hundred and twenty per cent) of the aforesaid amount. Upon final settlement of the Dispute, the aforesaid interim payment shall be adjusted and any balance amount due to be paid or returned, as the case may be, shall be paid or returned with interest calculated at the rate of 10% (ten per cent) per annum from the date of interim payment to the date of final settlement of such balance.

26.4 Adjudication by Regulatory Authority, Tribunal or Commission

In the event of constitution of a statutory regulatory authority, tribunal or commission, as the case may be, with powers to adjudicate upon disputes between the Contractor and the Authority, all Disputes arising after such constitution shall, instead of reference to arbitration under Clause 26.3, be adjudicated upon by such regulatory authority, tribunal or commission in accordance with the Applicable Law and all references to Dispute Resolution Procedure shall be construed accordingly. For the avoidance of doubt, the Parties hereto agree that the adjudication hereunder shall not be final and binding until an appeal against such adjudication has been decided by an appellate tribunal or court of competent jurisdiction, as the case may be, or no such appeal has been preferred within the time specified in the Applicable Law.

ARTICLE 27
MISCELLANEOUS

27.1 Governing law and jurisdiction

This Agreement shall be construed and interpreted in accordance with and governed by the laws of Odisha/ India, and the courts at Rourkela shall have exclusive jurisdiction over matters arising out of or relating to this Agreement.

27.2 Waiver of immunity

Each Party unconditionally and irrevocably:

(a) agrees that the execution, delivery and performance by it of this Agreement constitute commercial acts done and performed for commercial purpose;

(b) agrees that, should any proceedings be brought against it or its assets, property or revenues in any jurisdiction in relation to this Agreement or any transaction contemplated by this Agreement, no immunity (whether by reason of sovereignty or otherwise) from such proceedings shall be claimed by or on behalf of the Party with respect to its assets;

(c) waives any right of immunity which it or its assets, property or revenues now has, may acquire in the future or which may be attributed to it in any jurisdiction; and

(d) consents generally in respect of the enforcement of any judgement or award against it in any such proceedings to the giving of any relief or the issue of any process in any jurisdiction in connection with such proceedings (including the making, enforcement or execution against it or in respect of any assets, property or revenues whatsoever irrespective of their use or intended use of any order or judgement that may be made or given in connection therewith).

27.3 Delayed payments

The Parties hereto agree that payments due from one Party to the other Party under the provisions of this Agreement shall be made within the period set forth therein, and if no such period is specified, within 30 (thirty) days of receiving a demand along with the necessary particulars. In the event of delay beyond such period, the defaulting Party shall pay interest for the period of delay calculated at a rate equal to Base Rate plus 2 (two) percent, calculated at quarterly rests, and recovery thereof shall be without prejudice to the rights of the Parties under this Agreement including Termination thereof.

27.4 Waiver

27.4.1 Waiver, including partial or conditional waiver, by either Party of any default by the other Party in the observance and performance of any provision of or obligations under

this Agreement:-

(a) shall not operate or be construed as a waiver of any other or subsequent default hereof or of other provisions of or obligations under this Agreement;

(b) shall not be effective unless it is in writing and executed by a duly authorised representative of the Party; and

(c) shall not affect the validity or enforceability of this Agreement in any manner.

27.4.2 Neither the failure by either Party to insist on any occasion upon the performance of the terms, conditions and provisions of this Agreement or any obligation thereunder nor time or other indulgence granted by a Party to the other Party shall be treated or deemed as waiver of such breach or acceptance of any variation or the relinquishment of any such right hereunder.

27.5 Liability for review of Documents and Drawings

Except to the extent expressly provided in this Agreement:

(a) no review, comment or approval by the Authority or the Authority's Engineer of any Document or Drawing submitted by the Contractor nor any observation or inspection of the construction, or maintenance of the Project nor the failure to review, approve, comment, observe or inspect hereunder shall relieve or absolve the Contractor from its obligations, duties and liabilities under this Agreement, the Applicable Laws and Applicable Permits; and

(b) the Authority shall not be liable to the Contractor by reason of any review, comment, approval, observation or inspection referred to in Sub-clause (a) above.

27.6 Exclusion of implied warranties etc.

This Agreement expressly excludes any warranty, condition or other undertaking implied at law or by custom or otherwise arising out of any other agreement between the Parties or any representation by either Party not contained in a binding legal agreement executed by both Parties.

27.7 Survival

27.7.1 Termination shall:

(a) not relieve the Contractor or the Authority, as the case may be, of any obligations hereunder which expressly or by implication survive Termination hereof; and

(b) except as otherwise provided in any provision of this Agreement expressly limiting the liability of either Party, not relieve either Party of any obligations or liabilities for loss or damage to the other Party arising out of, or caused by, acts or omissions of such Party prior to the effectiveness of such Termination or arising out of such Termination.

27.7.2 All obligations surviving Termination shall only survive for a period of 3 (three) years following the date of such Termination.

27.8 Entire Agreement

This Agreement and the Schedules together constitute a complete and exclusive statement of the terms of the agreement between the Parties on the subject hereof, and no amendment or modification hereto shall be valid and effective unless such modification or amendment is agreed to in writing by the Parties and duly executed by persons especially empowered in this behalf by the respective Parties. All prior written or oral understandings, offers or other communications of every kind pertaining to this Agreement are abrogated and withdrawn. For the avoidance of doubt, the Parties hereto agree that any obligations of the Contractor arising from the Request for Qualification or Request for Proposals, as the case may be, shall be deemed to form part of this Agreement and treated as such.

27.9 Severability

If for any reason whatever, any provision of this Agreement is or becomes invalid, illegal or unenforceable or is declared by any court of competent jurisdiction or any other instrumentality to be invalid, illegal or unenforceable, the validity, legality or enforceability of the remaining provisions shall not be affected in any manner, and the Parties will negotiate in good faith with a view to agreeing to one or more provisions which may be substituted for such invalid, unenforceable or illegal provisions, as nearly as is practicable to such invalid, illegal or unenforceable provision. Failure to agree upon any such provisions shall not be subject to the Dispute Resolution Procedure set forth under this Agreement or otherwise.

27.10 No partnership

This Agreement shall not be interpreted or construed to create an association, joint venture or partnership between the Parties, or to impose any partnership obligation or liability upon either Party, and neither Party shall have any right, power or authority to enter into any agreement or undertaking for, or act on behalf of, or to act as or be an

agent or representative of, or to otherwise bind, the other Party.

27.11 Third parties

This Agreement is intended solely for the benefit of the Parties, and their respective successors and permitted assigns, and nothing in this Agreement shall be construed to create any duty to, standard of care with reference to, or any liability to, any person not a Party to this Agreement.

27.12 Successors and assigns

This Agreement shall be binding upon, and inure to the benefit of the Parties and their respective successors and permitted assigns.

27.13 Notices

Any notice or other communication to be given by any Party to the other Party under or in connection with the matters contemplated by this Agreement shall be in writing and shall:

(a) in the case of the Contractor, be given by facsimile or e-mail and by letter delivered by hand to the address given and marked for attention of the person set out below or to such other person as the Contractor may from time to time designate by notice to the Authority; provided that notices or other communications to be given to an address outside **Rourkela** may, if they are subsequently confirmed by sending a copy thereof by registered acknowledgement due, air mail or by courier, be sent by facsimile or e-mail to the person as the Contractor may from time to time designate by notice to the Authority;

[***]

(b) in the case of the Authority, be given by facsimile or e-mail and by letter delivered by hand and be addressed to the [Chairman] of the Authority with a copy delivered to the Authority Representative or such other person as the Authority may from time to time designate by notice to the Contractor; provided that if the Contractor does not have an office in [Delhi] it may send such notice by facsimile or e-mail and by registered acknowledgement due, air mail or by courier; and

(c) any notice or communication by a Party to the other Party, given in accordance herewith, shall be deemed to have been delivered when in the normal course of post it ought to have been delivered and in all other cases, it shall be deemed to have been delivered on the actual date and time of delivery; provided that in the case of facsimile or e-mail, it shall be deemed to have been delivered on the working day following the date of its delivery.

27.14 Language

All notices required to be given by one Party to the other Party and all other communications, Documentation and proceedings which are in any way relevant to this Agreement shall be in writing and in English language.

27.15 Counterparts

This Agreement may be executed in two counterparts, each of which, when executed and delivered, shall constitute an original of this Agreement.

27.16 Confidentiality

The Parties shall treat the details of this Agreement as private and confidential, except to the extent necessary to carry out obligations under it or to comply with Applicable Laws. The Contractor shall not publish, permit to be published, or disclose any particulars of the Works in any trade or technical paper or elsewhere without the previous agreement of the Authority.

27.17 Copyright and Intellectual Property rights

27.17.1 As between the Parties, the Contractor shall retain the copyright and other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor. The Contractor shall be deemed (by signing this Agreement) to give to the Authority a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:

(a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,

(b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and

(c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by this Agreement, including replacements of any computers supplied by the Contractor:

27.17.2 The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Authority for purposes other than those permitted under this Clause 27.17.

27.17.3 As between the Parties, the Authority shall retain the copyright and other intellectual property rights in this Agreement and other documents made by (or on behalf of) the

Authority. The Contractor may, at its cost, copy, use, and obtain communication of these documents for the purposes of this Agreement. They shall not, without the Authority's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the contract.

27.18 Limitation of Liability

27.18.1 Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with this Agreement, save and except as provided under Articles 23 and 25.

27.18.2 The total liability of one Party to the other Party under and in accordance with the provisions of this Agreement, save and except as provided in Articles 23 and 25, shall not exceed the Contract Price. For the avoidance of doubt, this Clause shall not limit the liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

ARTICLE 28
DEFINITIONS

28.1 Definitions

In this Agreement, the following words and expressions shall, unless repugnant to the context or meaning thereof, have the meaning hereinafter respectively assigned to them:

"**Accounting Year**" means the financial year commencing from the first day of April of any calendar year and ending on the thirty-first day of March of the next calendar year;

"**Advance Payment**" shall have the meaning set forth in Clause 19.2;

"**Affected Party**" shall have the meaning set forth in Clause 21.1;

"**Affiliate**" means, in relation to either Party {and/or Members}, a person who controls, is controlled by, or is under the common control with such Party {or Member} (as used in this definition, the expression "control" means, with respect to a person which is a company or corporation, the ownership, directly or indirectly, of more than 50% (fifty per cent) of the voting shares of such person, and with respect to a person which is not a company or corporation, the power to direct the management and policies of such person, whether by operation of law or by contract or otherwise);

"Agreement" means this Agreement, its Recitals, the Schedules hereto and any amendments thereto made in accordance with the provisions contained in this Agreement;

"Applicable Laws" means all laws, brought into force and effect by GOI or the State Government including rules, regulations and notifications made thereunder, and judgements, decrees, injunctions, writs and orders of any court of record, applicable to this Agreement and the exercise, performance and discharge of the respective rights and obligations of the Parties hereunder, as may be in force and effect during the subsistence of this Agreement;

"Applicable Permits" means all clearances, licences, permits, authorisations, no objection certificates, consents, approvals and exemptions required to be obtained or maintained under Applicable Laws in connection with the construction, operation and maintenance of the Project during the subsistence of this Agreement;

"**Appointed Date**" means that date which is later of the 30th day of the date of this Agreement, the date on which the Contractor has delivered the Performance Security in accordance with the provisions of Article 7 and the date on which the Authority has provided the working front on no less than 90% (Ninety per cent) of the total length of Project ;

"Arbitration Act" means the Arbitration and Conciliation Act, 1996 and shall include modifications to or any re-enactment thereof, as in force from time to time;

"Authority" shall have the meaning attributed thereto in the array of Parties hereinabove as set forth in the Recitals;

"Authority Default" shall have the meaning set forth in Clause 23.2;

"Authority's Engineer" shall have the meaning set forth in Clause 18.1;

"Authority Representative" means such person or persons as may be authorised in writing by the Authority to act on its behalf under this Agreement and shall include any person or persons having authority to exercise any rights or perform and fulfil any obligations of the Authority under this Agreement;

"Bank" means a bank incorporated in India and having a minimum net worth of Rs. 1,000 crore (Rupees one thousand crore) or any other bank acceptable to the Authority;

"Base Rate" means the floor rate of interest announced by the State Bank of India for all its lending operations;

"Base Date" means the last date of that calender month, which date precedes the Bid Due Date by at least 28 (twenty eight) days;

"Bid" means the documents in their entirety comprised in the bid submitted by the [selected bidder/Consortium] in response to the Request for Proposals in accordance with the provisions thereof;

"**Bid Security**" means the bid security provided by the Contractor to the Authority in accordance with the Request for Proposal, and which is to remain in force until substituted by the Performance Security;

"Change in Law" means the occurrence of any of the following after the Base Date:

(a) the enactment of any new Indian law;

(b) the repeal, modification or re-enactment of any existing Indian law;

(c) the commencement of any Indian law which has not entered into effect until the Base Date;

(d) a change in the interpretation or application of any Indian law by a judgement of a court of record which has become final, conclusive and binding, as compared to such interpretation or application by a court of record prior to the Base Date; or

"Change of Scope" shall have the meaning set forth in Article 13;

"Change of Scope Notice" shall have the meaning set forth in Clause 13.2.1;

"Change of Scope Order" shall have the meaning set forth in Clause 13.2.4;

"Completion Certificate" shall have the meaning set forth in Clause 12.4;

{";}[$]

"Construction" shall have the meaning set forth in Clause 1.2.1 (f);

"Construction Period" means the period commencing from the Appointed Date and ending on the date of the Completion Certificate;

"Contract Price" means the amount specified in Clause 19.1.1;

"Contractor" shall have the meaning attributed thereto in the array of Parties hereinabove as set forth in the Recitals;

"Contractor Default" shall have the meaning set forth in Clause 23.1;

"Cure Period" means the period specified in this Agreement for curing any breach or default of any provision of this Agreement by the Party responsible for such breach or default and shall:

(a) commence from the date on which a notice is delivered by one Party to the other Party asking the latter to cure the breach or default specified in such notice;

(b) not relieve any Party from liability to pay Damages or compensation under the provisions of this Agreement; and

(c) not in any way be extended by any period of Suspension under this Agreement; provided that if the cure of any breach by the Contractor requires any reasonable action by the Contractor that must be approved by the Authority or the Authority's Engineer hereunder, the applicable Cure Period shall be extended by the period taken by the Authority or the Authority's Engineer to accord their approval;

[$] This definition may be omitted if the Contractor is not a Consortium.

"Damages" shall have the meaning set forth in paragraph (w) of Clause 1.2.1;

"Defect" means any defect or deficiency in Construction of the Works or any part thereof, which does not conform with the Specifications and Standards, and in the case of Maintenance, means any defect or deficiency which is specified in Schedule-E;

"Defects Liability Period" shall have the meaning set forth in Clause 17.1;

"Dispute" shall have the meaning set forth in Clause 26.1.1;

"Dispute Resolution Procedure" means the procedure for resolution of Disputes set forth in Article 26;

"Drawings" means all of the drawings, calculations and documents pertaining to the Project as set forth in Schedule-I, and shall include 'as built' drawings of the Project;

"Document" or "Documentation" means documentation in printed or written form, or in tapes, discs, drawings, computer programmes, writings, reports, photographs, films, cassettes, or expressed in any other written, electronic, audio or visual form;

"Emergency" means a condition or situation that is likely to endanger the safety or security of the individuals on or about the Project , including Users thereof, or which poses an immediate threat of material damage to any of the Project Assets;

"Encumbrances" means, in relation to the Project, any encumbrances such as mortgage, charge, pledge, lien, hypothecation, security interest, assignment, privilege or priority of any kind having the effect of security or other such obligations, and shall include any designation of loss payees or beneficiaries or any similar arrangement under any insurance policy pertaining to the Project, where applicable herein but excluding utilities referred to in Clause 9.1;

"EPC" means engineering, procurement and construction;

"Final Payment Certificate" shall have the meaning set forth in Clause 19.15.1;

"**Final Payment Statement**" shall have the meaning set forth in Clause 19.13.1;

"Force Majeure" or "Force Majeure Event" shall have the meaning ascribed to it in Clause 21.1;

"GAD" or "General Arrangement Drawings" shall have the meaning set forth in Clause 4.1.3 (b);

"GOI" or "Government" means the Government of India;

"Good Industry Practice" means the practices, methods, techniques, designs, standards, skills, diligence, efficiency, reliability and prudence which are generally and reasonably expected from a reasonably skilled and experienced contractor engaged in the same type of undertaking as envisaged under this Agreement and which would be expected to result in the performance of its obligations by the Contractor in accordance with this Agreement, Applicable Laws and Applicable Permits in reliable, safe, economical and efficient manner;

"Government Instrumentality" means any department, division or sub-division of the Government or the State Government and includes any commission, board, authority, agency or municipal and other local authority or statutory body including panchayat under the control of the Government or the State Government, as the case may be, and having jurisdiction over all or any part of the Project or the performance of all or any of the services or obligations of the Contractor under or pursuant to this Agreement;**"IRC"** means the Indian Roads Congress;

"Indemnified Party" means the Party entitled to the benefit of an indemnity pursuant to Article 25;

"Indemnifying Party" means the Party obligated to indemnify the other Party pursuant to Article 25;

"Indirect Political Event" shall have the meaning set forth in Clause 21.3;

"Insurance Cover" means the aggregate of the maximum sums insured under the insurances taken out by the Contractor pursuant to Article 20, and includes all insurances required to be taken out by the Contractor under Clauses 20.1 and 20.9 but not actually taken, and when used in the context of any act or event, it shall mean the aggregate of the maximum sums insured and payable or deemed to be insured and payable in relation to such act or event;

"Intellectual Property" means all patents, trade marks, service marks, logos, get-up, trade names, internet domain names, rights in designs, blue prints, programmes and manuals, drawings, copyright (including rights in computer software), database rights, semi-conductor, topography rights, utility models, rights in know-how and other intellectual property rights, in each case whether registered or unregistered and including applications for registration, and all rights or forms of protection having equivalent or similar effect anywhere in the world;

"**Interim Payment Certificate**" or "**IPC**" means the interim payment certificate issued by the Authority's Engineer for payment to the Contractor in respect of Contractor's claims for payment raised in accordance with the provisions of this Agreement;

{ }[$] **"LOA" or "Letter of Acceptance"** means the letter of acceptance referred to in Recital (E);

"Maintenance" means the maintenance of the Project as set forth in Article 14 for the period specified therein;

"**Maintenance Inspection Report**" shall have the meaning set forth in Clause 15.2.1;

"Maintenance Manual" shall have the meaning ascribed to it in Clause 10.7;

"Maintenance Programme" shall have the meaning set forth in Clause 14.3;

"Maintenance Period" shall have the meaning set forth in Clause 14.1.1;

"Maintenance Requirements" shall have the meaning set forth in Clause 14.2;

"Major Bridge" means a bridge having a total length of more than 60 (sixty) metres between the inner faces of the dirt walls as specified in IRC:5-1998;

"**Manual**" shall mean the Manual of Standards and Specifications for Four Laning of Highways (IRC:SP:73-2007);

"Material Adverse Effect" means a material adverse effect of any act or event on the ability of either Party to perform any of its obligations under and in accordance with the provisions of this

$ This definition may be omitted if the Contractor is not a Consortium.

Agreement and which act or event causes a material financial burden or loss to either Party;

"Materials" are all the supplies used by the Contractor for incorporation in the Works or for the maintenance of the Project ;

"Monthly Maintenance Statement shall have the meaning set forth in Clause 19.6.1;

"**MORTH**" means the Ministry of Road Transport and Highways or any substitute thereof dealing with Highways;

"**Non-Political Event**" shall have the meaning set forth in Clause 21.2;

"Parties" means the parties to this Agreement collectively and "Party" shall mean any of the parties to this Agreement individually;

"Performance Security" shall have the meaning set forth in Clause 7.1;

"Plant" means the apparatus and machinery intended to form or forming part of the Works;

"Political Event" shall have the meaning set forth in Clause 21.4;

"Programme" shall have the meaning set forth in Clause 10.1.3;

"Project" means the construction and maintenance of the Project Redevelopment of road From Panposh Chowk to Ambedkar Chowk from 0.00 k.m to 3.62 k.m Section of MRO9 Road including streetscape , beatification , landscaping, intersection redesign, utility ducting and under ground cabling in Rourkela Smart City Limited (ABD) under Smart Cities mission through on EPC Mode in accordance with the provisions of this Agreement, and includes all works, services and equipment relating to or in respect of the Scope of the Project;

"Project Assets" means all physical and other assets relating to (a) tangible assets such as civil works and equipment including foundations, embankments, pavements, road surface, interchanges, bridges, culverts, road over-bridges, drainage works, traffic signals, sign boards, kilometre-stones, , electrical systems, communication systems, rest areas,Plantation and land scaping relief centres, maintenance depots and administrative offices; and (b) Project Facilities situated on the Site;

"Project Completion Date" means the date on which the Provisional Certificate is issued and in the event no Provisional Certificate is issued, the date on which the Completion Certificate is issued;

"Project Completion Schedule" means the progressive Project Milestones set forth in Schedule-J for completion of the Project on or before the Scheduled Completion Date;

"Project Facilities" means all the amenities and facilities situated on the Site, as described in Schedule-C;

"**Project** means the Site comprising the existing road from Panposh Chowk to Ambedkar Chowk forming part of MR 09** from km 0.00 to km 3.62 and all Project Assets, and its subsequent development and augmentation in accordance with this Agreement;

"Project Milestone" means the project milestone set forth in Schedule-J;

"Proof Consultant" shall have the meaning set forth in Clause 10.2.2;

"Provisional Certificate" shall have the meaning set forth in Clause 12.2;

"Punch List" shall have the meaning set forth in Clause 12.2.1;

"Quality Assurance Plan" or **"QAP"** shall have the meaning set forth in Clause 11.2**;**

"Re.", "Rs." or "Rupees" or "Indian Rupees" means the lawful currency of the Republic of India;

"**Request for Proposals**" *or* "**RFP**" shall have the meaning set forth in Recital 'D';

"Retention Money" shall have the meaning set forth in Clause 7.5.1;

"Right of Way" means the constructive possession of the Site free from encroachments and encumbrances, together with all way leaves, easements, unrestricted access and other rights of way, howsoever described, necessary for construction and maintenance of the Project in accordance with this Agreement;

"**Safety Consultant**" shall have the meaning set forth in Clause 10.1.5;

"Scheduled Completion Date" shall be the date set forth in Clause 10.3.1;

"Scope of the Project" shall have the meaning set forth in Clause 2.1;

"Section" means a part of the Project ;

"Site" shall have the meaning set forth in Clause 8.1;

"Specifications and Standards" means the specifications and standards relating to the quality, quantity, capacity and other requirements for the Project, as set forth in Schedule-D, and any modifications thereof, or additions thereto, as included in the design and engineering for the Project submitted by the Contractor to, and expressly approved by, the Authority;

"**Stage Payment Statement**" shall have the meaning set forth in Clause 19.4;

"**Structures**" means an elevated road or a flyover, as the case may be;

"Sub-contractor" means any person or persons to whom a part of the Works or the

Maintenance has been subcontracted by the Contractor and the permitted legal successors in title to such person, but not an assignee to such person;

"Suspension" shall have the meaning set forth in Article 22;

"Taxes" means any Indian taxes including excise duties, customs duties, value added tax, sales tax, local taxes, cess and any impost or surcharge of like nature (whether Central, State or local) on the goods, Materials, equipment and services incorporated in and forming part of the Project charged, levied or imposed by any Government Instrumentality, but excluding any interest, penalties and other sums in relation thereto imposed on any account whatsoever. For the avoidance of doubt, Taxes shall not include taxes on corporate income;

"Termination" means the expiry or termination of this Agreement;

"Termination Notice" means the communication issued in accordance with this Agreement by one Party to the other Party terminating this Agreement;

"Termination Payment" means the amount payable by either Party to the other upon Termination in accordance with Article 23;

"Terms of Reference" or "TOR" shall have the meaning set forth in Clause 18.2.1;

"Tests" means the tests set forth in Schedule-K to determine the completion of Works in accordance with the provisions of this Agreement;

"Time Extension" shall have the meaning set forth in Clause 10.5.1;

"User" means a person who travels or intends to travel on the Projectt or any part thereof in/on any vehicle;

"**Valuation of Unpaid works**" shall have the meaning set forth in Clause 23.5.1;

"Works" means all works including survey and investigation, design, engineering, procurement, construction, Plant, Materials, maintenance, temporary works and other things necessary to complete the Project in accordance with this Agreement; and

"WPI" means the wholesale price index for various commodities as published by the Ministry of Commerce and Industry, GOI and shall include any index which substitutes the WPI, and any reference to WPI shall, unless the context otherwise requires, be construed as a reference to the WPI published for the period ending with the preceding month.

IN WITNESS WHEREOF THE PARTIES HAVE EXECUTED AND DELIVERED THIS AGREEMENT AS OF THE DAY, MONTH AND YEAR FIRST ABOVE WRITTEN.

SIGNED, SEALED AND	SIGNED, SEALED AND
DELIVERED	DELIVERED
For and on behalf of	For and on behalf of
ROURKELA SMART CITY LTD by:	THE CONTRACTOR by:
(Signature)	(Signature)
(Name)	(Name)
(Designation)	(Designation)

In the presence of: 1.

2.

{COUNTERSIGNED and accepted by:

Name and particulars of other members of the Consortium}

Schedules

SCHEDULE - A

(See Clauses 2.1 and 8.1)

SITE OF THE PROJECT

1 The Site

1.1 Site of the Four-Lane Smart Road shall include the land, buildings, structures and road works as described in Annex-I of this Schedule-A.

1.2 The dates of handing over the Right of Way to the Contractor are specified in Annex-II of this Schedule-A.

1.3 An inventory of the Site including the land, buildings, structures, road works, trees and any other immovable property on, or attached to, the Site shall be prepared jointly by the Authority Representative and the Contractor, and such inventory shall form part of the memorandum referred to in Clause 8.2.1 of this Agreement.

1.4 The alignment plans of the Smart Road are specified in Annex-III. In the case of sections where no modification in the existing alignment of the Smart Road is contemplated, the alignment plan has not been provided. Alignment plans have only been given for sections where the existing alignment is proposed to be upgraded. The proposed profile of the Smart Roads shall be followed by the contractor with minimum FRL as indicated in the alignment plan. The contractor, however, improve/upgrade the Road Profile as indicated in Annexure-III based on site/design requirement.

1.5 The status of the environment clearances obtained or awaited is given in Annex IV.

Annex - I
(Schedule-A)

Site

1. Site

The Site of the Four-Lane Smart Road comprises the section of Panposh Road commencing from km 0.0 km to 3.6 km i.e. the Panposh Chowk to Ambedkar Chowk section in the State of ODISHA. The land, carriageway and structures comprising the Site are described below.

2. Land

The Site of the Project comprises the land (sum total of land already in possession and land to be possessed) with various features as described below:

3. Right of Way (ROW)

The site of smart road comprises of following Right of Way in existing conditions.

Sr. No.	CHAINAGE (m)	ROW (m)		TOTAL ROW(m)
		LHS	RHS	
1	0	10.25	10.25	
2	50	10.97	12.49	23.46
3	100	11.62	11.31	22.93
4	150	13.16	10.71	23.87
5	200	12.16	10.55	22.71
6	250	12.87	10.67	23.54
7	300	13.91	10.56	24.47
8	350	11.94	10.58	22.52
9	400	10.25	11.58	21.83
10	450	10.25	10.58	
11	500	10.25	10.74	
12	550	10.25	18.89	
13	600	12	23.66	
14	650	13.75	28.29	
15	700	15.5	16.93	
16	750	15.5	21.56	
17	800	15.5	21.36	
18	850	15.5	18.2	
19	900	15.5	17.53	
20	950	15.5	17.01	

Sr. No.	CHAINAGE (m)	ROW (m)		TOTAL ROW(m)
		LHS	RHS	
21	1000	15.5	16.85	
22	1050	15.5	17.61	
23	1100	15.5	18.17	
24	1150	13.34	10.5	
25	1200	10.64	10.5	
26	1250	10.25	10.5	
27	1300	10.25	11.19	
28	1350	12.08	11.93	
29	1400	10.25	10.25	
30	1450	10.25	10.25	
31	1500	10.25	10.25	20.5
32	1550	10.25	10.25	20.5
33	1600	10.25	10.25	20.5
34	1650	10.25	10.25	20.5
35	1700	10.25	10.9	21.15
36	1750	10.25	13.74	23.99
37	1800	10.25	13.59	23.84
38	1850	10.25	13.44	23.69
39	1900	10.25	13.97	24.22
40	1950	10.25	13.78	24.03
41	2000	11.65	14.14	25.79
42	2050	12.04	11.15	23.19
43	2100	12.68	10.68	23.36
44	2150	13.23	11.24	24.47
45	2200	12.86	11.31	24.17
46	2250	10.63	11.46	22.09
47	2300	9.82	11.57	21.39
48	2350		11.73	11.73
49	2400	11.09	14.06	25.15
50	2450	11.87	13.3	25.17
51	2500	12.65	12.64	25.29
52	2550	13.44	12.03	25.47
53	2600	13.99	10.94	24.93
54	2650	12.3	11.31	23.61
55	2700	12.92	11.8	24.72
56	2750	13.64		13.64
57	2800	10.25	10.25	20.5
58	2850	10.25	10.25	20.5

Sr. No.	CHAINAGE (m)	ROW (m)		TOTAL ROW(m)
		LHS	RHS	
59	2900	10.25	10.25	20.5
60	2950	10.25	13.8	24.05
61	3000	12.69	19.84	
62	3050	14.24	9.5	23.74
63	3100	12.36	11.04	23.4
64	3150	9.37	10.57	19.94
65	3200	12.61	9.45	22.06
66	3250	10.39	10.12	20.51
67	3300	11.58	15.08	26.66
68	3350	12.56	15.38	27.94
69	3400	12.46	9.5	21.96
70	3450	12.37	14.89	27.26
71	3500	13	15.15	28.15
72	3550	13.16	15.67	28.83
73	3600	13.53	15.58	29.11
74	3650	13.62	13.95	27.57

4. Carriageway

The present carriageway of the Smart Road is Four Lane. The type of the existing pavement is flexible.

SR.NO.	CHAINAGE (m)	WIDTH (m)		TOTAL WIDTH(m)
		LHS	RHS	
1	0	9.72	7.98	17.7
2	50	8.59	8.01	16.6
3	100	8.51	8.1	16.61
4	150	8.11	8.18	16.29
5	200	8.03	8.46	16.49
6	250	8.18	8.38	16.56
7	300	8.22	8.39	16.61
8	350	8.23	8.36	16.59
9	400	8.42	8.41	16.83
10	450	8.4	8.3	16.7
11	500	8.35	8.32	16.67
12	550	8.52	18.89	
13	600	8.52	23.66	
14	650	8.52	28.29	
15	700	8.52	16.93	

SR.NO.	CHAINAGE (m)	WIDTH (m)		TOTAL WIDTH(m)
		LHS	RHS	
16	750	8.46	21.56	
17	800	8.4	21.36	
18	850	8.39	18.2	
19	900	13.06	17.53	
20	950	12.2	17.01	
21	1000	11.38	16.85	
22	1050	10.05	17.61	
23	1100	9.77	18.17	
24	1150	10.13	7.5	17.63
25	1200	9.15	7.5	16.65
26	1250	8.57	7.5	16.07
27	1300	7.27	8.86	16.13
28	1350	6.7	9.09	15.79
29	1400	9.04	7.42	16.46
30	1450	9.15	7.31	16.46
31	1500	8.33	8.06	16.39
32	1550	8.45	7.4	15.85
33	1600	8.15	8	16.15
34	1650	8.29	8.07	16.36
35	1700	8.29	8.17	16.46
36	1750	8.09	8.28	16.37
37	1800	7.94	7.49	15.43
38	1850	7.75	8.64	16.39
39	1900	8.02	8.37	16.39
40	1950	8.27	8.2	16.47
41	2000	8.56	7.98	16.54
42	2050	8.42	7.88	16.3
43	2100	8.31	8.1	16.41
44	2150	8.06	8.51	16.57
45	2200	7.79	8.7	16.49
46	2250	8.01	8.55	16.56
47	2300	8.09	8.34	16.43
48	2350	8.28	8.17	16.51
49	2400	8.39	8.1	16.49
50	2450	8.1	8.36	16.46
51	2500	8.25	8.07	16.32
52	2550	8.46	7.92	16.38
53	2600	8.52	7.62	16.14

SR.NO.	CHAINAGE (m)	WIDTH (m)		TOTAL WIDTH(m)
		LHS	RHS	
54	2650	8.77	6.31	15.08
55	2700	8.18	7.67	15.85
56	2750	6.9	7.15	14.05
57	2800	6.44	6.71	13.15
58	2850	7.62	6.92	14.54
59	2900	8.1	7.74	15.84
60	2950	8.26	7.04	15.3
61	3000	8.19	8.22	16.41
62	3050	8.34	8.03	16.37
63	3100	8.02	8.31	16.33
64	3150	6.91	7.97	14.88
65	3200	8.28	7.8	16.08
66	3250	8.26	8.12	16.38
67	3300	8.06	8.17	16.23
68	3350	8.43	9.15	17.58
69	3400	8.7	10.11	18.81
70	3450	7.52	10.43	17.95
71	3500	6.8	10.98	17.78
72	3550	10.02	13.39	23.41
73	3600	10.42	12.57	22.99
74	3650	10.69	11.39	22.08

5. Road over-bridges (ROB)/ Road under-bridges (RUB)

The Site includes the following ROB (road over railway line)/RUB (road under railway line):

Sr. No.	Chainage (km)	Type of Structure		No. of Spans with span length (m)	Width (m)	ROB/ RUB
		Foundation	Superstructure			
1	**2400**			**17.5m**	**12**	**ROB**
2	**2800**			**17.5m**	**12**	**ROB**
3	**3500**			**16m**	**11**	**ROB**

6. Culverts

The Site has the following culverts:

Sr. No.	CHAINAGE (m)	Remarks
1	**1290**	**Storm Water**
2	**2825**	**Storm Water**

7. Bus bays/Shelter

The details of bus bays on the Site are as follows:

Sr. No.	CHAINAGE (m)	Type	
		Bus Bay	**Bus Shelter**
1	0	No	Yes
2	1150	No	Yes
3	2200	No	Yes
4	450	No	Yes

8. Road side drains

The details of the roadside drains are as follows:

Sr. No.	CHAINAGE (m)		DRAIN LOCATION		MISCELLANEOUS
	FROM	TO	RHS	LHS	
1	0	3600	YES	YES	PUCCA STORM WATER DRAIN (Covered)

9. Major & Minor junctions

The details of major & Minor junctions are as follows:

Sr. No.	CHAINAGE (m)	TYPE			
		MAJOR JUNCTIONS		MINOR JUNCTION (CROSS ROADS)	
		X-JUNCION	T-JUNCTION	RHS	LHS
1	0	Panposh Chowk			
2	3600		Ambedkar Chowk		
3	550			Government College Chowk	
4	1450		Nexa Chowk		
5	2400	STI Chowk			

6	1700			VESAJ PATEL HOSPITAL	
7	1260			Civil Township Road	
8	900			Civil Township Internal Road	
9	1150				Towards Railway Fatak
10	3400			RTO Office	
11	2050			Internal Civil township road	
12	3530			RDA Office	

10. Service Roads

The details of the existing service roads are as follows:

Sr. No.	CHAINAGE		LENGTH (m)		WIDTH - Average (m)	
	FROM	TO	RHS	LHS	RHS	LHS
1	800	1100	300	300	7.5	7.5
2	3500	3600	100	100	7.5	7.5

11. Light poles

Location of various light poles is given in below table.

Sr. No.	CHAINAGE (m)		No. of Light Poles		
	FROM	TO	RHS	Median	LHS
1	0	50		2	
2	50	100		1	
3	100	150		2	
4	150	200		2	
5	200	250		1	
6	250	300		2	
7	300	350		2	
8	350	400		1	
9	400	450		2	
10	450	500		2	
11	500	550			
12	550	600			
13	600	650			
14	650	700			
15	700	750			
16	750	800			

Sr. No.	CHAINAGE (m)		No. of Light Poles		
	FROM	TO	RHS	Median	LHS
17	800	850			
18	850	900	1		
19	900	950			
20	950	1000			
21	1000	1050			
22	1050	1100			
23	1100	1150		1	
24	1150	1200		2	
25	1200	1250		1	
26	1250	1300		2	
27	1300	1350		2	
28	1350	1400		1	
29	1400	1450		2	
30	1450	1500	1		
31	1500	1550		2	
32	1550	1600		2	
33	1600	1650		1	
34	1650	1700		1	
35	1700	1750	1	2	
36	1750	1800		1	
37	1800	1850		2	
38	1850	1900		2	
39	1900	1950		1	
40	1950	2000		2	
41	2000	2050		1	
42	2050	2100		2	
43	2100	2150		1	
44	2150	2200		2	
45	2200	2250		1	
46	2250	2300		1	
47	2300	2350		1	
48	2350	2400		2	
49	2400	2450		1	
50	2450	2500		1	
51	2500	2550		2	
52	2550	2600		1	
53	2600	2650		2	
54	2650	2700		2	

Sr. No.	CHAINAGE (m)		No. of Light Poles		
	FROM	TO	RHS	Median	LHS
55	2700	2750		2	
56	2750	2800		1	
57	2800	2850	1	2	1
58	2850	2900		2	
59	2900	2950		2	
60	2950	3000		2	
61	3000	3050		2	
62	3050	3100		2	
63	3100	3150		2	
64	3150	3200		2	
65	3200	3250		2	
66	3250	3300		2	
67	3300	3350		2	
68	3350	3400		2	
69	3400	3450		2	
70	3450	3500		2	1
71	3500	3550		2	2
72	3550	3600	2	1	1
73	3600	3650	2	1	1

12. Hand pumps

Sr. No.	Chainage (M)	HAND PUMP LOCATION	
		RHS	LHS
1	1125		YES
2	1475	YES	
3	1670	YES	
4	1850	YES	
5	2210	YES	
6	2700		YES
7	3300	YES	
8	3400	YES	

13. Electric Pole Location

Sr. No.	CHAINAGE (m)		No. of Electric Poles	
	FROM	TO	RHS	LHS
1	0	50		1
2	50	100		1
3	100	150		2
4	150	200		2
5	200	250		2
6	250	300		1
7	300	350		1
8	350	400		
9	400	450		
10	450	500		
11	500	550		
12	550	600		
13	600	650		
14	650	700	1	
15	700	750	2	
16	750	800	1	
17	800	850	2	
18	850	900	1	1
19	900	950	2	
20	950	1000	2	1
21	1000	1050		2
22	1050	1100	2	3
23	1100	1150	1	1
24	1150	1200	1	2
25	1200	1250	1	2
26	1250	1300		3
27	1300	1350		2
28	1350	1400		1
29	1400	1450		4
30	1450	1500		2
31	1500	1550	1	2
32	1550	1600	1	2
33	1600	1650	3	2
34	1650	1700	3	1
35	1700	1750	2	1
36	1750	1800	2	1
37	1800	1850	2	3

Sr. No.	CHAINAGE (m)		No. of Electric Poles	
	FROM	TO	RHS	LHS
38	1850	1900	2	2
39	1900	1950	1	3
40	1950	2000	2	2
41	2000	2050	5	5
42	2050	2100	1	4
43	2100	2150		3
44	2150	2200		3
45	2200	2250		3
46	2250	2300		
47	2300	2350		2
48	2350	2400		1
49	2400	2450	2	5
50	2450	2500	2	2
51	2500	2550	2	1
52	2550	2600	2	2
53	2600	2650	2	2
54	2650	2700	3	2
55	2700	2750	1	4
56	2750	2800		5
57	2800	2850		1
58	2850	2900		2
59	2900	2950		2
60	2950	3000	1	1
61	3000	3050	2	1
62	3050	3100	1	3
63	3100	3150	2	3
64	3150	3200	1	1
65	3200	3250		2
66	3250	3300	2	2
67	3300	3350	2	2
68	3350	3400	3	2
69	3400	3450	2	4
70	3450	3500	2	1
71	3500	3550	1	1
72	3550	3600		3
73	3600	3650	1	2

14. Trees

No. of Trees on Proposed Site				
Sr. No.	**CHAINAGE (m)**		**No. of Trees**	
	FROM	**TO**	**RHS**	**LHS**
1	1000	1050	0	1
2	1050	1100	0	2
3	1100	1150	0	1
4	1850	1900	1	0
5	2000	2050	1	0
6	2700	2750	0	1
7	2750	2800	0	1
8	3200	3250	0	1
9	3300	3350	1	0

Annex - II

(Schedule-A)

Dates for providing Right of Way

The dates on which the Authority shall provide Right of Way to the Contractor on different stretches of the Site are stated below:

S. No.	Right of Way (as a percentage of length of road)	Date of handover of Right of way
1	40% of the length of project	As per the agreement conditions (within 15 days of signing of agreement)
2	Another 20% of the length of project	Within 90 days from appointed date
3	Another 20% of the length of project	Within 150 days from appointed date
4	Balance 20% of the length of project	Within 200 days from appointed

90 % of is Right of way is with RSCL, can be hand over as per agreement condition for work

Annex - III
(Schedule-A)

Alignment Plans

The existing centerline alignment is indicated in the existing survey drawing set as part of the Part III of this document. The alignment details are tabulated under the Annex 1 of Schedule A.

Annex - IV
(Schedule-A)

Environment Clearances

The following environment clearances have been obtained: **NOT APPLICABLE**

The following environment clearances are awaited:

[***]

SCHEDULE - B
(See Clause 2.1)

Development of the Project Road

1. **Development of the Project Road**

   Development of the Smart Road shall include design and construction of the Smart Road as described in this Schedule-B and in Schedule-C.

2. **Redevelopment and Streetscape Enhancements**

   Redevelopment and streetscape enhancements shall include 3.6 Km of Streetscape Design, Junctions Beautification, Landscaping, Intersection Redesign, and Infrastructure Upgrades of the Project Site as described in Annex-I of this Schedule-B and in Schedule-C.

3. **Specifications and Standards**

   The Smart Road shall be designed and constructed in conformity with the Specifications and Standards specified in Annex-I of Schedule-D.

Annex - I
(Schedule-B)

Description of Smart Road Project Proposal

1. PROJECT OBJECTIVE

The main focus of this project is to create a balance between the movement of pedestrians, cyclists and vehicles by providing a distinct facility for each user and also enhancing the aesthetics of the road by undergrounding existing overhead electrical line. The works to be performed shall also include all general works preparatory to the construction of roads, bridges, canal crossings, drainage, underground cable laying and all other related works.
The works shall include work of any kind necessary for the due and satisfactory construction, completion and maintenance of works to the intent and meaning of the drawings and these Specifications and further drawings and orders that may be issued by the Engineer from time to time. The scope of work shall include compliance by the Contractor with all Conditions of Contract, whether specifically mentioned or not in the various Sections of these Specifications, all materials, apparatus, plant, equipment, tools, fuel, water, strutting, timbering, transport, offices, stores, workshop, staff, labour and the provision of proper and sufficient protective works, diversions, temporary fencing and lighting. It shall also include, safety of public workers, first-aid equipment, suitable accommodation for the staff and workmen with adequate sanitary arrangements, the effecting and maintenance of all insurances, the payment of all wages, salaries, fees, royalties, duties or other charges arising out of the erection of works and the regular clearance of rubbish, reinstatement and clearing-up of the site as may be required on completion of works, safety of the public and protection of the works and adjoining land.
The primary objectives of the Smart Road Design Project are:

- To improve non-motorized access along the corridor and to surrounding areas
- Cycle track and universally accessible paved footpath for pedestrians.
- Undergrounding of overhead cables for beautification and aesthetic improvement.
- Softscapping and hardscapping as per the available space along the smart road.

The Smart Road development shall also include the civil infrastructure as well the electrical works required for undergrounding of the existing overhead electrical power distribution. Following shall be the scope of work for the same under the Smart Road project:

- Supply, installation of cable tray, angle supports, clamps and other accessories so as to provide cable clamping support in proposed electrical trench chamber as per the applicable section.
- Excavation, Casting of RCC Electrical Trench (LT), with open able covers throughout, with necessary cable clamping arrangement as per applicable section.

- Supply and laying of DWC corrugated HDPE pipes.
- Supply and laying of RCC pipes for road crossing as per design philosophy.
- Fabrication of electrical manholes as per design philosophy.
- Interconnection of drain chambers being used as cable trench at discontinuity by means of trench or RCC pipe as per availability in the same precedence.
- Design, supply, laying of 11kV XLPE cable and LT XLPE cable suitable for undergrounding the existing overhead line as per the design philosophy and final approval of Authority's engineer. The contractor shall ensure restoration of the existing system with connection to all tapping points, consumers as per existing scenario.
- Design, supply, installation, testing of 11kV Distribution Board, LT Main Feeder Panels, LT Sub Feeder Pillar Panels, LT Junction Boxes, Outdoor Cable termination kits for connecting overhead lines and underground cables as per the design philosophy and final approval of Authority's engineer.
- Carrying out system study for the underground work ensuring fault level, voltage drop, etc as per design requirement.
- Dismantling of existing HT, LT Poles, overhead conductors and storage at WESCO store.

The Contractor shall first carry out a survey for the existing underground utility and consumer survey. The consumer survey shall be carried in coordination with Authority's engineer. Based on the survey output and taking load growth for next 15 years into consideration, the contractor shall prepare the undergrounding scheme, road section indicating all existing utilities and determine the available RoW for laying of new utility services such as electrical, OFC. All procurement work shall be started after approval of the same from Authority's engineer.

Necessary statutory approvals, new connection from WESCO for the electrical systems installed shall also be in the Contractor's scope.

All mounting and foundation supports and hardware accessories for electrical equipment/system installations.

All civil works associated with equipment/system electrical installations like embedment, chipping, punching, making holes, openings in walls, pipe sleeves, fire/ water proof sealing etc.

The CONTRACTOR shall be responsible for the selection and design of appropriate equipment to provide the best coordinated performance of the entire system. The design of various components, assemblies and sub-assemblies shall be so done that it facilitates easy field assembly and maintenance.

Equipments furnished shall be complete in all respects with all mountings, fittings, fixtures, and standard accessories normally provided with such equipment and / or needed for erection, completion and safe operation of the equipment as indicated in applicable codes, though they may not have been specifically detailed in the Technical Specification, unless included in the list of exclusions. Materials and component not specifically stated in the specification but which are necessary for commissioning and satisfactory operation unless specifically excluded shall be deemed to be included in the scope of specification and shall be supplied without any extra cost. All similar standard components/ parts of similar standard equipment provided shall be inter-changeable with one another.

All SAFETY considerations in design, manufacturing and installation of equipments and systems for safe operation & maintenance by EMPLOYER personnel and safe practices during installation at site shall be in the scope of the Contractor. Cost towards accomplishing the same shall be included in the BID price and no extra claim shall be entertained later.

2. GEOMETRIC DESIGN AND GENERAL FEATURES

To achieve the above objective, the project includes geometric redesign of intersection geometry to enhance pedestrian safety and addition of streetscape elements including, pavement designs, street furniture and public recreation spaces as part of the design proposal. The following details form the components of the project proposal as follows:

3. GENERAL

3.1 The Project shall follow the Urban Road Design Guidelines as per IRC 86: 1983, and MORTH Standards. The geometric design of the Project shall conform to the standards set out in this section as a minimum. As far as possible, uniformity of design standards shall be maintained throughout the length of the Project. Geometric design and general features of the Project shall be as provided under sections 2 to 10 provided below.

3.2 Centerline Alignment: The proposed redevelopment of the site follows the existing centerline as discussed in Schedule A, with deviations in the alignment, as approved by the Authority Engineer.

4. WIDTH OF CARRIAGEWAY

4.1 Two lanes of consistent travel lanes of 3.75m each on one side shall be provided for both directions on entire stretch of project site. The paved carriageway shall be 7.5m wide each direction with 1.5m wide median along entire area with the typical cross section drawings as enclosed in Part III of this document.

5. DESIGN SPEED

The design speed shall be the minimum design speed of 50 km per hr for plain terrain.

6. IMPROVEMENT OF THE EXISTING ROAD GEOMETRICS

6.1 The project involves changes to its existing alignment and road geometry as approved by the Authority and shown in the alignment plans specified in Annex I (clause 2.1) of Schedule-B. Geometric deficiencies, if any, in the existing horizontal and vertical profiles shall be corrected as per the prescribed standards for plain/rolling/hilly terrain to the extent land is available.

6.2 In the following sections, where improvement of the existing road geometrics to the prescribed standards is not possible, the existing road geometrics shall be improved to the extent possible within the given right of way and proper road signs and safety measures shall be provided as per the approval of the Authority Engineer.

7. RIGHT OF WAY

- Details of the Right of Way are given in Annex I of Schedule-A. The Authority would acquire the additional land required, if any. The minimum Right of Way for non-urban and urban areas should be as prescribed in IRC: 73 and IRC: 86 respectively.

8. TYPE OF SHOULDERS

(a) In built-up sections, footpaths shall be provided in the following stretches:

Sl. No.	**Stretch** (from km to km)	**Fully paved shoulders/ footpaths**	**Reference to cross section**
1	**0 to 3.6**	**Fully paved footpath above drain**	

(b) Design and specifications of paved shoulders and granular material shall conform to the requirements specified in Schedule D.

9. SERVICE ROADS

Service roads shall be constructed at the locations and for the lengths indicated below:

Sl No.	**Location of service road** (from km to km)	**Right hand side (RHS)/Left hand side (LHS)/ or Both sides**	**Length (km) of service road**
1	0.6 to 1.1	Both Side	0.5

10. CENTRAL MEDIAN

10.1 The median is proposed as a continuous planting strip with low height shrubs planted on good earth with appropriate details and specifications as approved by the Authority Engineer.

10.2 Median must incorporate the paved pedestrian refuges at all relevant spots that must be safeguarded with bollards and drop kerbs for ease of movement of pedestrians and cyclists as instructed and approved by the Authority Engineer.

10.3 Median must be raised to a level of not more than 150mm from the adjacent carriageway levels, defined by use of appropriate kerbs stones on either sides as indicated in the schematic drawings and on approval of the Authority Engineer.

11. PROVISION OF CYCLE TRACKS ON BOTH SIDES OF THE STREET

11.1 Bidirectional cycle tracks of 1.5m to be provided on both sides of the carriageway in conformity to specifications as mentioned in the Schedule D of this document. The cycle tracks shall be demarcated at all intersections and cross roads with adequate lane marking and paintings to ensure continuity as per relevant IRC codes and standards.

12. UTILITY ZONE

A continuous strip of 2000mm is provided beneath the footpath and the cycle track on both sides of the street.

13. TYPICAL CROSS-SECTIONS OF THE SMART ROAD

As per attached drawing.

14. INTERSECTIONS AND GRADE SEPARATORS

14.1 All existing intersections which are deficient shall be improved to achieve the prescribed standards for pedestrian and non-motorized transport users, as illustrated in the attached set of drawings in part III of the RFP.

14.2 Properly designed intersections with optimum turning radii, pedestrian crossings and appropriate signals where applicable, shall be provided at the locations and of the types and features given in the tables below and as approved by the Authority Engineer. At-grade intersections at present are given in following table.

14.3 All intersections must be provided with adequate crossing paint marking as per the IRC standards on pedestrian safety and approval of the Authority Engineer.

Sl. No.	Location of intersection	Type of intersection	Other features
1	0	+	
2	3600	T	
3	550	T	
4	1450	T	
5	2400	X	
6	1700	T	
7	1260	T	
8	900	T	
9	1150	T	
10	3400	T	
11	2050	T	
12	3530	T	

15. ROAD EMBANKMENT AND CUT SECTION

15.1 Widening and improvement of the existing road embankment/cuttings and construction of new road embankment/ cuttings shall conform to the Specifications and Standards given in schedule D and the specified cross sectional details. Deficiencies in the plan and profile of the existing road shall be corrected. Earthen shoulders shall be covered with 150 mm thick layer of granular material conforming to the requirements given in Clause 401 of MORTH Specifications.

15.2 In embankments with height more than 6.0 m, the granular shoulder may be raised with provision of kerb channel to channelize the drainage as an erosion control.

15.3 The composition and specification of the paved shoulder shall be same as of the main carriageway.

15.4 Raising/cuttings of the existing road shall be detailed by the contractor in reference to the standards and specifications as mentioned in relevant IRC codes as approved by the Authority Engineer.

16. PAVEMENT DESIGN

Pavement design shall be carried out in accordance with IRC 86:1983.

16.1 Type of pavement

Flexible pavement

16.2 Design requirements

The pavement designed as per latest code of IRC 37, & IRC 86 and MORTH guidelines in consultation and approval of the Authority Engineer.

16.2.1 Design Period and strategy

Flexible pavement for new pavement or for widening and strengthening of the existing pavement shall be designed for a minimum design period of **20 years** as per the relevant IRC standards and approval of Authority Engineer. Stage construction shall not be permitted.

16.2.2 Design Traffic

Notwithstanding anything to the contrary contained in this Agreement or the Manual, the Contractor shall design the pavement for a design traffic of **20 million** standard axles based on the approval of the Authority Engineer.

16.3 Reconstruction of stretches

The following stretches of the existing road shall be reconstructed. These shall be designed as new pavement.

Sl. No.	Stretch From km to km	Remarks
1	0 to 3.0	For 1.0m width of road, wherever pipe laying and manhole provision will take place.

Sl. No.	Stretch From km to km	Remarks
2	3.0 to 3.6	For 2.5m width of road both sides, wherever there is laying of pipes for cabling work.

The Remaining part of the road relaying of bituminous layer to be done as per the design guide lines.

17. DRAINAGE

17.1 Disposal arrangement of rain water and grey water from properties to the road side storm drain to be made. Special ducting arrangement to be made for crossing the utility duct.

17.2 Restructuring of the natural nalla in the landscaping garden near Raghunath palli area. Since the Nalla is running in between landscaping area, special attention to be provided for its aesthetic appealing.

18. DESIGN OF STRUCTURES

18.1 General

18.1.1 All bridges, culverts and structures shall be designed and constructed in accordance with approval from the Authority Engineer and shall conform to the cross-sectional features and other details specified therein.

18.1.2 The following structures shall be provided with footpaths in accordance to approval of Authority Engineer:

Sl. No.	Location at km	Remarks
1	0-3.6	1m widening on both side of the existing footpath

18.1.3 The following structures shall be designed to carry utility services specified in table below, in accordance with approval from Authority Engineer:

Sl. No.	Trench at km	Utility service to be carried	Remarks
1	3.0-3.6	Electrical cables in trench and DWC HDPE pipe	As per attached drawing
2	0-3.0	Electrical cables in existing utility chamber	Retrofitting in existing trench as per attached drawing
3	0-3.6	HDPE pipe for OFC	As per attached drawing

18.2 Culverts

18.2.1 Restructuring of existing culverts:

The existing culverts at different locations mentioned in Annex 1 of Schedule A shall be restructured as required for the revised dimensions to match with new alignment of foot path based on the approval of the Authority Engineer.

19. TRAFFIC CONTROL DEVICES AND ROAD SAFETY WORKS

Traffic control devices and road safety works shall be provided in accordance with relevant IRC codes as listed in the document and as approved by the Authority Engineer.

19.1 Safety during Construction and Operation & Maintenance

- The Concessionaire shall develop, implement and administer a surveillance and safety program for providing a safe environment on or about the Project, and shall comply with the safety requirements set forth in the Concession Agreement.
- Before taking up any construction or maintenance operation/work, the Concessionaire shall prepare a Traffic Management Plan for each work zone and furnish it to the Independent Engineer for comments duly incorporating the following:

(i) Designate a Site Safety Team headed by a qualified Safety Officer.

(ii) Traffic safety devices as per IRC:SP:55 with the following specifications:

(a) Signages of retro-reflective sheet of high intensity grade.

(b) Delineators in the form of cones/drums (300 to 500 mm dia and 1000 mm high) made of plastic/ rubber having retro reflective red and white band, at a spacing of maximum 5 m along with a reflective tape (red and white band) to be tied in between the gaps of cones/drums. A bulb/ flasher using solar energy is to be placed on the top of the cone/drum for night delineation.

(c) Barricades using iron sheet (plain) with adequate iron railing/frame painted with retro-reflective paint in alternate black and white (or yellow and black) stripes. Warning lights at 5.0 m spacing shall be mounted on the barricades and kept lit in the dark hours and night.

(iii) The arrangement of traffic during construction and maintenance shall conform to the requirements of Clause 112 of MORTH Specifications. Ensure availability of 7 m paved carriageway for traffic without potholes or other defects. At locations where available carriageway is less than 7 m, provide round the clock traffic signals with marshals carrying mobile/walky-talky at both ends to control both directions of traffic.

(iv) Sprinkling of water for dust control at work zones, haul roads and plant/camp sites.

(v) Noise/Pollution suppression measures at work zones, haul roads and plant/camp sites.

(vi) Mechanical, electrical and fire safety practices.

(vii) Safety measures like PPE (Personal Protection Equipment) for workers engaged.

(viii) First Aid and Emergency Response Arrangements i.e. First Aid Box, Ambulance, paramedical staff, alarms, etc.

(ix) Safety training/awareness programmes.

(x) Formats to maintain the accident records/emergency response provided during accidents.

(xi) A penalty scheme for violations in provision of adequate traffic control devices and proper traffic management should be proposed by the Concessionaire. In case of default, the amount of penalty shall be paid by the Concessionaire to the Authority.

(xii) A compensation scheme including insurance cover for third party for workers, road users and road side residents in case of death/injury/damage to the vehicle/ property resulting from accidents on the Project, irrespective of the person at fault should be proposed by the Concessionaire.

20. ROADSIDE FURNITURE

20.1 Roadside furniture shall be designed and constructed in accordance with the details and schematic designs as attached. The roadside furniture is further elaborated in Schedule C of this document

21. UNDERGROUNDING OF OVERHEAD ELECTRICAL LINES

21.1 Design Methodology

The proposed work comprises of undergrounding the exiting overhead power lines along the proposed road stretch. The system shall be designed as per the following methodology:

21.2 HT (11kV) Distribution System

The existing 11kV overhead distribution comprises of 100 mm² AAAC, 55 mm² and 35 mm² ACSR conductors. These overhead conductors are being fed from 33/11kV Panposh Substation, 33/11kV Civil Township Substation and 33/11kV Industrial Estate substation. The contractor shall carry out the survey for the existing system from source to end

consumer. Determining the substation feeder catering to the proposed area shall be in the contractor's scope.

The system shall be made underground using XLPE armoured cables with load growth consideration. 100% redundant HT cables shall be laid such that in case of fault at a section, the faulty cable shall be replaced from the circuit with redundant cable being connected at the end terminals. The distribution system shall be radial, as per existing system, with the connections to 11kV consumers or transformers being taken through a distribution board/ Ring Main Unit. The Distribution Board / Ring Main unit shall be provided with 2 Nos Load Break Switch and an isolation/breaker provision for 2 Nos of outgoing. The distribution board shall be such that the same can be integrated in a ring distribution system in future. The board shall be a type tested assembly with provision for FRTU. The distribution board shall be suitable for outdoor installation with rain hood and associated civil work. The distribution board shall be mounted on adequate civil support structure with necessary foundation such that the board is at a suitable operating height above or adjacent to the cable trench, as per site availability and approval of Authority's engineer.

21.3 LT Distribution Network

The existing overhead distribution is by means of 440V 80 mm² AAAC, 440V 35 mm² ACSR and 440V 95 mm² ABC cable. The system is a four wire radial system. The undergrounding shall be using XLPE armoured cables laid in trench. The LT distribution system shall comprise of Main Feeder Pillar, Sub Feeder Pillar and Distribution Boards from the transformer secondary to the consumer end.

Main Feeder Pillar (MFP) shall be placed near to the DT. Each MFP shall have ACB or MCCB as breaker for incomer, from DT secondary, and cater to 8-10 numbers of Service Feeder Pillars (SFPs) via MCCB of adequate current ratings sufficient to cater to the present load situation of the transformer outgoing.

Each SFP shall have MCCB at the incomer. SFP shall be 8 or 12 way with each outgoing catering to 3-5 Junction Boxes (JBs). If fault level is less than 10kA, MCBs shall be provided at the outgoings of SFP else MCCBs shall be provided. The JBs shall be directly connected by tapping from LT bus. The SFPs shall be placed at every 30m interval.

One JB shall be used to feed 3-5 numbers of Smart Meters installed at consumer premises. Smart Meter installation shall not be in the contractor's scope.

21.4 System Design Parameter:

The electrical system shall be designed as per relevant standards and local regulations with the stringent of the two regulations being the governing parameter.

Following System Parameter shall be adopted for designing the electrical system:

Nominal (Rated) System Voltage	11kV	0.415kV

Highest System Voltage	12kV	1.1kV
Lightning Impulse Withstand Voltage (1.2/ 50 microsecond)	75 kVp	-
Power Frequency Withstand Voltage for 1 minute	28 kV rms	3 kV rms
System Neutral Earthing	Solidly Earthed	Solidly Earthed
Fault Level of System	25kA for 1sec (As per exiting condition)	20kA for 1sec (As per exiting condition)
Frequency	50 Hz	50 Hz
Dynamic Short Circuit Current Rating	62.5 kA peak	As calculated

Service Condition:

(i) Design Ambient Temperature (Reference Ambient temperature for temperature rise consideration) – 50 ºC.

(ii) Relative Humidity – Maximum - 90%; Minimum – 15%.

21.5 System Design Criteria:

The system shall be designed taking in to consideration the following system variation:

Voltage: +10% to -10%

Frequency: +3% to -3%

Combined voltage and frequency variation: +10% to -10%

The system power factor shall be at least greater than 0.9.

In normal operating condition, cumulative voltage drop shall not exceed 5% measured at Transformer primary or consumer end from the 33/11kV Sub-station or Transformer secondary side for both 11kV and LT system respectively.

The fault level shall be considered as per existing system condition.

For Lighting, following shall be the parameters to be considered:

Nominal Voltage	240V
Phases	1
Frequency	50Hz
Connection	3 wires(Phase, Neutral & Earth)

21.6 LT Panels

Main Feeder Panels (MFPs) shall be outdoor type having incoming sectionalisation and outgoing switchgears as specified. Sub Feeder Panels (SFPs) shall be outdoor type with incoming MCCB breaker and bus bar. All panels design shall be cubical type with IP55 degree of enclosure protection for outdoor installation as per IS: 13947 (Part-I). MFP shall conform to FORM 3B as per IS 61439. The Junction box shall be wall mounted or floor mounted with TPN Aluminium bus bars having groves made for connection of house service connection and suitable for terminating cables from SFP. The LT Panels shall be as per the standards IEC 61439.

Busbar: All panels shall be provided with Aluminum busbar.

a) The bus-bars shall be sized considering the following criteria:

b) Sleeves made of insulating material on all bus bars.

c) Design ambient temperature 50°C.

d) Final temperature of the bus-bars complying with requirements of relevant standards.

e) Bus bars being inside the panel; De- ration for enclosure and ventilation.

f) Bus bar suitability for carrying rated current continuously. The current density (A/mm²) of the bus bar shall not exceed 0.8 for Aluminium bus and 1.6 for Copper bus.

g) Configuration of bus bars and Proximity effect.

h) The main bus shall be designed based on the load rating as well as the actual fault level for specified duration at the location of the panel with 10% positive tolerance.

i) Earth bus of the panel shall be sized suitable for the above fault level for the same duration.

Switchgear Sizing/ Selection:

Switchgear shall be sized/ selected considering the following:

(a) Rating suitable for carrying full load current of the feeder.

(b) Suitability for Short Circuit Rating for specified duration.

(c) In panel de-ration of minimum 20% or as provided in Manufacturer's catalogue, whichever is higher shall be considered.

(d) ACBs shall be considered for switchgear ratings above 630A and MCCB shall be considered up to 630A. All ACBs and MCCBs shall be rated for Bus fault level or next higher market rating available with Ics=Icu=Icw=100% for ACB and and Ics=Icu=100% for MCCBs.

(e) The MFP shall be provided with Microprocessor based overload (O/L), Short circuit (SC) and Earth fault (E/F) release at the panel incomer and outgoing.

(f) Multi-function meter for measuring current, voltage, power shall be provided for all the incomers, outgoing power feeders.

(g) 20% spare capacity shall be considered on each panel for future.

21.7 Cabling System

HT cables shall be 11kV earthed grade, multi-core, stranded and compacted aluminium contractor, extruded XLPE insulated (dry cured), extruded semi conducting compound screen with a layer of non-magnetic metallic tape screen, extruded PVC inner sheath (Type ST-2), armoured and extruded overall sheath with Fire Retardant Low Smoke (FRLS) PVC compound (Type ST-2). The cables shall conform to IS-7098 Part -II.

LT Cables shall be 1100V earthed grade, single/multi-core, stranded and compacted aluminium conductor, extruded XLPE insulated, extruded PVC inner sheath (Type ST-2), armoured and extruded overall sheath with Fire Retardant Low Smoke (FRLS) PVC compound (Type ST-2). The cables shall conform to IS-7098 Part -I.

Cables up to & including 10 mm² shall be Copper multi-stranded conductor with PVC insulation galvanized steel round wire armored & cables beyond 10 mm² shall be Aluminum multi-stranded conductor with XLPE insulation & galvanized steel flat strip armored.

All control cables shall be 650 V grade copper conductors FRLS PVC insulted cables conforming to IS 1544- Part I. For cables above 7 cores, minimum two spare cores shall be considered.

All LT cable shall be conforming to IS 7098 Part I for XLPE cables and IS 1544 – Part I for PVC cables.

The following main aspects shall also be considered while deciding the size of the cables/ wires:

(a) Supply voltage and frequency.

(b) Corresponding full load current under site conditions, i.e, necessary de-rating considerations.

(c) Route length and method of laying of cables.

(d) Maximum allowable temperature rise under normal full load condition based on the material of cable insulation (XLPE/ PVC).

(e) Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable. Load growth consideration for next 15 years shall be considered while arriving at the full load current.

(f) Following shall be the fault clearing time consideration:

(i) From transformer secondary to MFP incomer shall be 1s.

(ii) From ACB outgoing of the MFP shall be considered as 0.16s (for Tie feeders if any it shall be 0.5s).

(g) Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shall be considered for sizing the cable:

(i) Ambient Air Temperature (minimum 50^0 C).

(ii) Ambient ground temperature (minimum 40^0 C to be considered).

(iii) Method of cable laying.

(iv) Depth of cable burial.

(v) Thermal Resistivity of Soil (minimum 150^0 C Cm/ W to be considered).

(vi) No. of cables in a group

(vii) No. of cable trays in tier.

(viii) Any other de-ration factors as applicable & as per Manufacturer's catalogue.

Bending radius of 12D and 15D shall be provided for LT and HT cables respectively where D is the outer diameter of the cable.

100% redundant HT cables shall be provided for the entire system and 100% redundant LT cables shall be provided at road crossings. These redundant cables shall be provided with necessary end termination such that the same can be connected easily to the RMU/Boards. Necessary safety shall be ensured for these spare cables.

21.8 Electrical Cable undergrounding philosophy:

Based on the above inputs, the electrical distribution system has been planned to be a ring / tie network. Following are the alternate options that have to be adopted depending upon space availability:

Sr.	Description	Section A	Section C	Section D
1	Laying method	Cable Trench	Cable Trench	DWC Corrugated HDPE pipe
2	Space provision made	Clear in to in space of ≥500mm	Clear in to in space of 450 – 600 mm	HT Cable : 200mm (ID) DWC corrugated HDPE pipe for each cable Space at minimum 1 meter from FRL for laying of pipes.
3	Access points	Openable RCC cover at every 15m	Openable throughout	Manhole at every 30m interval or start and end of the pipe section for cable bending and termination.
4	Pipes laid (Dia / Nos.)	At transition of electrical cable laying section to Section – C&D.	At transition of electrical cable laying section to Section – A.	HT: 220mm (OD) DWC corrugated HDPE pipe – 9 Nos.
5	Cable support (Length / Nos.)	Angle support of trench available space – 2 Nos. 750mm vertical cable tray with necessary support– 1No.	Angle support of trench available space – 1 No.	NA
6	Order of preference based on space	I	II	II

Sr.	Description	Section A	Section C	Section D
	availability			

Refer drawing no. TCE.10839A-EL-3057-CT-40100 for details of the above proposed cable laying alternatives.

21.9 Methodology for selection of the applicable cable laying sections:

From the survey carried out, the contractor shall work out on the cable laying option based on:

- Available space in the drain chamber
- Available space between the property and drain edge
- Available space beneath the carriage way

These above parameters in the indicated precedence have been adopted to decide on the applicable cable laying section for road stretch being considered. The applicable section succeeding and preceding shall also been considered while deciding the section.

Trench Laying

In the case of trench, there shall be two situations – retrofitting of available chamber to be utilized as electrical trench and construction of new trench.

In case of the existing chamber being used, it shall be ensured that there is complete partition with the drain and no points from wherein water can enter. Any necessary civil work to ensure the same shall be carried out before retrofitting of the chamber. These trenches shall house both LT & HT cables with the mounting arrangement depending on the available space inside the trench. Cable or cable tray support by means of angle support from the walls shall be provisioned at an interval of 1500mm in case of cable tray laying, 1000mm in case of direct HT cable laying and 750mm in case of direct LT cable laying. Ladder type cable trays shall be used for vertically clamped LT cables. For interconnection to DBs, the cable shall be bent in the trench and terminated at the RMU end.

For new trench being constructed, Section C in the drawing shall be referred for details wherein a cable support of the entire available length shall be placed to carry the LT cables. The trench shall be made of RCC with 200mm wall thickness with proper water and fire proofing. At locations where there shall be available space concerns the existing utility chamber shall be retrofitted for making similar provision. Provision for dewatering sump and pump shall be kept based on requirement. The trench shall have 2 hours of fire

withstanding capability.

Pipe Laying:

DWC corrugated HDPE pipes shall be directly buried in ground with excavation and backfilling. The average depth of laying shall be 1.0 – 2.0 m below the finished road level as per the applicable section. The size (ID) of DWC corrugated HDPE pipes required shall be tentatively 200mm and 160mm for HT and LT cables respectively. The pipe size shall be ensured by the contractor as per following:

- For LT cables, the pipe sizes shall be arrived considering 40% occupancy by cables
- For HT cables, one pipe shall be considered for each cable.

A chamber shall be provided for terminating, jointing and bending of cables. The size of chamber required depends on the number of cables. A manhole chamber of 2100x1500mm with a depth of 2260mm shall be required for the proposed section D. These chambers shall be provided:

- At every 30m distance for straight run of cable or depending on the cable drum length
- At 11kV DBs cable termination
- At Road Junction or turning

The distance between subsequent chambers shall be varied as per site conditions to meet the above requirements. The chamber shall be made of RCC with openable double cover having capability to cater to the vehicular movement proposed over it. Arrangement shall be provided for 1-2 personals to enter into the chamber and carry out necessary repair / maintenance activities.

Crossing Philosophy

In order to cross the road from one side to other, 4 Nos of 200mm RCC pipe shall be provisioned at every 200m interval.

At road crossings where existing drain is missing, there new trench shall be provisioned. But in case of site limitation if the trench option stands not feasible the RCC pipes shall be used for crossing the same.

At the culverts, L section angle support from the culvert shall be used. Cable trays with closed covers shall be used to cross the culverts. The angle support shall be provided at every 750mm interval.

For transition from trench section to pipe sections and vice-versa, the cables shall cross the storm drain as per the bending trajectory, requirement of maintaining the cable bending radius, in DWC corrugated HDPE pipes and terminate at a cable connection chamber. From

the cable connection chamber, the cables shall be laid in pipes for crossing the road or cable being laid in pipes beneath the carriageway. Refer Section B for a typical sectional view. Based on the detailed design, the contractor shall design the cable connection chamber and the requisite nos.

Distribution Board (DB), Feeder Pillar (FP) locations

The 11kV DBs and 415 Feeder pillars shall be placed on the proposed footpath.

For road stretch having trenches (Section A or C), the DBs and FPs shall be located on the trench. The cable shall get its bending radius of 12D for LT and 15D for HT inside the trench.

For pipe laid (Section D), the DBs and FPs shall be located on the proposed footpath area and cables shall cross the drain by DWC corrugated HDPE pipes, as per the trajectory for cable bending requirement, and terminate at the panel. The applicable section shall be finalized in consultation with the Authority Engineer.

22. LANDSCAPING

Roadside landscaping to be carried out at locations as mentioned in the drawing no. TCE.10839A-CV-3054-SI-30310 & TCE.10839A-CV-3054-SI-30311 with following activities;

- Softscape works (All plantation areas with lawn, groundcovers, shrubs and trees)
- Hardscape works (All paved areas including foot path)
- Garden dust bins
- Garden benches
- Signages
- Roll-on Surfacing Material on entire foot path and cycle track

23. CHANGE OF SCOPE

The length of Structures and bridges specified hereinabove shall be treated as an approximate assessment. The actual lengths as required on the basis of detailed investigations shall be determined by the Contractor in accordance with the Specifications and Standards. Any variations in the lengths specified in this Schedule-B shall not constitute a Change of Scope, save and except any variations in the length arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 13.

24. Damage to the existing utilities

During execution if any damage happens to any utility services such as water supply pipes, sewer lines, drainage network, telecom and electricity cables and lighting etc. shall be repaired by the contractor with his own cost

25. LIST OF DRAWINGS ATTACHED

Sr. No.	Drawing Number	Drawing Title
1	TCE.10839A-CV-3054-SI-30407	AMBEDKAR CHOWK JUNCTION
2	TCE.10839A-CV-3054-SI-30413	NEXA JUNCTION (SANI TEMPLE)
3	TCE.10839A-CV-3054-SI-30416	PANPOSH JUNCTION
4	TCE.10839A-CV-3054-SI-30411	STI JUNCTION (FLYOVER)
5	TCE.10839A-CV-3054-SI-30209	TYPICAL ROAD CROSS SECTION OF PANPOSH ROAD (MR-09)
6	TCE.10839A-CV-3054-SI-30308	PLAN OF PANPOSH SMART ROAD CHAINAGE (0.00 TO 2100.0)
7	TCE.10839A-CV-3054-SI-30309	PLAN OF PANPOSH SMART ROAD CHAINAGE (2100.0 TO 3682.0)
8	TCE.10839A-CV-3054-SI-30103	EXISTING PLAN OF PANPOSH ROAD CHAINAGE (0.00 TO 2100.0)
9	TCE.10839A-CV-3054-SI-30104	EXISTING PLAN OF PANPOSH ROAD CHAINAGE (2100.0 TO 3682.0)
10	TCE.10839A-EL-3057-CT-40100	TYPICAL ROAD CROSS SECTION OF PANPOSH ROAD MR-09(CABLE TRENCH DETAILS) (SH 1 OF 2)
11	TCE.10839A-EL-3057-CT-40101	TYPICAL ROAD CROSS SECTION OF PANPOSH ROAD MR-09(CABLE PIPE LAYING DETAILS) (SH 2 OF 2)
12	TCE.10839A-CV-3054-SI-30310	PROPOSED PLAN OF PANPOSH ROAD CHAINAGE (0.00 TO 1850) UTILITIES AND LANDSCAPPING
13	TCE.10839A-CV-3054-SI-30311	PROPOSED PLAN OF PANPOSH ROAD CHAINAGE (1850 TO 3650) UTILITIES AND LANDSCAPPING
14	TCE.10839A-CV-3018-RC-30001	TYPICAL DETAIL OF PLAN AND SECTIONS OF DRAIN & PROPERTY DRAIN CHAMBER OF PANPOSH ROAD

SCHEDULE - C
(See Clause 2.1)

PROJECT FACILITIES

1. Project Facilities

The Contractor shall construct the Project Facilities in accordance with the provisions of this Agreement. Such Project Facilities shall include:
Fabricating, constructing, or procuring all relevant streetscape elements and furniture, including but not limited to:

- Kerbs
- Paving Materials
- Tree Plantation
- Trench, DWC HDPE Pipes and Cable Laying
- Benches
- Dustbins
- Bus Shelters
- Signage
- Bollards
- Cycle Track and Footpath
- Additional Elements, if any, as per instructions of approving authority, and based on technical specifications as listed under Schedule D of this tender document.

2. Description of Project Facilities

Each of the Project Facilities is described below:

Sr. No.	Project Facility	Location	Design Requirements	Other essential details
1	Cycle track	0 to 3.6 km both side	IRC : 11-2015	Pavement Composition shall be for Paver Block
2	Footpath	0 to 3.6 km both side	IRC- 103-2012	Pavement Composition shall be for Paver Block

3	Cable Trench	0 to 3km Retrofitting	As per IS 456	Water proofing, cable tray, angle supports, claps and other associated accessories for existing construction.
4	Cable Trench	3 km to 3.6 km new construction on both side	As per IS 456	Water proofing, cable tray, angle supports, claps and other associated accessories for new construction. Pipe Laying and Manhole
5	Conduits for carrying OFC Cables	0 to 3.6km on one side in LHS		Loop pit at every 200m, joint pit at every 2000m. Pipe lying.
6	Landscapping	0.550 km to 0.700 km on RHS 1.125 km to 1.275 km on RHS 1.3 km to 1.45 km on RHS	IRC SP 21 – 2009	Softscape, hardscape lighting and furniture.
7	Bus shelter	10 No.		Fabrication and supply of SS-304 grade, bus shelter of size approx 9m X 2.4 m size. Including aluminum signages and root map display with timings etc.
8	Road Signages , Advertisement Board		IRC 67-2012	For pedestrian crossings, speed limit and directional boards etc. Signages along ffotpath indicating segregation between cycle track and pedestrian area

				at 500 m center to center.
9	Road Markings		IRC 35-2015	Road marking with hot applied thermoplastic compound with reflector rising glass bands on bituminous surface. Marking type : Road painting solid line , break line, zebra crossing and arrow marking.
10	Drain	0.550 k to 0.850 km LHS 0.550 km to 0.900 km on RHS		Reconstruction
11	Plot Connection Chambers & its interconnection with existing stormwater	0 to 3.6km on both sides approximate 150		As per standard specification.

Note: The above mentioned details and designs are to be read in conjunction with each other. The contractor is expected to match the finishes and/or improve the designs to create an urban facilities and furniture family for the project site in consultation and approval by the Authority Engineer

The location and distribution of street lights and pedestrian lights are to be verified and approved for the appropriate lux level of illumination on site with relevant photometric tests and lighting standards subject to approval of the Authority Engineer.

The installation of street lights must be in coordination with the other existing initiatives in the city including but not limited to the existing contract on installation, repair and maintenance of LED street lights in Rourkela.

SCHEDULE - D
(See Clause 2.1)

TECHNICAL SPECIFICATIONS FOR ROAD WORKS

CODES AND SPECIFICATIONS

The following IS (Indian Standard) Codes and IRC (Indian Road Congress) Codes, specifications etc. shall be applicable. In all cases the latest revision of the codes and specifications shall be referred to:

Sr. No.	**IS / IRC Code Nos.**	**Description**
1	MORT&H	Specifications for Road and Bridge works, Fifth Revision, Ministry of Road Transport and Highways, New Delhi 2013
2	IRC : 35	Code of Practice for Road Markings.
3	IRC : 36	Recommended Practice for Construction of Earth Embankments and Sub-grade for road works
4	IRC : 86	Geometric Design standards for Urban roads in plans
5	IRC : 37	Guidelines for the Design of Flexible Pavements
6	IRC : 67	Code of Practice for Road Signs
7	IRC:SP:63	Guidelines for the use of Interlocking Concrete Block Pavement
8	IRC:SP:41	Guidelines on Design of At-Grade Intersections in Rural & Urban Areas
9	IRC : 94	Specification for Dense Bituminous Macadam
10	IRC : 29	Specifications for Bituminous Concrete for Road Pavement
11	IS : 73	Specifications for Paving Bitumen
12	IS : 217	Specification for cut back Bitumen
13	IS : 400	Specification for Test Sieve
14	IS : 454	Specification for Digboi type cut back Bitumen
15	IS : 456	Specifications for plain and reinforced concrete.
16	IS : 2720 : (Part 5)	Method of Test for Soils: Determination of Liquid and Plastic Limit.
17	IS : 2720 :	Method of Test for Soils: Determination of water content – dry density

Sr. No.	IS / IRC Code Nos.	Description
	(Part 8)	relation using Light compaction
18	IS : 2720 : (Part 16)	Method of Test for Soils: Laboratory determination of CBR
19	IS : 1124	Method of Test for determination of water Absorption, apparent specific gravity & porosity of Building stone
20	IRC: 103	Guidelines for Pedestrian Facilities

TABLE OF CONTENTS

NOTE

1. Relevant clauses of Ministry of Road Transport & Highways (MORT&H) Specifications for Roads and Bridge works relevant to this tender only are reproduced.
2. In case of any variation between the reproduced specification and the original specification of MORT&H Publication, the reproduce publication shall prevail and shall be construed accordingly.
3. If MORT&H clauses referred to in the reproduced specifications herein are not included in the latter, the same shall be read from MORT&H specifications.

Topographic Survey, & Geotechnical investigation

Contractor to conduct detail topographical site survey and Geotechnical investigation before execution of work and submit the same to the Engineer in charge for approval

Earthworks:

Earthworks shall involve of Clearing and Grubbing and excavation for roadway and drains, excavation for structures and embankment Construction for Road.

201.0 CLEARING AND GRUBBING

201.1 SCOPE

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc. which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

201.2 PRESERVATION OF PROPERTY/AMENITIES

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc. and where required undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials, etc. and the schedules for carrying out temporary and permanent erosion control works as stipulated in

Clause 306.3.

201.3 METHODS, TOOLS AND EQUIPMENT

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyre dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc. falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500mm of the sub-grade bottom. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/sub-grade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer, shall be cut down below ground level so that these do not present an unsightly appearance. All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding areas.

Anthills both above and below the ground as are liable to collapse and obstruct free sub-soil water flow shall be removed and their workings, which may extend to several metres, shall be suitably treated.

201.4 DISPOSAL OF MATERIALS

All materials arising from clearing and grubbing operations shall be taken over and shall be disposed of by the Contractor at suitable disposal sites with all leads and lifts. The disposal shall be in accordance with local, State and Central regulations.

301. EXCAVATION FOR ROADWAY AND DRAINS

301.1 SCOPE

This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of roadway, side drains and waterways, in accordance with requirements of these specifications and the lines, grades and cross–section shown in the drawings or as indicated by the Engineer. It shall include the hauling and stacking of or hauling to sites of embankment and sub-grade construction, suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, with all leads and lifts, reuse of cut materials as may be deemed fit, trimming and finishing of the road to specified dimensions or as directed by the Engineer.

Excavated material shall be stacked off in the manner indicated at the site including stacking of excavated material up to any lead and lift. The rate shall only cover the cost of excavation, stacking and/or spreading of the material, if required at the site.

301.2 CLASSIFICATION OF EXCAVATED MATERIAL

301.2.1 Classification.

All materials involved in excavation shall be classified by the Engineer in the following manner:

a) Soil:

This shall comprise topsoil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm shall be deemed to be covered under this category.

b) Ordinary Rock (not requiring blasting) :

This shall include:

i) rock types such as laterites, shales and conglomerates, varieties of limestone and sandstone etc., which may be quarried or split with crow bars, also including any rock which in dry state may be hard, requiring blasting but which, when wet, becomes soft and manageable by means other than blasting.

ii) macadam surfaces such as water bound and bitumen/tar bound; soling of roads, cement concrete pavement, cobble stone, etc, compacted moorum or stabilized soilpaths, etc. and hard core; compact moorum or stabilised soil requiring use of pick axe or shovel or both.

iii) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar below ground level, reinforced cement concrete which may be broken up with crow bars or picks and stone masonry in cement mortar below ground level; and

iv) boulders which do not require blasting found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin.

c) Hard Rock (requiring blasting) :

This shall comprise:

i) Any rock or cement concrete for the excavation of which the use of mechanical plant and/or blasting is required.

ii) Reinforced cement concrete below ground level and in bridge/ROB/RUB/flyover piers and abutments.

iii) boulders requiring blasting

d) Hard Rock (using controlled blasting)

Hard rock requiring blasting as described under (c) but where controlled blasting is to be

carried out in locations where built-up area, huts, and are situated at within 200m of the blast site.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (c) but where blasting is prohibited for any reason like people living within 20 m of blast sites etc, and excavation has to be carried out by chiselling, wedging of any other agreed method.

f) Marshy Soil

This shall include soils like soft clays and peats excavated below the original ground level of marshes and swamps and soils excavated from other areas requiring continuous pumping or bailing out of water.

301.2.2 Authority for Classification

The classification of excavation shall be decided by the Engineer and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer.

301.3 CONSTRUCTION OPERATIONS

301.3.1 Setting Out:

After the site has been cleared as per Clause 201, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer. Clause 109 shall be applicable for setting out operations.

301.3.2 Stripping and Storing Top Soil

When so directed by the Engineer, the top soil existing over the sites of excavation shall be stripped to specified depths and stockpiled at designated locations for re-use in covering embankment slopes, cut slopes, berms and other disturbed areas where re-vegetation is desired in accordance with Clause 305.3.3. Prior to stripping the topsoil, all trees, shrubs etc. shall be removed along with their roots with approval of the Engineer.

301.3.3 Excavation - General

All excavations shall be carried out in conformity with the directions laid herein under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilised as deemed fit or as approved by the Engineer.

While planning or executing excavations, the Contractor shall take all-adequate precautions against soil erosion, water pollution etc. as per Clause 306, and take appropriate drainage measures to keep the site free of water in accordance with Clause 311.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or directed by the Engineer. The Contractor shall not excavate outside the slopes or below the established grades or loosen any material outside the limits of excavation. Subject to the permitted tolerances, any excess depth excavated below the specified levels on the road

shall be made good at the cost of the Contractor with suitable material of similar characteristics to that removed and compacted to the requirements of Clause 305.

All debris and loose material on the slopes of cuttings shall be removed. No backfilling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in cut slopes these shall be excavated to approved depth on instructions of the Engineer and the resulting cavities filled with suitable material and thoroughly compacted in an approved manner.

After excavation, the sides of excavated area shall be trimmed and the area contoured to minimise erosion and ponding, allowing for natural drainage to take place.

301.3.4 Methods, Tools and Equipment:

Only such methods, tools and equipment as approved by the Engineer shall be adopted / used in the work. If so desired by the Engineer, the Contractor shall demonstrate the efficacy of the type of equipment to be used before the commencement of work.

301.3.5 Rock Excavation:

Rock, when encountered in road excavation, shall be removed up to the sub-grade top level or as otherwise indicated on the drawings. Where, however, unstable shales or other similar materials are intersected at the sub-grade top level, these shall be excavated to the extent of 500 mm below the formation level or as otherwise specified. In all cases, the excavation operations shall be so carried out that at no point on cut formations the rock protrudes above the specified levels. Rocks and boulders which are likely to cause differential settlement and also local drainage problems should be removed to the extent of 500 mm below the formation level in the formation width including side drains.

Where excavation is done to levels lower than those specified, the excess excavation shall be made good as per Clauses 301.3.3 and 301.6 to the satisfaction of the Engineer.

Slopes in rock cutting shall be finished to uniform lines corresponding to slope lines shown on the drawings or as directed by the Engineer. Notwithstanding the foregoing, all loose pieces of rock on excavated slope surface which move when pierced by a crowbar shall be removed.

Where blasting is to be resorted to, the same shall be carried out to Clause 302 and all precautions indicated therein observed.

Where pre-splitting is prescribed to be done for the establishment of a specified slope in rock excavation, the same shall be carried out as per Clause 303.

301.3.6 Marsh Excavation

The excavation of marshes/swamps shall be carried out as per the programme approved by the Engineer.

Excavation of marshes shall begin at one end and proceed in one direction across the entire marsh immediately ahead of back filling. The method and sequence of excavating and back-filling shall be such as to ensure, to the extent practicable, the complete removal or displacement of all muck from within the lateral limits indicated on the drawings or as staked by the Engineer.

301.3.7 Excavation of Road Shoulders/Verge/Median for Widening of Pavement or providing treated shoulders:

In the works involving widening of existing pavements or providing paved shoulders, the existing shoulder/verge/median shall be removed to its full width and upto top of the subgrade. The subgrade material within 500 mm from the bottom of the pavement for the widened portion or paved shoulders shall be loosened and recompacted as per Clause 305. Any unsuitable material found in this portion shall be removed and replaced with the suitable material. While doing so, care shall be taken to see that no portion of the existing pavement designated for retention is loosened or disturbed. If the existing pavement gets disturbed or loosened, it shall be dismantled and cut to a regular shape with sides vertical and the disturbed/loosed portion removed completely and re-laid as directed by the Engineer, at the cost of the Contractor.

301.3.8 Excavation for Surface/Sub-surface Drains

Where the Contract provides for construction of surface/sub-surface drains to Clause 309, excavation for these shall be carried out in proper sequence with other works as approved by the Engineer.

301.3.9 Slides:

If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of the Contractor as ordered by the Engineer. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or given rise to recurrent slides after construction. If finished slopes slide into the roadway subsequently, such slides shall be removed and paid for at the contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

301.3.10 De-watering:

If water is met with in the excavations due to springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry whenever so required or directed by the Engineer. Care shall be taken to so discharge the drained water as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore to the original condition at his own cost or compensate for the damage.

301.3.11 Use and Disposal of Excavated Materials:

All the excavated materials shall either be reused with the approval of the Engineer or disposed off with all leads and lifts as directed by the Engineer.

301.3.12 Back-filling :

Back-filling of masonry / concrete/ hume pipe or drain excavation shall be done with approved material with all lead and lifts after concrete/masonry hume pipe is fully set and carried out in such a way as not to cause undue thrust on any part of the structure and/or not to cause differential settlement. All space between the drain walls and the side of the excavation shall be

refilled to the original surface making due allowance for settlement, in layers generally not exceeding 150 mm compacted thickness to the required density, using suitable compaction equipment such as trench compactor, mechanical tamper, rammer or plate compactor as directed by the Engineer.

301.4 PLYING OF CONSTRUCTION TRAFFIC

Construction traffic shall not use the cut formation and finished sub grade without the prior permission of the Engineer. Any damage arising out of such use shall be made good by the contractor at his own cost.

301.5 PRESERVATION OF PROPERTY

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers or other sub-surface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which in the opinion of the Engineer, shall be continued in use without any change. Safety measures taken by the Contractor in this respect, shall be got approved by him from the Engineer. However, if any of these objects is damaged by reason of the Contractor's negligence, it shall be replaced or restored to the original condition at his cost. If the Contractor fails to do so, within the required time as directed by the Engineer or if, in the opinion of Engineer, the actions initiated by the Contractor to replace/restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement/restoration directly through any other agency at the risk and cost of the Contractor after issuing a prior notice to the effect.

301.6 PREPARATION OF CUT FORMATION

The cut formation, which serves as a sub-grade, shall be prepared to receive the sub-base/base course as directed by the Engineer.

Where the material, in the sub-grade has a density less than specified in Table 300-1, the same shall be loosened to a depth of 500 mm. and compacted in layers in accordance with the requirements of Clause 305 adding fresh material, if any required, to maintain the formation level as shown in the drawings. Any unsuitable material encountered in the sub-grade shall be removed as directed by the Engineer, replaced with suitable material compacted in accordance with Clause 305.

In rocky formations, the surface irregularities shall be corrected and the levels brought up to the specified elevation with granular base material as directed by the Engineer, laid and compacted in accordance with the respective specifications for these materials. The unsuitable material shall be disposed of in accordance with Clause 301.3.11. After satisfying the density requirements, the cut formation shall be prepared to receive the sub-base/base-course in accordance with Clause 310 and 311.

301.7 FINISHING OPERATIONS

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces.

When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm. measured at right angles to the slope, except where excavation is in rock (hard or soft)

where no point shall vary more than 300 mm from the designated slope. In no case shall any portion of the slope encroach on the roadway.

The finished cut formation shall satisfy the surface tolerances described in Clause 902.

Where directed, the topsoil removed earlier and conserved (Clauses 301.3.1 and 305.3.3) shall be spread over cut slopes, shoulders and other disturbed areas. Slopes may be roughened and moistened slightly, prior to the application of topsoil, in order to provide satisfactory bond. The depth of topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 to 100 mm.

304 EXCAVATION FOR STRUCTURES

304.1 SCOPE

Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, head-walls, cut off walls, pipe culverts and other similar structures, in accordance with the requirements of these Specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer. The work shall include construction of the necessary cofferdams and cribs and their subsequent removal; all necessary sheeting, shoring, bracing, draining, and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstructions necessary for placing the foundations; trimming bottoms of excavations; back filling and clearing up the site and the disposal of all surplus material.

304.2 CLASSIFICATION OF EXCAVATION

All materials involved in excavation shall be classified in accordance with Clause 301.2.

304.3 CONSTRUCTION OPERATIONS

304.3.1 Setting out:

After the site has been cleared to Clause 201, the limits of excavation shall be set out true to lines curves and slopes to Clause 301.3.1.

304.3.2 Excavation:

Excavation shall be taken to the width of the lowest step of the footing including additional width as required for construction operation. The sides shall be left plumb where the nature of soil allows it. Where the nature of soil or the depth of the trench and season of the year do not permit vertical sides, the Contractor at his own cost shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both width due regard to the safety of personnel and works and to the satisfaction of the Engineer.

The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of material encountered is such as to require changes, in

which case the depth shall be as ordered by the Engineer. Propping shall be undertaken when any foundation or stressed zone from an adjoining structure is within a line of 1 vertical to 2 horizontal from the bottom of the excavation.

Where blasting is to be resorted to, the same shall be carried out to Clause 302 and all pre -cautions indicated therein observed. Where blasting is likely to endanger adjoining foundations or other structures, necessary precautions such as controlled blasting, providing rubber mat cover to prevent flying of debris etc. shall be taken to prevent any damage.

304.3.3 Dewatering and Protection:

Normally, open foundation shall be laid dry. Where water is met with in excavation due to stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures such as bailing, pumping, constructing diversion channels, drainage channels, bunds, cofferdams and other necessary works to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the Contractor but subject to approval of the Engineer. Approval of the Engineer shall, however, not relieve the Contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and safety of the Works.

Where cofferdams are required, these shall be carried to adequate depths and heights, be safely designed and constructed and be made as watertight as is necessary for facilitating construction to be carried out inside them. The interior dimensions of the cofferdams shall be such as to give sufficient clearance for the construction and inspection and to permit installation of pumping equipments, etc. inside the enclosed area.

If it is determined beforehand that the foundations cannot be laid dry or the situation is found that the percolation is too heavy for keeping the foundation dry, the foundation concrete shall be laid under water by tremie pipe only. In case of flowing water or artesian springs, the flow shall be stopped or reduced as far as possible at the time of placing the concrete.

Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for a period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other similar means.

At the discretion of the Contractor, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area.

The Contractor shall take all precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property.

304.3.4 Preparation of Foundation:

The bottom of the foundation shall be levelled both longitudinally and transversely or stepped as directed by the Engineer. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer, the extra depth shall be made up with concrete or masonry of the foundation at the cost of the Contractor as per Clause 2104.1 Ordinary filling shall not be used for the purpose to bring the foundation to level.

When rock or other hard strata is encountered, it shall be freed or all soft and loose material, cleaned and cut to a firm surface either level, stepped or serrated as directed by the Engineer. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer. In the case of excavation in rock, annular space around footing shall be filled with lean concrete M 15 up to the top level of rock.

If the depth of fill required is more than 1.5 m in soft rock or 0.6 m in hard rock above the foundation level, the filling up to this level shall be done with M-15 concrete and portion above shall be filled by concrete or by boulders grouted with cement.

When foundation piles are used, the excavation for pile cap shall be done after driving/casting of all piles forming the group. After pile driving operations in a given pit are completed, all loose and displaced materials therein shall be removed to the level of the bottom of the pile cap.

304.3.5 Slips and Blows:

If there are any slips or blows in the excavation, these shall be removed by the Contractor at his own cost.

304.3.6 Public Safety:

Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures. For safety precautions, guidance may be taken from IS: 3764.

304.3.7 Back Filling:

Back filling shall be done with approved material after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the

structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface in layers not exceeding 150 mm compacted thicknesses. The compaction shall be done with the help of suitable equipment such as mechanical tamper, rammer, plate vibrator etc. after necessary watering, so as to achieve the maximum dry density.

304.3.8 Disposal of Surplus Excavated Materials:

Clause 301.3.11 shall apply.

305 EMBANKMENT CONSTRUCTION

305.1 GENERAL

305.1.1 Description:

These specifications shall apply to the construction of embankments, sub-grades, earthen shoulders and miscellaneous back fills with approved material obtained either from excavation for road construction, borrow pits or other sources. All embankments and sub-grades shall be constructed to accordance with the requirements of these specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

305.2 MATERIALS AND GENERAL REQUIREMENTS

305.2.1 Physical Requirements:

305.2.1.1 The materials used in embankments, sub-grades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, reclaimed material from pavement, fly ash, pond ash, a mixture of these or any other material as approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment.

The following types of material may be considered unsuitable for embankment:

a) Material from swamps, marshes or bogs

b) Peat, log, stump or perishable material; any soil classifies as OL, OI, OLL or Pt in accordance with IS: 1498.

c) Material susceptible to spontaneous combustions

d) Material in a frozen condition

e) Clay having liquid limit exceeding 50 and plasticity index exceeding 25; and

f) Materials with salts resulting in leaching in the embankment.

305.2.1.2 Expansive clay exhibiting marked swell and shrinkage properties (“free swelling index” exceeding 50 per cent when tested as per IS: 2720 – Part 40) shall not be used as a fill

material. Where an expansive clay having "free swelling index" value less than 50 percent is used as a fill material, sub-grade and top 500mm portion of the embankment just below sub-grade shall be non-expansive in nature.

305.2.1.3 Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO3) per litre when tested in accordance with BS: 1377, Part 3, but using a 2:1 water-soil ratio shall not be deposited within 500mm distance (or any other distance described in the Contract), of permanent works constructed out of concrete, cement bound materials or other cementitious material.

Material with a total sulphate content (expressed as SO3) exceeding 0.5 percent by mass, when tested in accordance with BS:1377, Part 3 shall not be deposited within 500 mm, or other distances described in the Contract, or metallic items forming part of the Permanent Works.

305.2.1.4 The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm. when being placed in the embankment and 50 mm. when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these specifications. The maximum particle size shall not be more than two-third of the compacted layer thickness.

305.2.1.5 Ordinarily, only the materials satisfying the density requirements given in Table 300.1 shall be employed for the construction of the embankment and the sub-grade.

TABLE 300.1 DENSITY REQUIREMENTS OF EMBANKMENT AND SUB-GRADE MATERIALS

Sl. No	Type of Work	Maximum laboratory dry density when tested as per IS: 2720 (Part 8)
1.	Embankments up to 3 m height, not subjected to extensive flooding.	Not less than 15.2 KN/cu.m
2.	Embankments exceeding 3 metre height or embankments of any height subject to long periods of inundation.	Not less than 16 KN/cu.m
3.	Sub-grade and earthen shoulders /verge/backfill	Not less than 17.5 KN/cu.m

Note:

1) This table is not applicable for lightweight fill material e.g. cinder, fly ash etc.

2) The material to be used in subgrade shall be non-expansive and shall satisfy design CBR at the specified dry density and moisture content. In case the available materials fail to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 or by any stabilization method approved by the Engineer shall be followed.

305.2.1.6 The material to be used in subgrade shall confirm to the design CBR value at the specified dry density and moisture content of the test specimen. In case the available materials fails to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 or by any stabilization method approved by the Engineer or by the IRC Accreditation Committee shall be followed.

305.2.1.7 The material to be used in high embankment construction shall satisfy the specified requirements of strength parameters.

305.2.2 General Requirements:

305.2.2.1 The materials for embankment shall be obtained from approved sources with preference given to acceptable materials becoming available from nearby roadway excavation under the same contract.

The work shall be so planned and executed that the best available materials are saved for the sub-grade and the embankment portion just below the sub-grade.

305.2.2.2 Borrow Materials:

The arrangement for the source of supply of the material for embankment and sub-grade and compliance with the guidelines, and environment requirements, in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable shall be the sole responsibility of the Contractor.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8m width should be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges to facilitate drainage. The depth the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also no pit shall be dug within the offset width from the toe of the embankment required as per the consideration of stability with a minimum width of 10 m.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

Where the excavation reveals a combination of acceptable and un-acceptable materials, the Contractor shall unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or siting of temporary buildings or structures.

305.2.2.3 Fly Ash

Use of fly ash shall confirm to the Ministry of Environment and Forest guidelines. Where fly-ash is used the embankment construction shall conform to the physical and chemical properties and requirements of IRC: SP: 38-2001, "Guidelines for Use of Fly ash in Road Construction". The term fly ash shall cover all types of coal ash such as pond ash, bottom ash or mound ash.

Embankment constructed out of fly ash shall be properly designed to ensure stability and protection against erosion in accordance with IRC guidelines. A suitable thick cover may preferably be provided at intervening layers of pond ash for this purpose. A thick soil cover shall bind the edge of the embankment to protect it against erosion. Minimum thickness of such soil cover shall be 500 mm.

305.2.2.4 Compaction Requirements

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the sub-grade material when compacted to the density requirements as in Table 300.2 shall yield the specified design CBR value of the sub-grade.

TABLE: 300.2 COMPACTION REQUIREMENTS FOR EMBANKMENT AND SUBGRADE

Sl. No	Type of Work/ Material	Relative compaction as percentage of max. laboratory dry density as per IS : 2720 (Part 8)
1.	Sub-grade and earthen shoulders	Not less than 97%
2.	Embankment	Not less than 95%
3.	Expansive clays a) Sub-grade and	

Sl. No	Type of Work/ Material	Relative compaction as percentage of max. laboratory dry density as per IS : 2720 (Part 8)
	500mm. portion just below	Not allowed
	b) Remaining portion of embankment	90 -95%

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval.

a) The values of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 8), appropriate for each of the fill materials he intends to use.

b) A graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

The maximum dry density and optimum moisture content approved by the Engineer shall form the basis for compaction.

305.3 CONSTRUCTION OPERATIONS

305.3.1 Setting Out:

After the site has been cleared to Clause 201, the work shall be set out to Clause 301.3.1. The limits of embankment/sub-grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

305.3.2 Dewatering:

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore it to original condition or compensate the damage at his own cost.

If the embankment is to be constructed under water, Clause 305.4.6 shall apply.

305.3.3 Stripping and Storing Top Soil:

When so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not less than 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily subjected to traffic either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

305.3.4 Compacting Ground Supporting Embankment/Sub-grade

Where necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in Table 300-2.

In a case where the difference between the sub grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 percent relative compaction with respect to the dry density (as given in Table 300-2), the ground shall be loosened up to a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with Clauses 305.3.5 and 305.3.6 to achieve dry density not less than 97 percent relative compaction as given in Table 300-2.

Where so directed by the Engineer any unsuitable material occurring in the embankment foundation (500 mm portion just below the sub-grade) shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in Clause 305.2.1, at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commence.

305.3.5 Spreading material in layers and bringing to appropriate moisture content.

305.3.5.1 The embankment and sub-grade material shall be spread in layers of uniform thickness in the entire width with a motor grader. The compacted thickness of each layer shall not be more than 250 mm when vibratory roller/vibratory soil compactor is used and not more than 200 mm when 80-100 KN static roller is used. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements

as in Table 300.2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

305.3.5.2 Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, using disc harrow until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, work on compaction shall be suspended.

Moisture content of each layer of soil shall be check in accordance with IS: 2720 (Part-2) and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction is in the range of 1 per cent above to 2 per cent below the optimum moisture content determined in accordance with IS: 2720 (Part-8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm. when being placed in the embankment and a maximum size of 50 mm. when being placed in the sub-grade.

305.3.5.3 Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical or 4 horizontal, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

305.3.6 Compaction:

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Static three wheeled roller, self propelled single drum vibratory roller, tandem vibratory roller, pneumatic tyre roller, pad foot roller etc, of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of self-propelled single drum vibratory roller or pad foot vibratory roller of 80 to 100 KN static weight or heavy pneumatic tyre roller of adequate capacity capable of achieving the required compaction. The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 302-2. Subsequent layers shall be placed only after the finalised layer has been tested according to Clause 903.2.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identical to that obtained from tests in accordance with IS:2720 (Part 28). A record of the same shall be maintained by the Contractor.

Where density measurements reveal any soft areas in the embankment/sub-grade/earthen shoulder, further compaction shall be carried out as directed by the Engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted using appropriate mechanical means such as light weight vibratory roller, double drum walk

behind roller, vibratory plate compactor, trench compactor or vibratory tamper to the density requirements and satisfaction of the Engineer.

305.3.7 Drainage:

The surface of the embankment/sub-grade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

305.3.8 Repairing of damages caused by rain/spillage of water

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

305.3.9 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders/verge road bed and side slopes to conform to the alignment, levels, cross - sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerances described in Clause 902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The top soil, removed and conserved earlier (Clauses 301.3.2 and 305.3.2) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75mm to 150mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding and mulching of slopes is prescribed, this shall be done to the requirement of Clause 308.

When earthwork operations have been substantially completed the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

305.4 CONSTRUCTION OF EMBANKMENT AND SUB-GRADE UNDER SPECIAL CONDITIONS

305.4.1 Earthwork for Widening Existing Road Embankment:

When an existing embankment and/or sub-grade is to be widened and its slopes are steeper than 1 vertical on 4 horizontal, continuous horizontal benches, each at least 300mm. wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment /sub-grade material to be added. The material obtained from cutting of benches could be utilised in the widening of the embankment/sub-grade. However, when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of usual wider rollers, compaction shall be carried out with the help of tandem sheep's foot rollers, mechanical tampers or other approved equipment. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances, when the extra width is too narrow to permit the movement of any other types of hauling equipment.

305.4.2 Earthwork for Embankment and Sub-grade to be Placed against Sloping Ground:

Where an embankment/sub-grade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 305.4.1, before placing the embankment/sub-grade material. Extra earthwork involved in benching or due to ploughing/scarifying etc. shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings before the fill is placed against sloping ground.

Where the contract requires construction of transverse sub-surface drain at the cut-fill interface, work on the same shall be carried out to Clause-309 in proper sequence with the embankment and sub-grade work as approved by the Engineer.

305.4.3 Earthwork over Existing Road Surface:

Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:

i) If the existing road surface is of granular or bituminous type and lies within 1m of the new formation levels, it shall be scarified to a depth of 50mm. or as directed so as to provide ample bond between the old and new material ensuring that at least 500mm. portion below the top of new sub-grade level is compacted to the desired density.

ii) If the existing road surface is of bituminous type or cement concrete and lies within 1m of the new formation level, the bituminous or cement concrete layer shall be removed completely.

iii) If the level difference between the existing road surface and the new sub-grade level is more than 1m the existing surface shall be roughened after ensuring that the maximum thickness of 500 mm of sub grade is available.

305.4.4 Embankment and Sub-grade around Structures:

To avoid interference with the construction abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points to be determined by the Engineer suspend work on embankments forming approaches to such structures, until such time as the construction of the letter is sufficiently advanced to permit the completion of approaches without the risk of interference of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures up to distance of twice the height of the road from the back of the abutment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and sub-grade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS : 2720 (Part-5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in IRC: 78-1983 The fill material shall be deposited in horizontal layers not exceeding 150mm in loose thickness and compacted thoroughly to the requirements of Table 300-2.

Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in Clause 2504 unless otherwise specified in the contract.

Where it may be impracticable to use power rollers or other heavy equipment, mechanical tampers shall carry out the compaction or other methods approved by the Engineer. Care shall be taken to see that the compaction equipment does not hit or come too close to any structural member so as to cause any damage to them or excessive pressure against the structure.

305.4.5 Construction of embankment over ground incapable of supporting construction equipment.

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geo-synthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contractor will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3.

305.4.6 Embankment Construction under Water and Waterlogged Areas

305.4.6.1 Embankment construction under Water

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall be of GW, SW, GP, SP as per IS: 1498 and consist of graded, hard durable particles with maximum particle size not exceeding 75mm. The material should be non-plastic having uniformity coefficient of not less than 10. The placed in open water shall be deposited by end tipping without compaction.

305.4.6.2 Embankment construction in Waterlogged and Marshy Areas

The work shall be done as per IRC:34

305.4.7 Earthwork for high embankment

The material for high embankment construction shall confirm to Clause 305.2.1.7. In the case of high embankments (more than 6 m), the Contractor shall normally use fly ash in conformity with Clause 305.2.1.1 or the material from the approved borrow area.

Where provided, stage construction of embankment and controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.

Where required, the Contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the contract. If settlement of surcharged fill results the Contractor shall bring the resultant level up to formation level with acceptable material for use in fill.

305.4.8 Settlement Period

Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wing wall, retaining wall, footings, etc. or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the contract or as directed by the Engineer.

305.5 PLYING OF TRAFFIC

Construction and other vehicular traffic shall not use the prepared surface of the embankment and / or sub-grade without the prior permission of the Engineer. Any damage arising out of such use shall, however, be made good by the Contractor at his own cost as directed by the Engineer.

305.6 SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction of sub-grade shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

305.7 SUB-GRADE STRENGTH

305.7.1 It shall be ensured prior to actual execution that the borrow area material to be used in the sub-grade satisfies the requirement of design CBR.

305.7.2 Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on remoulded samples, compacted to the field density at the field moisture content and tested for soaked/unsoaked condition as specified in the Contract.

401 GRANULAR SUB-BASE

401.1 SCOPE

This work shall consist of laying and compacting well-graded material on prepared sub-grade in accordance with the requirements of this specifications. The material shall be laid in one or more layers as sub-base of lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross sections shown on the drawings or as directed by the Engineer.

401.2 MATERIALS

401.2.1 The material to be used for the work shall be natural sand, murum, gravel, crushed stone, crushed slag, or combinations thereof depending upon the grading required. Use of materials like brick metal, kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and conform to one of the three grading given in Table 400-1 and physical requirements given in Table 400-2.Gradings III and IV shall preferably be used in lower sub-base. Gradings V and VI shall be used as a sub-base cum drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

401.2.2 If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

TABLE 400-1

GRADING FOR GRANULAR SUB-BASE MATEIRALS

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0mm.	100	--	--		100	
53.0 mm.	80-100	100	100	100	80-100	100
26.5.5mm	55-90	70-100	55-75	55-80	55-90	75-100
9.50mm.	35-65	50-80	--	--	35-65	55-75
4.75mm.	25-55	40-65	10-30	15-35	25-50	30-55
2.36mm.	20-40	30-50	--	--	10-20	10-25

0.85mm.	--	--	--	--	2-10	--
0.425mm.	10-15	10-15	--	--	0-5	0-8
0.075mm.	<5	<5	<5	<5	--	0-3

TABLE 400-2

PHYSICAL REQUIREMENTS FOR MATERIALS FOR GRANULAR SUB-BASE

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 Maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

401.3 CONSTRUCTION OPERATIONS

401.3.1 Preparation of Sub-grade:

Immediately prior to the laying of sub-base, the sub-grade already finished to Section 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes 80-100 kN smooth wheeled roller.

401.3.2 Spread and Compacting:

The sub-base material of grading specified in the Contract shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and maintain the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mix-in-place method.

Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part-2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that at the time of compaction it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS:2720 (Part 8). While adding water,

due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer up to 200mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 KN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km. per hour.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

401.4 SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance With Section 900.

401.5 ARRANGEMENT FOR TRAFFIC

During the period of construction arrangement of traffic shall be maintained in accordance with Clause 112.

402 LIME TREATED SOIL FOR IMPROVED SUBGRADE

402.1 SCOPE

This work shall consist of laying and compacting an improved sub-grade/lower sub-base of soil treated with lime on prepared sub-grade in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. Lime treatment is generally effective for soils, which contain a relatively high percentage of clay and silty clay.

402.2 Materials

402.2.1 Soil:

Except when otherwise specified, the soil used for stabilisation shall be the local clayey soil having a plasticity index greater than 8.

402.2.2 Lime:

Lime for lime-soil stabilisation work shall be commercial dry lime slaked at site or pre-slaked lime delivered to the site in suitable packing. Unless otherwise permitted by the Engineer, the lime shall have purity of not less than 70 per cent by weight of Quicklime (CaO) when tested in accordance with IS: 1514. Lime shall be properly stored to avoid prolonged exposure to the atmosphere and consequent carbonation, which would reduce its binding properties.

402.2.3 Quantity of Lime in stabilised mix:

Quality of lime to be added as percentage by weight of the dry soil shall be as specified in the Contract. The quantity of lime used shall be related to its calcium oxide content, which shall be specified. Where the lime of different calcium oxide content is to be used, its quantity shall be suitably adjusted to the approval of the Engineer so that equivalent calcium oxide is incorporated in the work. The mix design shall be done to arrive at the appropriate quantity of lime to be added, having due regard to the purity of lime, the type of soil, the moisture-density relationship, and the design CBR/Unconfident Compressive Strength (UCS) value specified in the Contract. The laboratory CBR/UCS value shall be at least 1.5 times the minimum field value of CBR/UCS stipulated in the Contract.

402.2.4 Water:

The water to be used for lime stabilisation shall be clean and free from injurious substances. Potable water shall be preferred.

402.3 Construction Operations

402.3.1 Weather limitations:

Lime-soil stabilisation shall not be done when the air temperature in the shade is less than 10 C.

402.3.2 Degree of pulverisation:

For lime-soil stabilisation, the soil before addition of stabiliser, shall be pulverised using agricultural implements like disc harrows (only for low volume roads) and rotavators to the extent that it passes the requirements set out in Table 400-3 when tested in accordance with the method described in Appendix -3, "Method of Sieving for wet soils to determine the degree of pulverisation".

TABLE 400-3.

SOIL PULVERISATION REQUIREMENTS FOR LIME STABILISATION

IS Sieve Designation	Minimum Percent by weight passing the IS Sieve
26.5mm	100
5.6mm	80

402.3.3 Equipment for Construction:

Stabilised soil sub-bases shall be constructed by mix-in-place method of construction or as otherwise approved by the Engineer. Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs.

The equipment used mix-in-place construction shall be rotavator or similar approved equipment capable of pulverising and mixing the soil with additive and water to specified degree to the full thickness of the layer being processed, and of achieving the desired degree of mixing and uniformity of the stabilised material. If so desired by the Engineer, trail runs with the equipment shall be carried out to establish its suitability for work.

The thickness of any layer to be stabilised shall be not less than 100 mm when compacted. The maximum thickness shall be 200 mm, provided the plant used is accepted by the Engineer.

402.3.4 Mix-in-place method of construction:

Before deploying the equipment, the soil after it is made free of undesirable vegetation or other deleterious matters shall be spread uniformly on the prepared sub-grade in a quantity sufficient to achieve the desired compacted thickness of the

stabilised layer. Where single-pass equipment is to be employed, the soil shall be lightly rolled at the discretion of the Engineer.

The Equipment used shall either be of single-pass or multiple pass type. The mixers shall be equipped with an appropriate device for controlling the depth of processing and the mixing blades shall be maintained or reset periodically so that the correct depth of mixing is obtained at all times.

With single-pass equipment the forward speed of the machine shall be so selected in relation to the rotor speed that the required degree of mixing, pulverisation and depth of processing is obtained. In multiple-pass processing, the prepared sub-grade shall be pulverised to the required depth with successive passes of the equipment and the moisture content adjusted to be within prescribed limits mentioned hereinafter. The blending or stabilising material shall then be spread uniformly and mixing continued with successive passes until the required depth and uniformity of processing have been obtained.

The mixing equipment shall be so set that it cuts slightly into the edge of the adjoining lane processed previously so as to ensure that all the material forming a layer has been properly processed for the full width.

402.3.5 Construction with manual means:

Where manual mixing is permitted, the soil from borrow areas shall first be freed of all vegetation and other deleterious matter and placed on the prepared sub-grade. The soil shall then be pulverised by means of crow-bars, pick axes or other means approved by the Engineer.

Water in requisite quantities may be sprinkled on the soil for aiding pulverisation. On the pulverised soil, the blending materials(s) in requisite quantities shall be spread uniformly and mixed thoroughly by working with spades or other similar implement till the whole mass is uniform. After adjusting the moisture content to be within the limits mentioned later, the mixed material shall be levelled up to the required thickness so that it is ready to be rolled.

402.3.6 Addition of Lime :

Lime may be mixed with the prepared material either in slurry form or dry state at the option of the Contractor with the approval of the Engineer.

Dry lime shall be prevented from blowing by adding water to the lime or other suitable means selected by the Contractor, with the approval of the Engineer.

The tops of windrowed material may be flattened or slightly trenched to receive the lime. The distance to which lime may spread upon the prepared material ahead of the mixing operation shall be determined by the Engineer.

No traffic other than the mixing equipment shall be allowed to pass over the spread lime until after completion of mixing.

Mixing or re-mixing operations, regardless of equipment used, shall continue until the material is free of any white streaks or pockets of lime and the mixture is uniform.

Non-uniformity of colour reaction, when the treated material is tested with the standard phenolphthalein alcohol indicator, will be considered evidence of inadequate mixing.

402.3.7 Moisture content for compaction:

The moisture content at compaction checked vide IS: 2720 (Part 2) shall neither be less than the optimum moisture content corresponding to IS: 2720 (Part 8) nor more than 2 per cent above it.

402.3.8 Rolling:

Immediately after spreading, grading and levelling of the mixed material, compaction shall be carried out with approved equipment preceded by a few passes of lighter rollers if necessary. Rolling shall commence at edges and progress towards centre, except at superelevated portions where it shall commence at the inner edge and progress towards outer edge. During rolling the surface shall be frequently checked for grade and cross-fall (camber) and any irregularities corrected by loosing the material and removing/adding fresh material. Compaction shall continue until the density achieved is at least 98 per cent of the maximum dry density for the material determined in accordance with IS: 2720 (Part 8).

Care shall be taken to see that the compaction of lime stabilised material is completed within three hours of its mixing or such shorter period as may be found necessary in dry weather.

During rolling it shall be ensured that roller does not bear directly on hardened or partially hardened treated material previously laid other than what may be necessary for achieving the specified compaction at the joint. The final surface shall be well closed, free from movement under compaction planes, ridges, cracks or loose material. All loose or segregated or otherwise defective areas shall be made good to the full thickness of the layer and re-compacted.

402.3.9 Curing:

The sub-base course shall be suitably cured for a minimum period of 7 days after which subsequent pavement courses shall be laid to prevent the surface from drying out and becoming friable. No traffic of any kind shall ply over the completed sub-base unless permitted by the Engineer.

402.4 Surface Finish and Quality Control of Work

The surface finish of construction shall confirm to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

402.5 Strength

When lime is used for improving the sub-grade, the soil-lime mix shall be tested for its CBR value. When lime stablised soil is used in a sub-base, it shall be tested for unconfined compressive strength (UCS) at 7 days. In case of variation from the design CBR/UCS, in situ value being lower, the pavement design shall be reviewed based on the actual CBR/UCS value shall be constructed by the Contractor at his own cost.

402.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be provided and maintained in accordance with Clause 112.

406. WET MIX MACADAM SUB-BASE / BASE

406.1. SCOPE

This work shall consist of clean aggregates mechanically interlocked by rolling and bonding together with sceening, binding material where necessary and water laid on a properly prepared subgrade/sub-base/base or existing pavement, as the case may be and finsihed in accordance with the requirements of these specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be upto 200 mm with the approval of the Engineer.

406.2. MATERIALS

406.2.1. Aggregates

406.2.1.1. Physical requirements:

Coarse aggregates shall be crushed stone. If crushed gravel is used, not less than 90 percent by weight of the gravel pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements as given below table 400-12.

TABLE 400-12 PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUB-BASE/BASE COURSES

Test	Test Method	Requirements

Test		Test Method	Requirements
1.	• Los Angeles Abrasion Value* Or • Aggregate Impact Value*	IS : 2386 (Part – 4) IS : 2386 (Part – 4) or IS:5640 **	40 per cent (Max) 30 per cent (Max)
2.	Combined Flakiness and Elongation Indices (Total)	IS : 2386 (Part – 1)	30 per cent (Max)**

* Aggregate may satisfy requirements of either of the two tests.

** To determine this combined proportion, the flaky stone from a Representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part- 5).

406.2.1.2. Grading Requirements

The aggregates shall conform to the grading given in Table 400-13.

TABLE 400-13. GRADING REQUIR EMENTS OF AGGREGATES FOR WET MIX MACADAM

IS Sieve Designation	Per Cent by Weight Passing IS Sieve
53 mm	100
45 mm	95-100
26.50 mm	-
22.4 mm	60-80
11.2 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600 micron	8-22

IS Sieve Designation	Per Cent by Weight Passing IS Sieve
75 micron	0-5

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

406.3. CONSTRUCTION OPERATIONS

406.3.1. Preparation of base:

Clause 404.3.1 shall apply.

406.3.2. Provision of lateral confinement of aggregates:

While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 404.3.3.

406.3.3. Preparation of mix:

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. The plant shall have features:

i. For feeding aggregates – three/four bin feeders with variable speed motor

ii. Vibrant screen for removal oversize aggregates

iii. Conveyor belt’

iv. Controlled system for addition of water

v. Forced/positive mixing arrangement like pug-mill or pan type mixer

vi. Centralized control panel for sequential operation of various devices and precise process control

vii. Safety devices

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

406.3.4. Spreading of mix:

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. The paver finisher shall be self-propelled, having the following features:

i. Loading hoppers and suitable distribution system, so as to provide a smooth uninterrupted material flow for different layer thickness from the tipper to the screed.

ii. Hydraulically operated telescopic screed for paving width up to 8.5m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.

iii. Automatic levelling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used with the prior approval of the Engineer. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual mixing and/or laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual mixing/laying in inaccessible/remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual mixing/laying is intended to used, the same shall be done with the approval of the Engineer.

406.3.5. Compaction:

After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-

lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 meter straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross fall. In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

406.3.6. Setting and drying

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

406.4. <u>OPENING TO TRAFFIC</u>

No vehicular traffic shall be allowed on the finished wet mix macadam surface. Construction equipment may be allowed with the approval of the Engineer.

406.5. <u>SURFACE FINISH AND QUALITY CONTROL OF WORK</u>

406.5.1. The surface finish of construction shall confirm to the requirements of Clause 902.

406.5.2. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

409 CEMENT CONCRETE KERB

409.1 SCOPE

This work shall consist of constructing cement concrete kerbs along the Footpath in conformity with the lines, levels and dimensions as specified in the drawings or as directed by the Engineer.

409.2 MATERIALS

Kerbs shall be provided in cement concrete of grade M20 in accordance with clause 1700 of these specifications.

409.3 TYPE OF CONSTRUCTION

These shall be cast-in-situ construction with suitable kerb casting machine in all situations except at locations where continuous casting with equipment is not practicable. In those situations pre-cast concrete blocks shall be used.

409.4 EQUIPMENT

A continuous kerb casting equipment of adequate capacity and controls, capable of laying the kerbs in required cross-sections and procuring a well-compacted mass of concrete free of voids and honeycombs, shall be used.

409.5 CONSTRUCTION OPERATION

409.5.1 Kerbs shall be laid on firm foundation of minimum 150mm concrete of M15 grade cast in situ or on extended width of pavement; the foundation shall have a projection of 50mm beyond the kerb stone. Before laying the foundation of lean concrete, the base shall be levelled and slightly watered to make it damp.

409.5.2 In the median portions in the straight reaches, the kerb shall be cast in continuous lengths. In the portions where footpath is provided and/or the slope of the carriageway is towards median (as in case of super elevated portions), there shall be sufficient gap/recess left in the kerb to facilitate drainage openings.

409.5.3 After laying the kerbs and just prior to hardening of the concrete, saw-cut grooves shall be provided at 5m intervals or as specified by the Engineer.

409.5.4 Kerbs on the drainage ends such as along the footpath or the median in super elevated portions shall be cast with monolithic concrete channels as indicated in drawings. The slope of the channel towards drainage pipes shall be ensured for efficient drainage of the road surface.

409.5.5 Vertical and horizontal tolerance with respect to true line and level shall be ±6mm.

410 FOOTPATHS AND SEPARATORS

410.1 Scope

The work shall consist of constructing footpaths and/or separators at locations as specified in the drawings or as directed by the Engineer.

The lines, levels and dimensions shall be as per the drawings. The scope of the work shall include provision of all drainage arrangements as shown in the drawings or as directed by the Engineer.

410.2 Materials

The footpaths and separators shall be constructed with any of the following types:

a) Cast-in-situ cement concrete of Grade M 20 as per Section 1700 ofthe

Specifications. The minimum size of the panels shall be as specified in

the drawings.

b) Precast cement concrete blocks and interlocking blocks/tiles of grade

not less than M 30 as per Section 1700 of the Specifications. The thickness and size of the cement concrete blocks or interlocking blocks/ tiles shall be as specified in the drawings.

c) Natural stone slab cut and dressed from stone of good and sound

quality, uniform in texture, free from defects and at least equal to a

sample submitted by the Contractor and approved by the Engineer.

The thickness and size of the natural stone slab shall be as specified in

the drawings.

410.3 Construction Operations

410.3.1 Drainage pipes below the footpath originating from the kerbs shall be first

laid in the required slope and connected to the drains/sumps/storm water drain/drainage

chutes as per provisions of the drawings, or as specified.

410.3.2 Portion on back side of kerbs shall be filled and compacted with granular sub-base material as per Clause 401 of the Specifications in specified thickness.

410.3.3 The base for cast-in-situ cement concrete panels/ tiles/ nature stone slab shall be prepared and finished to the required lines, levels and dimensions as indicated in the drawings. Over the prepared base, precast concrete interlocking blocks/tiles/natural stone slabs and/or cast-in- situ slab shall be set/laid as described in Clauses 410.3.4 and 410.3.5.

410.3.4 Tiles/Natural Stone Slabs

The blocks/tiles/slabs shall be set on a layer of average 12 mm thick cement-sand mortar (1 :3) laid on prepared base in such a way that there is no rocking. The gaps between the blocks/tiles/slabs shall not be more than 12 mm and shall be filled with cement-sand mortar (1 :3).

410.3.5 Cast-in-5itu Cement Concrete

The panels of specified size shall be cast on the prepared base in panels of specified size in a staggered manner. Construction joints shall be provided as per Section 1700 of the Specifications.

410.3.6 Precast Concrete Blocks and Interlocking Concrete Block Pavements)

The precast concrete blocks and interlocking concrete block pavement shall be laid on a bedding of sand of thickness specified in the drawing. The grading of the sand layer shall be as in Table 400-16.

Table 400-16

IS Sieve Size	Percent Passing
9.52 mm	100
4.75 mm	95–100
2.36 mm	80–100
1.18 mm	50–95
600 micron	25–60
300 micron	10–30
150 micron	0–15
75 micron	0–10

The joints shall be filled with sand passing a 2.35 mm size with the grading as in Table 400-17.

IS Sieve Size	Percent Passing
2.36 mm	100
1.18 mm	90–100
600 micron	60–90
300 micron	30–60
150 micron	15–30
75 micron	0–10

The bedding sand slightly moist, the moisture content being about 4 percent. The bedding sand shall be compacted by vibratory plate compactor.

The blocks shall be laid to the levels indicated on the drawings and to the pattern directed by the Engineer. The surface tolerance shall be ±10 mm with respect to the design level. The blocks shall be embedded using a hammer.

502 PRIME COAT OVER GRANULAR BASE

502.1 SCOPE

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix. The work shall be carried out on a previously prepared granular/ stabilized surface to Clause 501.8.

502.2 Materials

502.2.1 The primer shall be cationic bitumen emulsion SS1 grade conforming Bto IS: 8887 or medium curing cutback bitumen conforming to IS:217 or as specified in the Contract.

502.2.2 Quantity of SS1 grade bitumen emulsion for various types of granular surface shall be as given in Table 500-3.

Table;- 500-3 Quantity of Bitumen Emulsion for Various Types of Granular Surfaces

Type of Surface	Rate of Spray (kg/sq.m)
WMM/WBM	0.7–1.0
Stabilized soil bases/Crusher Run Macadam	0.9–1.2

502.2.3 502.2.3 Cutback for primer shall not be prepared at the site. Type and quantity of cut back bitumen for various types of granular surface shall be as given in Table 500-4.

Table;- 500-4 Type and Quantity of Cutback Bitumen for Various Types of Granular Surface

502.2.4

Type of Surface	Type of Cutback	Rate of Spray (kg/sq.m)
WMM/WBM	MC 30	0.6–0.9
Stabilized soil bases/ Crusher Run Macadam	MC 70	0.9–1.2

502.2.5 The correct quantity of primer shall be decided by the Engineer and shall be such that it can be absorbed by the surface without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm.

502.3 Weather and Seasonal Limitations

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 100C. Cutback bitumen as primer shall not be applied to a wet surface. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. Surface can be just wet by very light sprinkling of water.

502.4 Construction

502.4.1 Equipment

The primer shall be applied by a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying shall not be allowed except in small areas, inaccessible to the distributor, or in narrow strips where '" primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

502.4.2 Preparation of Road Surface

The granular surface to be primed shall be swept clean by power brooms or mechanical sweepers and made free from dust. All loose material and other foreign material shall be removed completely. If soil/ moo rum binder has been used in the WBM surface, part of this should be brushed and removed to a depth of about 2 mm so as to achieve good penetration.

502.4.3 Application of Bituminous Primer

After preparation of the road surface as per Clause 502.4.2, the primer shall be sprayed I uniformly at the specified rate. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and 'i method to be used is capable of producing a uniform spray, within the tolerances specified.

No heating or dilution of SS1 bitumen emulsion and shall be permitted at site. Temperature of cutback bitumen shall be high enough to permit the primer to be sprayed effectively though the jets of the spray and to cover the surface uniformly.

502.4.4 Curing of Primer and Opening to Traffic

A primed surface shall be allowed to cure for at least 24 hours or such other higher period as is found to be necessary to allow all the moisture/volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with a light application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course.

502.5 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

502.6 Arrangements for Traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

503 TACK COAT

503.1 SCOPE

The work shall consist of the application of a single coat of low viscosity liquid bituminous material to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with Clause 501.8.

503.2 Materials

The binder used for tack coat shall be either Cationic bitumen emulsion (RS 1) complying with IS:8887 or suitable low viscosity paving bitumen of VG 10 grade conforming to IS:73. The use of cutback bitumen RC:70 as per IS:217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

503.3 Weather and Seasonal Limitations

Bituminous material shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet. Where the tack coat is of cutback bitumen, the surface shall be dry.

503.4 Construction

503.4.1 Equipment

The tack coat shall be applied bya self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying

shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

503.4.2 Preparation of Base

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and In any extraneous material, and be otherwise prepared in accordance with the requirements of Clauses 501.B. The granular or stabilized surfaces shall be primed as per Clause 502.Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

503.4.3 Application of Tack Coat

The application of tack coat shall be at the rate specified in Table 500-5, and it shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract, then it shall be the rate specified in Table 500-5. No dilution or heating at site of RS1 bitumen emulsion shall be permitted. Paving bitumen if used for tack coat shall be heated to appropriate temperature in bitumen boilers to achieve viscosity less than 2 poise. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C and for cutback, 50°C to BO°C. The method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Table 500-5 : Rate of Application of Tack Coat

Type of Surface	Rate of Spray of Binder in Kg per sq. m
Bituminous surfaces	0.20 – 0.30
Granular surfaces treated with primer	0.25 – 0.30
Cement concrete pavement	0.30 – 0.35

503.4.4 Curing of Tack Coat

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

503.5 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

503.6 Arrangements for Traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

505 DENSE BITUMINOUS MACADAM

505.1 Scope

The specification describes the design and construction procedure for Dense Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. The work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50 mm to 100 mm.

505.2 Materials

505.2.1 Bitumen

The bitumen shall be viscosity grade paving bitumen complying with the Indian Standard Specification IS:73, modified bitumen complying with Clause 501.2.1 or as otherwise specified in the Contract.

The type and grade of bitumen to be used shall be specified in the Contract.

505.2.2 Coarse Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates has poor affinity for bitumen, the Contractor shall produce test results that with the use of anti-stripping agents, the stripping value is improved to satisfy the specification requirements. The Engineer may approve such a source and as a condition for the approval of that source, the bitumen shall be treated with an approved anti-stripping agent, as per the manufacturer's recommendations, at the cost of the Contractor. The aggregates shall satisfy the requirements specified in Table 500-8.

Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

505.2.3 Fine Aggregates

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a

combination of the two, passing the 2.36 mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable, dry and free from dust, and soft or friable

matter, organic or other deleterious matter. Natural sand shall not be allowed in binder courses. However, natural sand upto 50 percent of the fine aggregate may be allowed in base courses. The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS:2720 (Part 37). The plasticity index of the fraction passing the in 0.425 mm sieve shall not exceed 4, when tested in accordance with IS:2720 (Part 5).

505.2.4 Filler

Filter shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. The filler shall be graded within the limits indicated in Table 500-9. The filler shall be free from organic impurities and have a plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-8, then 2 percent by total weight of aggregate, of hydrated lime shall be used and percentage of fine aggregate reduced accordingly.

505.2.5 Aggregate Grading and Binder Content

505.2.5.1. When tested in accordance with IS:2386 Part 1 (wet sieving method), the :l combined grading of the coarse and fine aggregates and filler for the particular mixture shall 3 fall within the limits given in Table 500-10 for grading 1 or 2 as specified in the Contract. To avoid gap grading, the combined aggregate gradation shall not vary from the lower limit on one sieve to higher limit on the adjacent sieve.

Table 500-8 : Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices*	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 35% Max 27%	IS:2386 Part IV
Durability	Soundness either :Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386 Part V
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min. 80%	AASHTO 283

*To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and longation index so found are added up.

** If the minimum retained tensile test strength falls below 80 percent, use of anti tripping agent is recommended to meet the requirement.

Table 500-9: Grading Requirements for Mineral Filler

IS sieve (mm)	Cumulative Percent Passing by Weight of Total Aggregate
0.6	100
0.3	95 – 100
0.075	85 – 100

Table 500-10: Composition of Dense Graded Bituminous macadam

Grading	1	2
Nominal aggregate size*	37.5 mm	26.5 mm
Layer thickness	75 – 100 mm	50 – 75 mm
IS Sieve[1] (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	95 – 100	100
26.5	63-93	90-100
19	–	71-95
13.2	55-75	56-80
9.5	–	–
4.75	38-54	38-54
2.36	28-42	28-42
1.18	–	–
0.6	–	–
0.3	7 – 21	7 – 21
0.15	–	–
0.075	2 – 8	2-8
Bitumen content % by mass of total mix	Min 4.0**	Min 4.5**

* The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained

** Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 3aoC or lower and lowest daily air temperature is - 1 aoc or lower, the bitumen content may be increased by 0.5 percent.

505.2.5.2. Bitumen content indicated in Table 500-10 is the minimum quantity. The quantity shall be determined in accordance with Clause 505.3.

505.3 Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS-2.

The Fines to Bitumen (FIB) ratio by weight of total mix shall range from 0.6 to 1.2.

505.3.1 Requirements for the Mix

Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 500-11.

Table 500-11 : Requirements for Dense Graded Bituminous Macadam

Properties	Viscosity Grade Paving Bitumen	Modified bitumen		Test Method
		Hot climate	Cold climate	
Compaction level	75 blows on each face of the specimen			
Minimum stability (kN at 600C)	9.0	12.0	10.0	AASHTO T245
Marshall flow (mm)	2 – 4	2.5 – 4	3.5 – 5	AASHTO T245
Marshall Quotient $\left(\frac{\text{Stability}}{\text{Flow}}\right)$	2 – 5	2.5 – 5		MS-2 and ASTM D2041
% air voids	3 – 5			
% Voids Filled with Bitumen (VFB)	65 – 75			
Coating of aggregate particle	95% minimum			IS:6241
Tensile Strength ratio	80% Minimum			AASHTO T 283
% Voids in Mineral Aggregate (VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 500-13			

505.3.2 Binder Content

The binder content shall be optimized to achieve the requirements of the mix set out in

Table 500-11. The binder content shall be selected to obtain 4 percent air voids in the mix design. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2.

Where maximum size of the aggregate is more than 26.5 mm, the modified Marshall method using 150 mm diametre specimen described in MS-2 and ASTM D 5581 shall be used. This

method requires modified equipment and procedures. When the modified Marshall test is used, the specified minimum stability values in Table 500-12 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

Table 500-12 : Minimum Percent Voids In Mineral Aggregate (VMA)

Nominal Maximum Particle Size[1] (mm)	Minimum VMA Percent Related to Design Percentage Air voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

505.3.3 Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

i) Source and location of all materials;

ii) Proportions of all materials expressed as follows:

a) Binder type, and percentage by weight of total mix;

b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;

iii) A single definite percentage passing each sieve for the mixed aggregate;

iv) The individual grading of the individual aggregate fraction, and the proportion of each in the combined grading;

v) The results of mix design such as maximum specific gravity of loose mix (Gmm), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test;

vi) Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch;

vii) Test results of physical characteristics of aggregates to be used;

viii) Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix

Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

505.3.4 Plant Trials - Permissible *Variation* in Job Mix Formula

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved

job mix formula. The permissible variations of the individual percentages of the various

ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 500-13 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with Section 900.

Table 500-13 : Permissible Variations in the Actual Mix from the Job Mix Formula

Description	Base/binder Course
Aggregate passing 19 mm sieve or larger	± 8%
Aggregate passing 13.2 mm, 9.5 mm	± 7%
Aggregate passing 4.75 mm	± 6%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 5%
Aggregate passing 0.3 mm, 0.15 mm	± 4%
Aggregate passing 0.075 mm	± 2%
Binder content	± 0.3%
Mixing temperature	± 10°C

505.3.5 Laying Trials

Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid and compacted all in accordance with Clause 501. The laying trial shall be carried out on a suitable area which is not to form part of the works. The area of the laying trials shall be a minimum of 100 sq.m of construction similar to that of the project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method. The compacted layers of Dense Graded Bituminous Macadam (DBM) shall have a minimum field density equal to or more than 92% of the density based on theoretical maximum specific gravity (Gmm) obtained on the day of compaction in accordance with ASTM D 2041.

Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials.

505.4 Construction Operations

505.4.1 Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply.

505.4.2 Preparation of Base

The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate, or as directed by the Engineer.

505.4.3 Geosynthetics

Where Geosynthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

505.4.4 Stress Absorbing Layer

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 517.

505.4.5 Prime Coat

Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of Clause 502, or as directed by the Engineer.

505.4.6 Tack Coat

Where the material on which the dense bituminous macadam is to be laid is either bitumen bound layer or primed granular layer, tack coat shall be applied, as specified, in accordance with the provisions of Clause 503, or as directed by the Engineer.

505.4.7 Mixing arid Transportation of the Mix

The provisions as specified in Clauses 501.3 and 501.4 shall apply. Table 500-2 gives the mixing, laying and rolling temperature for dense mixes using viscosity grade bitumen. In case of modified bitumen, the temperature of mixing and compaction shall be higher than the mix with viscosity grade bitumen. The exact temperature depends upon the type and amount of modifier used and shall be adopted as per the recommendations of the manufacturer. In order to have uniform quality, the plant shall be calibrated from time to time.

505.4.8 Spreading

The provisions of Clauses 501.5.3 and 501.5.4 shall apply.

505.4.9 Rolling

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

505.5 Opening to Traffic

It shall be ensured that the traffic is not allowed without the approval of the Engineer in writing, on the surface until the dense bituminous layer has cooled to the ambient temperature.

505.6 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

505.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

507 BITUMINOUS CONCRETE

507.1 Scope

This work shall consist of construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single layer of bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 30 mm/40 mm/50 mm thick.

507.2 Materials

507.2.1 Bitumen

The bitumen shall conform to Clause 504.2.1.

507.2.2 Coarse Aggregates

The coarse aggregates shall be generally as specified in Clause 504.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-16 and where crushed ravel is proposed for use as aggregate, not less than 95 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

Table 500-16 : Physical Requirements for Coarse Aggregate for Bituminous Concrete

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 30% Max 24%	IS:2386 Part IV
Durability	Soundness either:Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386 Part V
Polishing	Polished Stone Value	Min 55	BS:812-114
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength*	Min 80%	AASHTO 283

* If the minimum retained tensile test strength falls below 80 percent, use of anti stripping agent is recommended to meet the requirement.

507.2.3 Fine Aggregates

The fine aggregates shall be all as specified in Clause 505.2.3.

507.2.4 Filler

Filler shall be as specified in Clause 505.2.4.

507.2.5 Aggregate Grading and Binder Content

When tested in accordance with IS:2386 Part 1 (Wet grading method), the combined rading of the coarse and fine aggregates and filler shall fall within the limits shown in Table 500-17. The grading shall be as specified in the Contract.

Table 500-17 : Composition of Bituminous Concrete Pavement Layers

Grading	1	2
Nominal aggregate size*	19 mm	13.2 mm
Layer thickness	50 mm	30–40 mm
IS Sieve[1] (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	90-100	100
13.2	59-79	90-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix	Min 5.2*	Min 5.4**

Notes:

* The nominal maximum particle size is the largest specified sieve size up on which any of the aggregate is retained.

** Corresponds to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is - 1 DoC or lower, the bitumen content may be increased by 0.5 percent.

507.3 Mix Design

507.3.1 Requirements for the Mix

Clause 505.3.1 shall apply.

507.3.2 Binder Content

Clause 505.3.2 shall apply.

507.3.3 Job Mix Formula

Clause 505.3.3 shall apply.

507.3.4 Plant Trials - Permissible Variation in Job Mix Formula

The requirements for plant trials shall be as specified in Clause 505.3.4, and permissible limits for variation as given in Table 500-18.

Table 500-18 : Permissible Variations in Plant Mix from the Job Mix Formula

Description	Permissible Variation
Aggregate passing 19 mm sieve or larger	± 7%
Aggregate passing 13.2 mm, 9.5 mm	± 6%
Aggregate passing 4.75 mm	± 5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 4%
Aggregate passing 0.3 mm, 0.15 mm	± 3%
Aggregate passing 0.075 mm	± 1.5%
Binder content	± 0.3%
Mixing temperature	± 10°C

507.3.5 Laying Trials

The requirements for laying trials shall be as specified in Clause 505.3.5. The compacted layers of bituminous concrete (BC) shall have a minimum field density equal to or more than 92 percent of the average theoretical maximum specific gravity (G) obtained on the day of . mm compaction in accordance with ASTM 02041.

507.4 Construction Operations

507.4.1 Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply.

507.4.2 Preparation of Base

The surface on which the bituminous concrete is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot get access, other approved methods shall be used as directed by the Engineer.

507.4.3 Geosynthetics

Where Geosynthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

507.4.4 Stress Absorbing Layer

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 517.

507.4.5 Tack Coat

The provisions as specified in Clause 504.4.6 shall apply.

507.4.6 Mixing and Transportation of the Mix

The provisions as specified in Clauses 501.3,501.4 and 504.4.7shall apply.

507.4.7 Spreading

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

507.4.8 Rolling

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

507.5 Opening to Traffic

Provisions in Clause 504.5 shall apply.

507.6 Surface Finish and Quality

The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

507.7 Control Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

903 QUALITY CONTROL TESTS DURING CONSTRUCTION

903.1 General

The materials supplied and the works carried out by the Contractor shall conform to the specifications prescribed in the Clauses for the relevant items of work.

For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control tests, as described hereinafter. The testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to carry out additional tests as frequently as he may deem necessary, to satisfy himself that the materials and works comply with the appropriate specifications. However, the number of tests recommended in Tables 900-3 and 900-4 may be reduced at the discretion of the Engineer if it is felt that consistency in the quality of materials can still be maintained with the reduced number of tests.

Test procedures for the various quality control tests are indicated in the respective Sections of these Specifications or for certain tests within this Section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Engineer.

Table 900-3 : Control Tests and their Minimum Frequency for Sub-Bases and Bases

S. No.	Type of Construction	Test		Frequency (min.)
1)	Granular	i)	Gradation	One test per 400 cu.m
		ii)	Atterberg limits	One test per 400 cu.m
		iii)	Moisture content prior to compaction	One test per 400 cu.m
		iv)	Density of compacted layer	One test per 1000 sq.m
		v)	Deleterious constituents	As required
		vi)	CBR	As required
2)	Lime/Cement Stabilised Soil Sub-base	i)	Quality of lime/ cement	One test for each consignment subject to a minimum of one test per 5 tonnes
		ii)	Lime/Cement content	Regularly, through procedural checks
		iii)	Degree of pulverization	Periodically as considered necessary
		iv)	CBR or Unconfined Compressive Strength test on a set of 3 specimens	As required
		v)	Moisture content prior to compaction	One set of two tests per 500 sq.m
		vi)	Density of compacted layer	One set of two tests per 500 sq.m
		vii)	Deleterious constituents	As required
3)	Water Bound Macadam	i)	Aggregate Impact Value	One test per 1000 cu.m of aggregate
		ii)	Grading of aggregate	One test per 250 cu.m
		iii)	Combined Flakiness and Elongation Indices	One test per 500 cu.m of aggregate
		iv)	Atterberg limits of binding material	One test per 50 cu.m of binding material
		v)	Atterberg limits of screenings	One test per 100 cu.m of aggregate
4)	Wet Mix Macadam	i)	Aggregate Impact Value	One test per 1000 cu.m of aggregate
		ii)	Grading of aggregate	One test per 200 cu.m of aggregate
		iii)	Combined Flakiness and Elongation Indices	One test per 500 cu.m of aggregate
		iv)	Atterberg limits of portion of aggregate passing 425 micron sieve	One test per 200 cu.m of aggregate
		v)	Density of compacted layer	One set of three tests per 1000 sq.m

Table 900-4: Control Tests for Bituminous Works and their Minimum Frequency

5)	Dense Bituminous Macadam/Bituminous Concrete	i)	Quality of binder	Number of samples per lot and tests as per IS:73 or IRC:SP:53, IS:15462
		ii)	Aggregate Impact Value/ Los Angeles Abrasion Value	One test per 350 cu.m of aggregate for each source and whenever there is change in the quality of aggregate
		iii)	Flakiness and Elongation Indices	One test per 350 cu.m of aggregate for each source and whenever there is change in the quality of aggregate
		iv)	Soundness test (Sodium or Magnesium Sulphate test)	One test for each source and whenever there is change in the quality of aggregate
		v)	Water absorption of aggregates	One test for each source and whenever there is change in the quality of aggregate
		vi)	Sand equivalent test	One test for each source and whenever there is change in the quality of aggregate
		vii)	Plasticity Index	One test for each source and whenever there is change in the quality of aggregate
		viii)	Polished stone value	One test for each source and whenever there is change in the quality of aggregate
		ix)	Percentage of fractured face	One test per 350 cu.m of aggregate when crushed gravel is used
		x)	Mix grading	One set for individual constituent and mixed aggregate from dryer for each 400 tonnes of mix subject to minimum of two tests per day per plant
		xi)	Stability and voids analysis of mix including theoretical maximum specific of loose mix	Three tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to minimum of two tests per day per plant
		xii)	Moisture Susceptibility of mix (AASHTO T283)	One test for each mix type whenever there is change in the quality or source of coarse or fine aggregate
		xiii)	Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	At regular intervals
		xiv)	Binder content	One set for each 400 tonnes of mix subject to minimum of two tests per day per plant
		xv)	Rate of spread of mix material	After every 5th truck load
		xvi)	Density of Compacted layer	One test per 700 sq.m area

800 TRAFFIC SIGNS, MARKINGS AND OTHER ROAD APPURTENANCES

801 TRAFFIC SIGNS

801.1 Scope

The work shall consist of the fabrication, supply and installation of ground mounted traffic signs on roads. The details of the signs shall be as shown in the drawings and in conformity with the Code of Practice for Road Signs, IRC:67-2010.

801.2 Materials

The various materials and fabrication of the traffic signs shall conform to the following requirements:

801.2.1 Concrete

Concrete for foundation shall be of M 15 Grade as per Section 1700 or the grade shown on the drawings or otherwise as directed by the Engineer.

801.2.2 Reinforcing Steel

Reinforcing steel shall conform to the requirement of IS:1786 unless otherwise shown on the drawing.

801.2.3 Bolts, Nuts, Washers

High strength bolts shall conform to IS:1367 whereas precision bolts, iluts, etc., shall conform to IS:1364.

801.2.4 Plates and Supports

Plates and support sections for the sign posts shall conform to IS:226 and IS:2062 or any other relevant IS Specifications.

801.2.5 Substrate

Sign panels shall be fabricated on aluminium sheet, aluminium composite panel, fibre glass sheeting, or sheet moulding compound. Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS:736-Material Designation 24345 or 1900. Aluminium Composite Material (ACM) sheets shall be sandwiched construction with a thermoplastic core of Low Density Polyethylene (LOPE) between two thick skins/sheets of aluminium with overall thickness and 3 mm or 4 mm (as specified in the Contract), and aluminium skin of thickness 0.5 mm and 0.3 mm respectively on both sides.

The mechanical proportion of ACM and that of aluminium skin shall conform to the requirements given in Table 800-1, when tested in accordance with the test methods mentioned against each of them.

Table 800-1 : Specifications for Aluminium Composite Material (ACM)

S. No.	Description	Specification	
		Standard Test	Acceptable Value
A	**Mechanical Properties of ACM**		
1)	Peel off strength with retro reflective sheeting (Drum Peel Test)	ASTM D903	Min. 4 N/mm
2)	Tensile strength	ASTM E8	Min. 40 N/mm²
3)	0.2% Proof Stress	ASTM E8	Min. 34 N/mm²
4)	Elongation	ASTM E8	Min. 6%
5)	Flexural strength	ASTM 393	Min. 130 N/mm²
6)	Flexural modulus	ASTM 393	Min. 44.00 N/mm²
7)	Shear strength with Punch shear test	ASTM 732	Min. 30 N/mm²
B	**Properties of Aluminium Skin**		
1)	Tensile strength (Rm)	ASTM E8	Min. 65 N/mm²
2)	Modulus of elasticity	ASTM E8	Min. 70,000 N/mm²
3)	Elongation	ASTM E8	A50 Min. 2%
4)	0.2% Proof Stress	ASTM E8	Min. 10 N/mm²

801.2.6 Plate Thickness

Shoulder mounted ground sings with a maximum side dimension not exceeding, 600 mm shall not be less than 1.5 mm thick with Aluminium and 3 mm thick with Aluminium Composite Material. All other signs be at least 2 mm thick with Aluminium and 4 mm thick with Aluminium Composite Material. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under prevailing wind and other loads.

801.2.7 In respect of sign sizes not covered by IRC:67, the structural details (thickness, etc.) shall be as per the approved drawings or as directed by the Engineer.

801.3 Traffic Signs having Retro-Reflective Sheeting

801.3.1 General Requirements

The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-ref/ection *over* its entire surface. It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for co-efficient of retro-reflection, day/night time colour luminous, shrinkage, flexibility, linear removal, adhesion, impact resistance, specular gloss and fungus resistance and its having passed these tests shall be obtained from a Government Laboratory / institute, by the manufacturer of the sheeting. The retro-reflective sheeting shall be either of Engineering Grade material with enclosed lens, High Intensity Grade with encapsulated lens or Micro-prismatic Grade retro-reflective element material as given in Clauses

801.3.2 to 801.3.7. Guidance on the recommended application of each class of sheeting may be taken from IRC:67.

801.3.2 High Intensity Grade Sheeting

801.3.4.3 Prismatic Grade Sheeting (Type XI)

A Retro-reflective sheeting typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro-reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM E 810) as indicated in Table 800-6.

Table 800-6 : Acceptable Minimum Co-efficient of Retro-Reflection for Prismatic Grade Sheeting Type A (Type XI) (Candelas Per Lux per Square Metre)

Obser-vation	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluore-scent Yellow/ Green	Fluore-scent Yellow	Fluore-scent Orange
0.1°B	-4°	830	620	290	83	125	37	25	660	500	250
0.1°B	+30°	325	245	115	33	50	15	10	260	200	100
0.2°	-4°	580	435	200	58	87	26	17	460	350	175
0.2°	+30°	220	165	77	22	33	10	7.0	180	130	66
0.5°	-4°	420	315	150	42	63	19	13	340	250	125
0.5°	+30°	150	110	53	15	23	7.0	5.0	120	90	45
1.0°	-4°	120	90	42	12	18	5.0	4.0	96	72	36
1.0°	+30°	45	34	16	5.0	7.0	2.0	1.0	36	27	14

A. Minimum Coefficient of Retro reflection (RA) *cdffcfft*> (cd-lx-1 m2)

B. Values for 0.1^0 observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original Retro-reflectance.

801.3.5 Adhesive

The sheeting shall have a pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent other preparation for adhesion to a smooth clean surface, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be forma durable bond to smooth, corrosion and weather resistant surface of the base plate sucht hat it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. The sheeting shall be applied in accordance with the manufacturer's specifications.

801.3.6 Fabrication

Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure-sensitive adhesives shall be overlapped not less than 5 mm. Where screen printing with transparent colours is proposed, only butt joint 'shall be used.- The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

801.3.7 Messages/Borders

The messages (legends, letters, numerals etc.) and borders shall either be screen-printed or of cut out from durable transparent overlay or cut out from the same type of reflective sheeting for the cautionary/mandatory sign boards. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. For the informatory and other sign boards, the messages (legends, letters, numerals etc.) and borders shall be cut out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut-outs shall be from durable transparent overlay materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. For screen-printed transparent coloured areas on white sheeting, the coefficient of retro-reflection shall not be less than 50 percent of the values of corresponding colour in Tables 800-2 to 800-8 as applicable. Cut-out messages and borders, wherever used, shall be either made out of retro-reflective sheeting or made out of durable transparent overlay except those in black which shall be of non-reflective sheeting or opaque in case of durable transparent overlay.

801.3.8 Colour for Signs

801.3.8.1 Signs shall be provided with retro-reflective sheeting and/or overlay film screening ink. The reverse side of all signs shall be painted grey.

801.3.8.2 Except in the case of railway level crossing signs the sing posts shall be painted in 250 mm side bands, alternately black and white. The lowest band next to be ground shall be in black.

801.3.8.3 The colour of the material shall be located within the area defined by the chromaticity coordinates in Table 800-7 and comply with the luminance factor when measured as per ASTM 0-4956.

Table 800-7 : Colour Specified Limits (Daytime)

Colour	1		2		3		4		Daytime Luminance Factor (Y%)	
	x	y	x	y	x	y	x	y	Min.	Max.
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329	15	- -
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472	24	45
Green	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771	2.5	11
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346	2.5	11
Blue	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216	1	10
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404	12	30
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390	1	6
Fluorescent Yellow-Green	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540	60	- -
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442	45	- -
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355	25	- -

The colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

801.3.8.4 The Regulatory/Prohibitory and warning signs shall be provided with white background and red border. The legend/ symbol for these signs shall be in black colour. he Mandatory sign shall be provided with Blue background and white Symbol/letter.

801.3.8.5 The colours chosen for informatory or guide signs shall be distinct for different classes of roads. For National Highways and State Highways, these signs shall be of green' background and for Expressways these signs shall be of blue background with white border, legends and word messages.

801.3.9 Refurbishment

Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminum backing or materials as per Clause 801.2,5, pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

801.3.10 Sizes of Letters

801.3.10.1 Letter size should be chosen with due regard to the speed, classification and location of the road, so that the sign is of adequate size for legibility but without being too large or obtrusive. The size of the letter, in terms of x-height, to be chosen as per the design speed is given in Table 800-8.

Table 800-8 : Acceptable Limits for Sizes of Letters

Design Speed (Km./hr.)	Minimum 'x' Height of the Letters (mm)	Minimum Sight Distance/ Clear Visibility Distance (m)	Maximum Distance from Centre Line (m)
40	100	45	12
50	125	50	14
65	150	60	16
80	250	80	21
100	300	90	24
120	400	115	32

The thickness of the letters and their relation to the x-height, the width, the heights are indicated in Table IV (a) of the Annexure-4 of IRC:67 to facilitate the design of the informatory signs and definition plates.

801.3.10.2 For advance direction signs on non-urban roads, the letter size ('x' height) should be minimum of 150 mm for Expressway, National and State Highways and 100 mm for other roads. In case of overhead signs, the size ('X' height) of letters may be minimum. 300 mm. Thickness of the letter could be varied from 1/6 to 1/5 of the letter 'x' size. The size of the initial uppercase letter shall be 1-1/3 times x-height. In urban areas, letter size shall be 100 mm on all directional signs. For easy and better comprehension, the word messages shall be written in upper case letters only.

801.3.10.3 Letter size on definition plates attached with normal sized signs should be 100 mm or 150 mm. In the case of small signs, it should be 100 mm. Where the message is long, as for instance in "NO PARKING" and "NO STOPPING" signs, the message may be broken into two lines and size of letters may be varied in the lines so that the definition plate is not too large. The lettering on definition plates will be all in upper case letters.

801.3.11 Warranty and Durability

The Contractor shall obtain from the manufacturer a ten year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of micro-prismatic sheeting and a seven-year warranty for high intensity grade and submit the same to the Engineer. The warranty shall be inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting. The Contractor/supplier shall also furnish the LOT numbers and certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty and that the contractor/supplier is the authorized converter of the particular sheeting.

All signs shall be dated during fabrication with indelible markings to indicate the start of warranty. The warranty shall also cover the replacement obligation by the sheeting manufacturer as well as contractor for replacement/repair/restoration of the retro-reflective efficiency.

A certificate in original shall be given by the sheeting manufacturer that its offered retroreflective sheeting has been tested for various parameters such as co-efficient of retroreflection, day/night time colour and luminance, shrinkage, flexibility, linear removal,

adhesion, impact resistance, specular gloss and fungus resistance; the tests shall be carried out by a Government Laboratory in accordance with various ASTM procedures and the results must show that the sheeting has passed the requirements for all the above mentioned parameters. A copy of the test reports shall be attached with the certificate.

801.4 Installation

801.4.1 The traffic signs shall be mounted on support posts, which may be of GI pipes conforming to IS:1239, Rectangular Hollow Section conforming to IS:4923 or Square Hollow Section conforming to IS:3589. Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area up to 0.9 sq.m shall be mounted on a single post, and for greater area two or more supports shall be provided. Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant Specifications as specified.

801.4.2 All components of signs (including its back side) and supports, other than the reflective portion and G.I. posts shall be thoroughly de-scaled, cleaned, primed and painted with two coats of epoxy/ fiber glass/ powder coated paint. Any part of support post below ground shall be painted with protective paint.

801.4.3 The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

803.4 Hot Applied Thermoplastic Road Marking

803.4.1 Thermoplastic Material

803.4.1.1 General

The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads. The colour of the compound shall be white or yellow (IS colour No. 356) as specified in the drawings or as directed by the Engineer.

803.4.1.2 Requirements:

i. Composition: The pigment, beads, and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table *800-9.*

Table 800-9 : Proportions of Constituents of Marking Material (Percentage by Weight)

Component	White	Yellow
Binder	18.0 min.	18.0 min.
Glass Beads	30–30	30–30
Titanium Dioxide	10.0 min.	- -
Calcium Carbonate and Inert Fillers	42.0 max.	See Note below
Yellow Pigments	- -	See Note below

Note: Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirements of this Specification are met.

ii. Properties: The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262-(Part I), shall be as below:

a) luminance:

White: Daylight luminance at 45°-65 percent min. as per AASHTO M249

Yellow: Daylight luminance at 45°-45 percent min. as per AASHTO M 249

b) Drying time: When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.

c) Skid resistance: not less than 45 as per BS:6044.

d) Cracking resistance at low temperature: The material shall show no cracks on application to concrete blocks.

e) Softening point: 1 02.5°C ± 9.5°C as per ASTM D 36.

f) Yellowness index (for white thermoplastic paint): not more than 0.12 as per AASHTO M 249

iii. Storage life : The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/Contractor.

iv. Reflectorisation: Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.2.

v. Marking: Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

1) The name, trade mark or other means of identification of manufacturer

2) Batch number

3) Date of manufacture

4) Colour (white or yellow)

5) Maximum application temperature and maximum safe heating temperature.

vi. Sampling and Testing: The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturers of the thermoplastic

material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

803.4.2 Reflectorizing Glass Beads

803.4.2.1 General

This Specification covers two types of glass beads to be used for the production of refiectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-9 and Type 2 beads are those which are to be sprayed on the surface vide Clause 803.6.4.

803.4.2.2 The glass beads shall be transparent, colourless and free form milkiness, dark particles and excessive air inclusions. These shall conform to the requirements spelt out in Clause 803.4.2.3.

803.4.2.3 Specific Requirements

a. Gradation: The glass beads shall meet the gradation requirements for the two types as given in Table 800-10.

Table 800-10: Gradation Requirements for Glass Beads

Sieve Size	Percent Retained	
	Type 1	Type 2
1.18 mm	0 to 3	
850 micron	5 to 20	0 to 5
600 micron	- -	5 to 20
425 micron	65 to 95	- -
300 micron	- -	30 to 75
180 micron	0-10	10 to 30
Below 180 micron	- -	0 to 15

b. Roundness: The glass beads shall have a minimum of 70 percent true spheres.

c. Refractive index: The glass beads shall have a minimum refractive index of 1.50.

d. Free flowing properties: The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test.

803.4.2.4 Test Methods

The specific requirements shall be tested with the following methods:

i. Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter dessicator which is filled within 25 mm of

the top of a dessicator plate with sulphuric acid water solution (specific gravity 1.10). Cover the dessicator and let it stand for 4 hours at 20°C to 29°C. Remove sample from dessicator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be free of lumps and clusters and shall flow freely through the funnel.

ii. The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS:6088 and BS:3262 (Part I).

iii. The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of these Specifications. However, if so required, these tests may be carried out as directed by the Engineer.

803.4.3 Application Properties of Thermoplastic Material

803.4.3.1 The thermoplastic material shall readily get screeded /extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

803.4.3.2 The material upon heating to application temperatures shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

803.4.4 Preparation

i. The material shall be melted in accordance with the manufacturer's instructions in a heater with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on. no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.

ii. After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

803.5 Reflectorised Paint

Refiectorised paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Refiectorising glass beads for refiectorising paints where

used shall conform to the requirements of Morth Clause 803.4.2.

803.6 Application

803.6.1 Marking shall be done by machine. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

803.6.2 Where the compound is to be applied to cement concrete pavement, a sealing pnmier as recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

803.6.3 The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

803.6.4 The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line. Such new material shall so bond itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

803.6.5 The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices Band C of BS: 3262 (Part 3).

803.6.6 The markings shall be done to accuracy within the tolerances given below:

i. Width of lines and other markings shall not deviate from the specified width by more than 5 percent.

ii. The position of lines, letters, figures, arrows and other markings shall not eviate from the position specified by more than 20 mm

iii. The alignment of any edge of a longitudinal line shall not deviate from the specified alignment by more than 10 mm in 15 m.

iv. The length of segment of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

In broken lines, the length of segment and the gap between segments shall be as indicated on the drawings; if these lengths are altered by the Engineer, the ratio of the lengths of the painted sections shall remain the same.

803.6.7 Properties of Finished Road Markings

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

a) The stripe shall not be slippery when wet.

b) The marking shall not lift from the pavement in freezing weather.

c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures upto 60°C.

d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil dripping from traffic.

e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.

f) The colour of yellow marking shall conform to IS Colour No. 356 as given in IS:164

803 REFLECTIVE PAVEMENT MARKERS (ROAD STUDS)

804.1 Scope

The work shall cover the providing and fixing of reflective pavement marker (RPM) or road stud, a device which is bonded to or anchored within the road surface, for lane marking and delineation for night-time visibility, as specified in the Contract.

804.2 Material

804.2.1 Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Styrene Acrylonitrite) or HIPS (Hi-impact Polystyrene) or Acrylonitrile Butadiene Styrene (ABS) or any other suitable material approved by the Engineer. The markers shall support a load of 13,635 kg tested in accordance with ASTM 04280.

804.2.2 Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be moulded of methyl methecrylate conforming to ASTM 0 788 or equivalent.

804.3 Design

The slope or retro-reflecting surface shall preferably be 35 ± 5° to base and the area of each retro-reflecting surface shall not be less than 13.0 sq.cm.

804.4 Optical Performance

804.4.1 Unidirectional and Bi-directional Studs

Each reflector or combination of reflectors on each face of the stud shall have a Coefficient of Luminous Intensity (C.I.L). not less than that given in Tables 800-13 or 800-14 as appropriate.

804.4.2 Omni-directional Studs

Each Omni-directional stud shall have a C.I.L. of not less than 2 mcd/l

Table 800-13 : Minimum C.I.L. Values for Category 'A' Studs

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 5° L &R	0.3°	220	110	44
0° U 10° L&R	0.5°	120	60	24

Table 800-14 : Minimum C.I.L. Values for Category 'B' Studs

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 6° L&R	0.3°	20	10	4
0° U 10° L&R	0.5°	15	7.5	3

Note:

1. The entrance angle of 0° U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.

2. The stud incorporating one or more corner cube reflectors shall be included in Category't>;. The stud incorporating one or more bi-convex reflectors shall be included in Category 'B'.

804.5 Tests

804.5.1 Co-efficient of luminance intensity can be measured by procedure described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS:873-Part 4: 1973.

804.5.2 Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at anyone position of measurement is less than the values specified in Tables 800-13 or 800-14 provided that

i) The value is not less than 80 percent of the specified minimum, and

ii) The average of the left and right measurements for the specific angle is greater than the specified minimum.

804.6 Solar Powered Road Markers (Solar Studs)

Deleted

804.7 Fixing of Reflective Markers

804.7.1 Requirements

The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic. The reflecting portions of the studs shall be free from crevices or ledges where dirt might accumulate. Marker height shall not be less than 10 mm and shall not exceed 20 mm. and its width shall not exceed 130 mm. The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface. All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

804.7.2 Placement

The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 hours. The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the of the marker in a quantity sufficient to result in complete coverage of the area of contract of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place. For epoxy installations, excess adhesive around the edge of the marker, excess adhesive

on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed.

804.7.3 Warranty and Durability

The contractor shall submit a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel, to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer, at his own cost.

900 QUALITY CONTROL

Please refer to Clause 900, Quality Control for Road works in "Specifications for road and bridge works", (Fifth Revision) Ministry of Road Transport and Highways, Published by Indian Road Congress, New Delhi 2013.

3000 MAINTENANCE OF ROAD

Please refer to Clause 3005, Maintenance of Cement Concrete Road in "Specifications for road and bridge works", (Fifth Revision) Ministry of Road Transport and Highways, Published by Indian Road Congress, New Delhi 2013.

Paver Blocks

Providing and fixing pre-cast Rubber Dye inter locking concrete block 60mm thick with grade of concrete M-30 compressed by mechanically pressed and as per approved design including 50 mm Sand layer for levelling and filling the joint with sand in proper line and level etc complete.

Scope work:

The scope of work includes supplying and lying of precast paver blocks at site, as mentioned in the Item. All relevant provisions of IS 15658:2006 shall apply. Laying of paver blocks at site as per requirement in technical specification, within shortest possible time. The site is public place hence care should be taken to ensure that the routine activities shall not be disturbed. The job of laying may required to be carried out during night also. The work shall be executed in perfect line and level as per instructions of Engineer in charge. Colored concrete paver blocks shall be manufactured as per specifications using approved color pigment. The color shade shall be as selected by employer before commencement of the work. The contractor shall guarantee that all material and components designed, fabricated, supplied and laid by him shall be free from any

type of defect due to faulty material and/Workmanship/erection For a period of One year from the date of completion of work.

ANNEX - 1
PAINT SYSTEM SELECTION GUIDE

Durability of Paint System	Suitable for areas depencing on atmospheric condition..	Recommended for Structures	Paint System	Surface Preparation	Primer Coat (µm)	Intermediate Coat (µm)	Top Coat (µm)	Total Df. (µm)
Very low durability of 2 -5 yrs	Minimum pairting system required for structures irrespective of atmospheric condition: **Imp Note**: This system not to be recommended unless insisted upon by client insists	Station Building structures Boiler Supporting structures Mill & Burker Bay structures Coal Handling structures. ESP Structures Pipe & cable Racks. Misc Open Structures Misc Covered Structures **(Not suitable for DM Plant & Steel Chimney)**	PS-1	St-2	Inorganic Zinc Phosphate 2x35=70		Synthetic Enamel 2x25=50	120
Medium Durability (5-10 yrs)	Suitable for Normal Inland Atmosphere	Station Building structures Boiler Supporting structures Mill & Burker Bay structures ESP Structures Misc Covered Structures	PS-2	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75		HB Epoxy Polyamide (Pigmented) 1x75=75	150
		DM Plant Structures	PS-3	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	Aromatic Polyurathane Acid Resistant 1x50=50	200
		Coal Handling structures. Ash Handling Structures	PS-4	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	HB Epoxy Polyamide (Pigmented) 1x75=75	225
		Pipe & cable Racks. Misc Open Structures	PS-5	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75		Aliphatic Polyurathene(UV Resistant) 1x50=50	125
Medium Durability (5-10 yrs)	Suitable for Normal Coastal & Polluted Inland Atmosphere	Station Building structures Boiler Supporting structures Mill & Burker Bay structures ESP Structures Misc Covered Structures	PS-6	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	HB Epoxy Polyamide (Pigmented) 1x75=50	225
		DM Plant Structures	PS-7	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	Aromatic Polyurathane Acid Resistant 2x50=100	250
		Coal Handling structures. Ash Handling Structures	PS-8	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	HB Epoxy Polyamide (Pigmented) 2x75=150	300
		Pipe & cable Racks. Misc Open Structures	PS-9	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	Aliphatic Polyurathene(UV Resistant) 1x50=50	200
Medium Durability (5-10 yrs)	Suitable for Polluted Coastal Atmosphere	Station Building structures Boiler Supporting structures Mill & Burker Bay structures ESP Structures Misc Covered Structures	PS-10	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	HB Epoxy Polyamide (Pigmented) 2x75=150	300
		DM Plant Structures	PS-11	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x100=100	Aromatic Polyurathane Acid Resistant 2x50=100	275
		Coal Handling structures. Ash Handling Structures	PS-12	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 2x75=150	HB Epoxy Polyamide (Pigmented) 2x75=150	375
		Pipe & cable Racks. Misc Open Structures	PS-13	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	Aliphatic Polyurathene(UV Resistant) 2x50=100	250
Medium Durability (5-10 yrs)	Exclusively for Steel chimney irrespective of atmospheric condition	Steel Chimneys Temperature range 30°C to 200°C	PS-14	Sa 2 ½	Inorganic Zinc Silicate or Epoxy Zinc Rich 1x75=75		Heat resistant -Silicon Based aluminium paint 1x40=40	115

CIVIL WORK – TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS FOR CONCRETE WORK

EARTHWORK

SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with earthworks of all underground supplies and services and for all structural units, stock piling, of specifications and applicable drawings, and subject to terms and conditions of the contract. The scope of this section of specifications is also covered with detailed specifications as laid down herein.

GENERAL

The Contractor shall acquaint himself with the nature of the ground, existing structures, foundations and subsoil which might be encountered during excavation of earthworks. The Employer does not guarantee or warrant in any way that the material to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the report, drawings or in any other contract documents or to material obtained from boring or trail holes. The contractor shall be deemed to have made local and independent inquiries and shall take the whole risk of the nature of the ground subsoil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.

All excavations, cutting, and fills shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the period of maintenance the ground shall be at the required lines, levels and gradients.

During the course of the Contract and during the period of maintenance any damage or defects in cuttings and fills, structures and other works, caused by slips, falls or basins or any other ground movement due to the Contractor's negligence shall be made good by the Contractor at this own cost.

SITE PREPARATION

The Contractor shall construct and maintain accurate bench marks so that the lines and levels can be easily checked by the Project Engineer. The Contractor shall Construct and maintain such ditches, in addition to those shown on the plans, as will adequately drain areas under construction.

The Contractor shall perform a joint survey with the Project Engineer's representative of the area where earthwork is required, plot the ground levels on the drawings and obtain approval from him before starting the earthwork.

The Contractor shall Construct and maintain such ditches, in addition to those shown on the plans, as will adequately drain areas under construction.

The Contractor shall perform a joint survey with the Project Engineer's representative of the area where earthwork is required, plot the ground levels on the drawings and obtain approval from him before starting the earthwork.

EXCAVATIONS

Excavation shall include the removal of all material of every name and nature. Excavations shall be carried out in accordance with excavation plans and sections shown on the Drawings and as directed by the Project Engineer.

The major portion of excavations shall be carried out by mechanical excavators and excavated materials disposed off to stock on spoil as per drawings or as directed by the Project Engineer. The excavation which cannot be done by mechanical means including leveling, trimming and finishing to the required levels and dimensions shall be done manually. The material suitable for fill and back fill shall be stock piled within the free haulage limit of the 200m of the works.

The Contractor shall give reasonable notice that he intends to commence any excavation and he shall submit to the Project Engineer full details of his proposals. The Project Engineer may require modifications to be made if he considers the Contractor's proposals to be unsatisfactory and the Contractor shall give effect to such modifications but shall not be relieved of his responsibility with respect to such work.

For major excavations, the Contractor shall submit for the prior approval of the Project Engineer full details and drawings showing the proposed method of supporting and strutting etc. The design, provisions construction, maintenance, and removal of such works shall be the responsibility of the Contractor and all cost in these respects shall be included in the unit rates for the permanent work.

The Contractor's attention is drawn particularly to his obligations under the general conditions in respect of those works which are in close proximity to existing buildings.

The Contractor shall preserve the complete excavation from damage from slips and earth movements, ingress of water from any source what so ever and deterioration by exposure to the sun and the effects of the weather.

All excavation of every description, in whatever material encountered shall be performed to the elevations and dimensions shown on the drawings in such a manner as to avoid interruption to work in other parts of the site. The Contractor shall be responsible for injury to the permanent works caused by excavation on other parts of the works.

Excavation shall extend to sufficient distance from walls and footing to allow for placing and removal of forms, installations of services and for inspection, except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces.

All excavations in foundations shall be taken to 150mm and shall be trimmed carefully to a smooth and level surface, immediately after trimming to the final elevation a layer of building concrete shall be placed to the thickness shown on the drawings. All excavations for foundations which have been trimmed and disturbed shall be compacted and covered by concrete by the end of the day. It is specifically brought to the notice of the Contractor that any excavation taken down to the trimmed elevation which is left overnight or for any length of time thereafter, uncovered by the blinding concrete, shall be required to be trimmed to such lower elevation as directed by the Project Engineer and any extra work or any consequent increase in the quantities caused thereby shall not be paid to the Contractor.

No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the Project Engineer and his permission to proceed given. If excavation for sub-structures are carried below the required level, as shown in the drawings or as directed by the Project Engineer, the surplus depth shall be filled in with concrete of same grade as of blinding concrete at the sole cost of the Contractor.

All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry and the Contractor shall have sufficient equipment for this purpose. Adequate precautions shall be taken to prevent any corrosion due to undercutting from underneath the previously constructed adjoining foundations.

Existing utility lines to be retained, as well as utility lines constructed during excavation and backfilling, and if damaged, shall be required to be repaired by the Contractor at his expense. Any existing utility lines which are not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired by the Contractor and adjustment in payment will be made as approved by the Project Engineer. When utility lines which are to be removed, are encountered within the area of operations the Contractor shall notify the Project Engineer in ample time for necessary measures to be taken to prevent interruption of the service.

Excavated material suitable for use as filling material shall be stock piled within the free haulage limit 200m of works as directed by the Project Engineer. This stock piled material shall be transported back to places requiring fill or backfill. Surplus or material unsuitable for use as filling shall be disposed of by the Contractor at locations approved by the Project Engineer within specified free haulage limit.

The Contractor shall make independent enquiries and perform and make independent observations to ascertain the water table in the areas of excavations during the period when the construction works are in progress. The Contractor shall take whole risk of any nature for fluctuation of the water table from his own findings. The Employer is not bound in any way and shall not be responsible for any information given by him or any information, observations or values obtained from his reports, drawings and documents.

Excavation for Recharge pits, Recharge trenches shall be taken out to the levels and dimensions as the Project Engineer may direct.

Before starting the excavations, the Contractor shall ensure the correct alignment of the recharge trenches and location of recharge pits on the ground, the depth and width of excavation of the trench and pits, all in accordance with the drawings and instructions of the Project Engineer.

The Contractor at his cost shall provide to the satisfaction of the Project Engineer all timbering, approved supports and shores and bracings to the sides of the excavated trench and foundations in such a manner to secure the sides of the trench and excavations from falling or adverse movement. All responsibility connected with such shoring shall rest with the Contractor. Adequate clearance / working space on both sides of the structure/pipe line shall be provided for which no payment shall be made.

Without the written permission of the Project Engineer no more than 50.0m the trench shall be opened in advance of the completed pipe line. The bottom of all excavations shall be carefully leveled. Any pockets of soft or loose material in the bottom of the pits and trenches shall be removed and the cavities so formed filled with lean concrete at the Contractor's expense.

The Project Engineer may require the Contractor to excavate below the elevations shown on the drawings or he may order him to step above the elevations shown depending upon the suitable foundation material encountered.

If for any reasons, the levels grades or profiles of the excavations are changed adversely, the Contractor shall at his own cost be liable to bring the excavations to the required levels and profiles as shown on the drawings or as directed by the Project Engineer.

EXCAVATION TOLERANCES

Excavation shall be performed within the tolerances for excavation limits indicated on the drawings. Where no tolerance limits are indicated excavation shall be performed to tolerances established by the Project Engineer as accepted for the design and type of work involved.

BACK FILLING

After completion of foundation footing, foundation, walls, and other construction below the elevation of the final grades and prior to backfilling, forms shall be removed and the excavation shall be cleaned of trash and debris.

The backfilling shall include filling around the foundations, trenches.

Filling shall be approved selected material from excavation or other predominantly granular material and free from slurry, mud, organic or other unsuitable matter and capable for compaction by ordinary means.

The excavated material if found suitable shall be stock piled within the free haulage limit of the site of the works. This material shall be used for backfilling if approved by the project engineer and shall be transported by the contractor any where required for the purpose of backfilling work in this contract.

The contractor shall provide the approved quality fill and backfilling material as required to complete the fill/backfilling work. Filling in trenches and foundation shall be placed in 200 mm layers and compacted at optimum moisture content by mechanical means or other means as approved by the project engineer.

Fill in around trenches and pits shall be carefully placed with fine material to cover the completely before the normal infilling is done.

Material for back filling shall be as approved by the project engineer and shall be placed in layers of 150 mm measured as compacted material and saturated with sufficient water and compacted to produce in-situ density not less than 95% of the maximum density at optimum moisture content, achieved in test no.15 of IS 1377:1975 or similar clause of relevant is code.

All filled areas shall be left neat, smooth and well compacted with the top surface consisting of the normal site surface soil unless otherwise directed.

Depending on the depth of fill the project engineer may instruct increased thickness of successive layer to be placed.

Fill shall not be placed against foundation walls prior to approval by the project engineer. Fill shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the fill shall not be operated closer to the wall than a distance equal to the height of the fill above the top of footing.

Depending on the depth of fill the project engineer may instruct increased thickness of successive layer to be placed.

Fill shall not be placed against foundation walls prior to approval by the project engineer. Fill shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the fill shall not be operated closer to the wall than a distance equal to the height of the fill above the top of footing.

In case the contractor is instructed to arrange for the fill material the quality of the fill material will be subject to the approval of the project engineer. The project engineer shall require the contractor to carry out various tests of the fill material. All such tests shall be made at an approved laboratory at the cost of the contractor. Once a material from a specific source has been approved, the material for the same quality and from that source only shall be used. Any fill material from borrow pits which has not been approved or the quality of which differs from the approved material shall be rejected out rightly. The project engineer reserves the right to order removal of any such materials brought to the site of works at his discretion at contractor's expense. In order to ensure satisfactory compaction, it will be necessary to carry out, depending upon the type of material, particle size distribution tests, determination of organic content tests, maximum and minimum density tests and determination of optimum moisture content for the filling material.

The method of compaction, namely type of compactor, type of roller, weight of roller and number of passes proposed by the contractor for any particular fill material shall be subject to the approval of the project engineer after completion of satisfactory field tests, subsequent to the laboratory analyses, using the materials and equipment proposed to be used for the earth work in conditions similar to those likely to be encountered during construction.

The final selection of the soil moisture content, the thickness of layers, the type of compaction equipment and the number of passes shall be decided after these tests, which shall be conducted at contractor's expense.

Having established the method of compaction to be used, no departure from this approved method shall be permitted without the prior approval of the project engineer. Adequate control of the fill and compacting operations shall be ensured by in-situ density tests and in order to obtain significant results, not less than two measurements shall be carried out per one hundred square meters of area compacted. The frequency of tests shall be determined on site and may be varied at the discretion of the project engineer. Compaction shall not be less than 95% in-situ density with respect to the maximum density, at optimum moisture content.

The exact thickness of layers and the method of placing and compacting the fill shall be determined by the field tests, as stated above, but not withstanding the results of these trails, fill shall not be placed in layers exceeding 200mm in thickness. In order to maintain control of the thickness of layers, timber profiles shall be used wherever feasible. The travelers of such profiles for each layer of fill shall be checked by the supervisory staff of the project engineer. The contractor shall provide adequate supply of water and sufficient capacity of mechanical water carriers to ensure uniform and uninterrupted operation of compaction. The project engineer may forbid the contractor to proceed with placing and/or compaction of fill and/or order removal and re-compaction of such fill when he finds that the contractor has insufficient or defective equipment or that the fill has been improperly laid and/or compacted.

If it is found necessary to alter the moisture content of the fill material in any way, then very strict control shall be exercised over the wetting and/or the drying process and frequent moisture content tests.

The fill material should be well graded non-cohesive and nearly silt-free (silt content between 5 to 10 percent) salt free and free of organic materials (less than 2%). It should also be free of stones larger than 100 mm. Maximum dimension. It should be of such nature and characteristics that it can be compacted to the specified densities in reasonable length of time. It shall be free of plastic clays, of all materials subject to decay, decomposition or dissolution and or cinder or other material which corrode piping and other metals.

TOLERANCES

The stabilization of compacted backfill/fill surfaces shall be smooth and even and shall not vary more than 100mm in 3 meters from true profile and shall not be more than 12.5mm from true elevation.

DISPOSAL OF SURPLUS MATERIAL

The rejected unsuitable material and surplus excavated material shall be disposed of within 200 m free haulage limit measured from boundary of the works to places or as directed by the Project Engineer.

The disposal of surplus excavated material shall include loading, unloading, transporting, stacking, spreading as directed by the Project Engineer.

PLAIN AND REINFORCED CEMENT CONCRETE

The work covered by this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials, and in performing all operations in connection with the supply and installation of plain and reinforced concrete work, complete in strict accordance with this section of the Specifications and relevant documents, subject to the Conditions of the Contract.

GENERAL

Full co-operation shall be given to other trades to install embedded items and/or any associated services.

Embedded items shall have been inspected, and tests for concrete and other material or for mechanical operations shall have been completed and approved, before concrete is placed.

Formwork shop drawings shall be designed and prepared by the Contractor at his own cost. Approval of shop drawings as well as those of mock-ups /actual samples of finished concrete shall be obtained before Work is commenced.

Contractor shall prepare bar bending schedules, and get the same approved by the Project Engineer, prior to commencement of work.

RELATED SPECIFICATIONS

The codes and standards generally applicable to the work of this section are listed herein after.

IS 269	:	Ordinary and low heat Portland Cement
IS 8041	:	Rapid Hardening Portland Cement
IS 455	:	Portland slag cement
IS 1489	:	Portland Pozzolana Cement
IS 8112	:	High Strength Ordinary Portland Cement
IS 383	:	Coarse and fine aggregates from natural sources for concrete
IS 456	:	Code of practice for plain and reinforced concrete
IS 516	:	Method of sampling and analysis of concrete
IS 1199	:	Method of sampling and analysis of concrete
IS 1139	:	Hot rolled deformed bars
IS 23896	:	Methods of testing of aggregates for concrete (Part I to III)
IS 2751	:	Recommended Practice for welding for reinforcement bars
IS 9103	:	Admixtures for concrete
IS 10262	:	Recommended guide lines for concrete mixed design

MATERIALS

CEMENT

a. Cement shall conform to standards listed in section 2 of IS:456, latest edition.
b. Only one brand of each type of cement shall be used for concrete in any individual member of the structure. Cement shall be used in the sequence of receipt of shipment, unless otherwise directed.
c. There shall be sufficient cement at site to ensure that each section of Work is completed without interruption.
d. Cement reclaimed from cleaning of bags or from leaky containers shall not be used.
e. Contractor shall provide and erect, at his own cost, in a suitable place, dry, well ventilated, and water proof shed of sufficient capacity to store the cement.
f. The cement shall be used as soon as possible after delivery, and cement which the Project Engineer considers has become stale or unsuitable through absorption of moisture from the atmosphere or otherwise shall be rejected and removed immediately from the site at Contractor's expense.
g. The mixing together of different types of cement shall not be permitted.

AGGREGATES

a. The sources of supply of all fine and coarse aggregates shall be subject to the approval of Project Engineer.
b. All fine and coarse aggregates shall be clean and free from clay, loam, silt, and other deleterious matter. If required, Project Engineer reserves the right to have them washed by the Contractor at no additional expenses. Coarse and fine aggregates shall be delivered and stored separately at Site. Aggregates shall not be stored on muddy ground or where they are likely to become dirty or contaminated.
c. Fine aggregate shall be hard coarse sand, crushed stone or gravel screenings and shall conform to requirements of IS: 383 latest edition.
d. Coarse aggregate shall be gravel or broken stone or hard, durable material free from laminated structure and conforming to IS: 383 latest edition. The aggregates shall be graded as follows for use in mass concrete as in foundations:

TOTAL PASSING	PERCENT BY WEIGHT
2" B.S. Sieve (50.00 mm)	100
1-1/2" Sieve (38.10 mm)	95-100
3/4" Sieve (19.00 mm)	35- 70
3/8" Sieve (9.50 mm)	10- 30
No. 4 Sieve (4.75 mm)	0- 5

Coarse aggregate for all cast-in-place concrete other than mass concrete as for foundations shall be graded with the following limits:-

TOTAL PASSING	PERCENT BY WEIGHT
1" Sieve (25.00 mm)	100
3/4" Sieve (19.00 mm)	90-100
3/8" Sieve (9.50 mm)	20- 55
No. 4 Sieve (4.75 mm)	0- 10

Water:

Only clean potable water from the city supply, tube well installed at the Site or from other sources approved by Project Engineer shall be used. Contractor shall supply sufficient water for all purposes, including mixing the concrete, curing and cleaning plant and tools. Where doubts exist as to the suitability of the water, it shall be tested in accordance with IS: 3025. Where water can be shown to contain any sugar or an excess of acid, alkali or salt, Project Engineer may refuse to permit use. As a guide, the following concentrations represent the maximum permissible values:

a. To neutralize 200 ml sample it should not require more than 2 ml of 0.1 normal NaOH.
b. To neutralize 200 ml sample it should not require more than 10 ml of 0.1 normal HCL.
c. Percentage of solids should not exceed the following:

	PERCENT
Organic	0.02
Inorganic	0.30

Sulphates	0.05
Alkali Chlorides	0.10

In case of doubt, Project Engineer may require that concrete mixed with water proposed to be used should not have a compressive strength lower than 90 percent of the strength of concrete mixed with distilled water.

Reinforcement

a. Reinforcement for concrete shall conform to the respective IS or other standards as specified in the drawings and Contract Documents or as may be specified by Project Engineer.
b. Unless otherwise specified, all plain reinforcing bars shall comply with the requirements of IS: 432, and shall have a minimum yield stress of 248 N/sq mm.
c. Unless otherwise specified, all deformed reinforcing bars shall comply with the requirements of IS: 1786 for deformed cold worked steel bars and shall have minimum characteristic stress of 415 N/sq mm.
d. Reinforcement shall be obtained only from manufacturer's approved by Project Engineer. If and when required Contractor shall provide all necessary facilities to Project Engineer for the selection of test pieces and shall cause these to be prepared and submitted where directed for tests at Contractor's cost.
e. If the reinforcement is to be supplied by Employer, Contractor shall inform Project Engineer of his requirements much before its use in construction.
f. Reinforcement of all types is to be stored at Site in an approved manner so as to avoid damage.
g. Contractor shall report immediately on receipt of any consignment, having any deviation in the standard weights of the reinforcing bars beyond those allowed in respective standards mentioned in clause (3.3.3.4.b) and (3.3.4.4.c) herein before.

CONCRETE MIX PROPORTIONS

General:

The proportions of ingredients shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement by the methods of placing and consolidation employed on the Work, but without permitting the materials to segregate or excessive free water to collect on the surface. Specific approval of the Project Engineer is required to waive limitations on mixture proportions.

The proportions of ingredients shall be selected in accordance with Section 5.7 to produce the proper placebility, durability, strength and other required properties.

Strength

The Specified compressive strength of the concrete cube, shall be 15 N/sq mm. or 20 N/sq mm.. Samples from fresh concrete shall be taken as per IS: 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS: 516.

Durability
Requirements of Clause 7 of IS: 456-1978 shall be followed.

Slump

Unless otherwise permitted or specified, the concrete shall be proportioned and produced to have a slump of 100 mm or less. A tolerance of up to 25 mm above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit.

Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

Note: If S.R. Cement is used, permissible water-cement ratio may be increased by 0.05.

Slump shall be determined by the "Test for slump for Portland Cement Concrete" as per relevant IS code.

Maximum Size of Coarse Aggregate:

The nominal maximum size of the aggregate shall be 20.mm for all portions of the structure except footings which may be 38 mm. These limitations may be waived if, in the judgment of the Project Engineer, workability and methods of consolidation are such that the concrete can be placed without honeycomb or voids.

Admixtures:

If required or permitted, admixtures used shall be in accordance with the manufacturer's instructions except as otherwise specified herein.

Methods of Obtaining Mix Design:

For concrete of normal weight, mix proportions to provide the desired characteristics shall be developed using the methods/procedure covered by the Recommended Practice for Selecting Proportions for Normal Weight Concrete ACI-211.1-77/ IS:456- 1978.

Trial mixtures having proportions and consistencies suitable for the Work shall be made based on above codes, using at least three different water-cement ratios which will produce a range of strengths encompassing those required for the Work. Trial mixes shall be designed to produce the specified slump. The temperature of concrete used in trial batches shall be reported.

For each water-cement ratio, compression test of cube shall be made, cured, and tested in accordance with IS:1199 and IS:516. From the results of these tests a curve shall be plotted showing the relationship between the water-cement ratio and compressive strength. From this curve, the water-cement ratio to be used in the concrete shall be selected to produce the required design strength. The cement content and mixture proportions to be used shall be such that this water- cement ratio is not exceeded when slump is the maximum permitted. Control in the field shall be based upon maintenance of proper cement content and slump.

Ready mix concrete

GRADES AND STRENGTH REQUIREMENTS OF CONCRETE

General

Ready mix Concrete shall consist of the material described under site batched concrete sections, using separate coarse and fine aggregate in an appropriate combination determined in the course of the of mix design . The overall grading shall be such as to produce a concrete of the specified quality which will work readily in to position without segregation. The ready mix concrete shall conform to IS: 4926 and shall be delivered in agitating trucks. The RMC may contain flyash as per the acceptable norms.

Slump

The water shall be added to the cement and aggregate during mixing to produce concrete having a sufficient workability to enable it to be well consolidated, to be worked in to the corners of the shuttering and around the reinforcement to give the specified surface finish, and to have the specified strength. Water cement ratio shall be maintained as per IS456-1978 when a suitable amount of water has been determined, the resulting consistency shall be maintained throughout the corresponding parts of the work and tests shall be conducted to ensure the maintenance of this consistency. The max slump at the point of the discharge should not exceed 110mm max.

Concrete Grades

Grade of concrete used in the works shall be shown on the drawings or as directed by the Architect/Project Manager. The minimum cement used for M-20 shall be 300 Kg. Per Cum, 350 Kgs for M-25 and 400Kgs for M-30.

TRANSPORTING CONCRETE

Concrete shall be transported in agitating trucks without contamination, loss of ingredients or segregation. In no case shall a period of more than 4 hours have elapse between the wetting of mix and discharge of the concrete at site.

CONCRETE PLACEMENT

Concrete, when deposited, shall have a temperature of not less than 5oC (41oF) and not more than 32oC(90oF).

The concrete shall be placed in the positions and sequences indicated on the drawings, in this specification and/or as directed by the Architect/Project Manager.

Contractor shall give adequate notice to the Architect/Project Manager of his intention to concrete any section of the works.

Except where otherwise directed, concrete shall not be placed unless the representative of the Architect/Project Manager is present and has previously examined and approved the positioning, fixing and condition of the reinforcement or any other items to be embedded and the cleanliness, positioning and suitability of the concreting surface.

The concrete shall be deposited as nearly as possible in its final position. It shall be placed in such a manner as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall be brought up in horizontal layers not exceeding 450 mm in compacted thickness unless otherwise authorized or directed by Architect/Project Manager. Concrete shall not be placed simultaneously on each side of large horizontal specified or approved construction joints.

Shutters for walls or thin sections of considerable height shall be provided with openings or other devices that will facilitate the cleaning of the accumulation of hardened concrete on the shutters or on the metal reinforcement above the level of theconcrete and the removal of concrete in the case of segregations.

Quality Control

In order to ensure that the quality of materials and the mix proportions are suitable for the particular grade of concrete required are so maintained, sampling and testing shall be carried out regularly during the course or the works.

Workability testing shall be carried out in accordance with IS:456. The results shall lie within the range upon which the accepted mix design is based. Testing shall be carried out at such a frequency that the required workability is consistently achieved.

Samples of concrete shall be taken at random in accordance with IS: 516 at the time and place of deposition of the concrete at a frequency of sampling for each grade of concrete and from each concrete mixing plant at six cubes of 150 mm nominal size per 50 cubic meters of concrete placed in the works or twice per week.

Notwithstanding the foregoing, additional samples shall be taken by the contractor when directed by the Architect/Project Manager. The test cube procedure shall be in accordance with IS: 516 throughout.

Compliance with the specified characteristic strength shall be assumed if:

a. Each of the six cubes in a group has a test strength not less than the characteristic strength or,
b. Not more than one cube has a test strength less than the specified characteristic strength but not less than 85% of the specified characteristic strength and the average strength of the group of four test results is not less than the specified characteristic strength plus the standard deviation of the group.

Seven day cube tests

Acceptance of concrete is based on the 28th day results. However, the contractor shall establish a relationship between 7 days and 28 days strengths by carrying out 7 days tests at the time of performing the laboratory testing and from subsequent quality control testing. This relationship shall be used in interpreting any further test results to predict the probable value of the corresponding 28 days cube strengths. The contractor shall without delay advise the Architect/Project Manager of any sample that appears likely to fail to meet the specification and the contractor shall take any necessary action to minimize the effect of such failure.

Acceptance Criteria

The general Acceptance Criteria of any and all of the concrete work shall be as per the relevant Clauses of IS. 456. If any of the works tests are not up to the standard, the Architect/Project Manager shall have the power to stop the work until the reason is investigated and steps taken to prevent further low results. The contractor shall not be entitled to any claims on account of such delays. Any concrete carried out from the batch that is afterwards found to be faulty, will be liable for rejection and if so directed, the contractor shall at his own expenses dismantle and replace the defective work and any work built thereon or shall take such other measures as may be deemed necessary by the Architect/Project Manager. At the discretion of the Architect/Project Manager, the contractor may be allowed to prove by means of a load test to be carried out at his own expense, that the concrete is capable of safely withstanding the loads as specified in the test.

Quality of Water

- Water used for both mixing and curing shall conform to IS: 456. Potable water is generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.
- The pH value of water shall not be less than 6.
- Seawater shall not be used for concrete mixing and curing.
- The proposed admixtures shall comply with requirements of specification part 11- Water sealing materials.

STEEL REINFORCEMENT

SCOPE OF WORK

The work to be done under this section consists of furnishing, cutting, fabricating, bending, placing and tying steel reinforcement in concrete structures or elsewhere as shown on the drawings or directed by the Project Engineer. The scope of this section of this section of specifications as laid down herein.

MATERIAL AND SIZE OF BARS

Reinforcement for concrete shall conform to the respective Indian or other standards as specified in the drawings and in the contract documents or as may be specified by the Project Engineer.

Unless otherwise specified, all plain mild steel reinforcing bars shall comply with the requirements of IS: 432 (Part- I) and shall have a minimum yield stress of 250 N/mm.sq.

Unless otherwise specified, all deformed reinforcing bars shall comply with the reinforcements of IS: 1786 for deformed cold twisted steel bars and shall have a minimum characteristic strength of 415 N/mm.

Reinforcement shall be obtained only from manufacturers approved by the Consultant/Project Engineer. Each consignment of reinforcement steel shall be accompanied by a manufacturer's certificate or shall refer to a previous certificate, if the consignment is from the same batch, showing that the reinforcement steel complies with the following requirement

If such certificate is not made available or if the Consultant / Project Engineer considers that the manufacturer's tests are inadequate, samples shall be taken for acceptance test from different consignments as the Project Engineer may direct and shall be tested at the Contractor's cost should the result of such that any sample does not meet with the specifications, the whole consignment shall be rejected and removed from the site at the Contractor's cost.

Reinforcement of all types is to be stored on site in approved manner so as to avoid damage.

Reinforcement shall be free from all loose or flaky rust and mill scale or coating, including ice, and other substance that would reduce or destroy the bond. Reduced section steel reinforcement shall not be used.

If such certificate is not made available or if the Consultant / Project Engineer considers that the manufacturer's tests are inadequate, samples shall be taken for acceptance test from different consignments as the Project Engineer may direct and shall be tested at the Contractor's cost should the result of such that any sample does not meet with the specifications, the whole consignment shall be rejected and removed from the site at the Contractor's cost.

If such certificate is not made available or if the Consultant / Project Engineer considers that the manufacturer's tests are inadequate, samples shall be taken for acceptance test from different consignments as the Project Engineer may direct and shall be tested at the Contractor's cost should the result of such that any sample does not meet with the specifications, the whole consignment shall be rejected and removed from the site at the Contractor's cost.

Reinforcement of all types is to be stored on site in approved manner so as to avoid damage.

Reinforcement shall be free from all loose or flaky rust and mill scale or coating, including ice, and other substance that would reduce or destroy the bond. Reduced section steel reinforcement shall not be used.

Steel wire mesh reinforcement shall conform to requirement of relevant Indian codes or those of ASTM: A 185-64 or BS. 4483, 1969: Standard Specifications for welded steel wire fabric for concrete reinforcement. It shall be used where shown on the drawings.

Applicable standards

Latest editions of Indian Standards as per 4.3 or other International Standards

DELIVERY & STORAGE

Delivery

Steel reinforcement bars shall be delivered in bundles firmly secured and tagged. Each bars or bundle of bars shall be identified by marks stamped on hot or cold or painted on or by any other means. The identifying marks shall contain the following information:

Name of the producer or his trade.

Standard to which the bars have been manufactured.

The clause, type and strength respectively.

The diameter.

The number of the test certificate (if available).

Storage

The method of storage shall be approved by the Project Engineer. Reinforcing bars shall be stored in racks or platforms above the surface of ground and shall be protected free from scaling, rusting, oiling, coatings, damage, contamination and structural defects prior to placement in works. Bars of different diameters and grades of steel reinforcement shall be kept separate.

BAR BENDING SCHEDULES

The Contractor shall prepare bar bending schedule of all the reinforcing steel bars and these bar bending schedules will be supplied to the Consultants/Project Engineer in duplicate on the basis of which the work shall be carried out. However, the Contractor shall be responsible to satisfy himself as to the correctness and accuracy of the bar bending schedule. Any discrepancy shall immediately be notified to the Consultant / Project Engineer before commencing work.

DWC HDPE PIPE WORK

GENERAL

Design of HDPE pipes including material details and the maximum allowable hydrostatic design stress taking into consideration, the temperature and design life of pipes shall be in accordance with the relevant clauses of IS:14333

Material

The DWC (Double Wall Corrugated) High Density Polyethylene Pipes (HDPE) shall be in the range of 160 mm to 1000 mm nominal diameter of pressure rating of PN6 / PN 8 on material grade of PE 80. Material Grade, Minimum Required Strength and Maximum Allowable Hydrostatic Design Stress shall conform to the relevant clause of IS – 14333. The material used for the manufacturer of pipes should not constitute toxicity hazard, should not support microbial growth, should not give rise to unpleasant taste or odour, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material by any reputed organization as per the satisfaction of the Engineer

Examining

The specimen of pipes for the following tests shall be selected in accordance with relevant clause of IS: 2530 and tests in accordance with the methods described in relevant clause of IS: 14333. Following tests shall be taken in consideration:

Hydrostatic Test

II. Reversion Test

III. Density Test

IV. Melt Flow Test

V. Carbon Black Content and Dispersion.

Three samples of the same size and same pressure rating selected at random shall be tested for compliance with the requirements of the type test for Internal Pressure Creep Rupture Test.

In case, any of the samples fails in the type test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number and subject them to type test again. In case of the sample fails in the repeat tests, the type of pipe shall not be approved.

Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of

the lot.

A lot having satisfied dimensional and visual requirements shall be tested for hydraulic characteristics, reversion, density, MFR and Carbon Black content / dispersion requirements. The lot shall be considered to have met the requirements of these tests, if none of the samples tested fails.

WORKMANSHIP AND FINISH

Pipes shall be free from all defect including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe.

Laying

For lowering and laying of pipes, the following points shall be considered:

a) Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Engineer shall be laid.
b) While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. The bedding for HDPE pipes shall be provided as per relevant drawing and as directed by engineer. While laying in rocky areas suitable bed of sand or gravel should be provided. The fill to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, 15cm thick sand bed as approved by the engineer shall be provided.
c) As PE pipes are flexible, long lengths of fusion-jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets.

d) During the pipe laying of continuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc) and at branch connections. Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day.)
e) For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.

f) The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.
g) The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus the total system enables directional changes within

the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 25 times the OD of the pipe.

h) The Installation of flanged fittings such as connections to sluice / air / gate valves on pumping main requires the use of stub ends (flange adaptors complete with backing rings and gaskets. Care should be taken when tightening these flanges to provide even and balance torque.

i) Provision should be made at all heavy fittings installation points for supports (such as anchoring of the flange in the soil) for the flange joint to avoid the transfer of valve wheel turning torque on to the PE flange joint.

j) PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done

k) When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.

l) However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.

m) Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density

Making Joint

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as per IS: 7634 (Part II) shall be selected considering site and working condition, pressure and flow of liquids.

CLEANING

As soon as a stretch of HDPE pipes has been laid complete from manhole to manhole or for a stretch as directed by Engineer, Contractor shall remove soil, debris etc and clean the entire stretch to the satisfaction of Engineer . The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by Engineer to prevent entry of mud or slit etc. If as a result of the removal of any obstruction, Engineer considers that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory Contractor shall amend the work and carry out such further tests as are required by Engineer. It shall also be ascertained by Contractor that each stretch from manhole to manhole or the stretch as directed by Engineer is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise

FITTIING AND SPECIALS

All HDPE fittings/ specials shall be fabricated in accordance with IS: 8360 (Part I & III). PE

Injection moulded fittings shall be as per IS: 8008 (Part I to IX). All fittings/specials shall be fabricated or injection moulded at factory only. No fabrication or moulding will be allowed at site, unless specifically permitted by the Engineer. Fittings will be butt welded on to the pipes or other fittings by use of heat fusion.

1.8 RCC PIPE WORK

1.8.1 GENERAL

Design of RCC pipes, details of reinforcement and the ends of the pipe shall be in accordance with the relevant clauses of IS: 458. The Class of the pipe shall be of RCC NP3 conforming to IS 458.

1.8.2 Material

For all materials, Factory's test result and written guarantee document with necessary analysis data shall be submitted to obtain the approval of the Engineer before carrying to sites.

1.8.2.1 Cement Ordinary Portland cement/Sulphate Resisting : Cement as specified in Data Sheet –A shall be used for the manufacture of RCC pipes and fittings and shall conform to relevant IS codes. The use of pozzolana as an admixture to Portland cement shall not be permitted.

1.8.2.2 Aggregates : Aggregates used for the manufacture of RCC pipes shall conform to IS: 383. The maximum size of aggregate should be 10mm for pipes of internal diameter 150 to 250mm but should not exceed one third thickness of the pipe or 20mm, whichever is smaller, for pipes of internal diameter above 250mm.

1.8.2.3 Mixing and Curing Water : Water used for mixing of concrete and curing of pipes shall conform to IS: 456. Water shall be clean, colorless and free from objectionable quantities of organic matter, alkali, acid, salts, or other impurities that might reduce the strength, durability or other desirable qualities of concrete and mortar. Contractor shall submit water quality report before using it.

1.8.2.4 Reinforcement: Reinforcement used for the manufacture of the spigot and socket RCC pipes shall be mild steel Grade I or medium tensile steel bars conforming to IS: 432 (Part-1) or hard-drawn steel wire conforming to IS: 432 (part- 2). A reinforcement cage for pipes shall be as per relevant requirement of IS: 458.

1.8.2.5 Concrete: Concrete used for the manufacture of spigot and socket RCC pipes shall conform to IS: 456. The minimum cement content and minimum compressive strength of concrete shall be as per relevant requirements of IS: 458. Compressive strength tests shall be conducted on 15cm cubes in accordance with the relevant requirements of IS: 456 and IS: 516.

CURINIG

Pipes manufactured in compliance with IS: 458 shall be either water cured or steam cured in

accordance with the relevant requirements of IS: 458.

WORKMANSHIP AND FINISH

a) Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench no opening between ends in contact shall exceed 3mm in pipes upto 600mm diameter (inclusive), and 6mm in pipes larger than 600mm diameter.

b) The outside and inside surfaces of the pipes shall be smooth, dense and hard, and shall not be coated with cement wash or other preparation unless otherwise agreed to between Engineer and the manufacturer or supplier.

c) The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or moulding.

d) The pipes shall be free from local dents or bulges greater than 3.00 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.

e) The deviation from straight in any pipes throughout its effective length, tested by means of a rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters, 3 mm for every meter run.

Laying

All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure/pipeline of water, gas, sewage etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches and bedding work for pipes at the bottom of the trenches are approved and measured by Engineer. Pipes shall be carefully lowered in the trenches. Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes shall be made by Contractor. In no case pipes shall be dropped. Slings of canvas or equally non-abrasive material of suitable width or special attachment to fit the ends of pipes shall be used to lift and lower the pipes. The pipes shall be inspected for defects and be rung with a light hammer preferably while suspended to detect cracks. If doubt persists, further confirmation shall be done by pouring a little kerosene/dye on the inside, of the pipe at the suspected spot. No sign of kerosene/dye should appear on the outside surface. Pipes damaged during lowering or aligning shall be rejected by Engineer. All the pipes are to be laid perfectly true both in alignment and to gradient specified and the socket end of the pipe shall face upstream. The laying of pipes shall always proceed upgrade of a slope. After placing a pipe in the trench, the spigot end shall be cantered in the socket and the pipe forced home and aligned to required gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. Pipes which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Engineer. During the period that the plug is on, the Contractor shall take

proper precautions against floating of the pipe owing to entry of water into the trench. In case of pipes, with joint to be made with loose collars, the collars shall be slipped on before the next pipe is laid. The pipes shall be laid such that the marking on pipes appears at the top of the pipes.

Making Joint

Collar Joint

Jointing of RCC pipes shall be done as per the requirements of following Specifications and as per the relevant IS. The type of joints shall be spigot and socket type. After jointing extraneous material if any, shall be removed from the inside of the pipe and newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these shall conform to IS: 5382. The pipe joint work must be done neatly and keep even slope and level for pipe laying works.

Spigot and Socket Joint (Flexible)

The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipes. The manufacturer's instructions shall be used, and the manufacturer's instructions shall be deemed to form a part of these Specifications. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer. The socket of RCC pipes shall face up the gradient.

Cleaning of pipes

As soon as a stretch of RCC pipes has been laid complete from manhole to manhole or for a stretch as directed by Engineer, Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by Engineer to prevent entry of mud or slit etc. If as a result of the removal of any obstruction, Engineer considers that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory Contractor shall amend the work and carry out such further tests as are required by Engineer. It shall also be ascertained by Contractor that each stretch from manhole to manhole or the stretch as directed by Engineer is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise.

Testing at works site

After laying and jointing of RCC pipes is completed the pipe line shall be tested at work site as per the following Specifications and as directed by Engineer. All equipment for testing at work site shall be supplied and erected by the Contractor and shall be rectified by him to the full satisfaction of Engineer. Water used for test shall be removed from pipes and not released to the

excavated trenches. After the joints have been thoroughly jointed and have been checked by Engineer and before backfilling the trenches, the entire section of the sewer shall be proved by Contractor to be water tight by filling in pipes with water at a constant head of 2.5m above the top of ground level for the highest pipe in the stretch and heading the water up for the period of one hour. The testing apparatus used for the purpose shall normally be fixed on the upstream end and should be got approved by Engineer. Contractor if required by Engineer shall dewater the excavated pit and keep it dry during the period of testing. The loss of water over a period of 30 minutes should be measured by adding water from a measuring vessel at regular intervals (not more than 1 minute) and noting the quantity of water required to maintain the original water level. For the approval of this test the average quantity added should not exceed 1 litre / hour / 100 linear meters / 10 mm nominal internal diameter. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good. All of results of test and inspection data must be prepared by contractor at site so that the Engineer shall make decision of "fail or pass" at once. All cost for the inspection shall be borne by the Contractor. Notes a) If any damage is caused to the pipeline during the execution of work or while cleaning / testing the pipeline as specified, Contractor shall be held responsible for the same and shall replace the damaged pipeline and retest the same at his own cost to the full satisfaction of Engineer. b) Water for testing of pipeline shall be arranged by Contractor at his own cost.

PRE –CAST RCC MANHOLE COVERS

Pre-cast reinforced cement concrete manhole covers intended for use in electrical trenches and manhole works shall generally conform to IS 12592.

1.9.1 Materials

Cement: Cement used for the manufacture of pre-cast concrete manhole covers shall be 43 grade Portland cement conforming to IS-8112.

Aggregates: The aggregates used shall be clean and free from deleterious matter and shall conform to the requirements of IS-383. The aggregates shall be well graded and the nominal maximum size of coarse aggregate shall not exceed 20 mm.

Concrete: The mix proportions of concrete shall be determined by the manufacturer and shall be such as will produce a dense concrete without voids, honey combing etc. The minimum cement content in the concrete shall be 410 kg/m3 with a maximum water cement ratio of 0.45. Concrete weaker than grade M- 30 (design mix) shall not be used. Compaction of concrete shall be done by machine vibration.

Reinforcement

(a) The reinforcement steel shall conform to IS 1786. Reinforcement shall be clean and free from loose mill scale, loose rust, and mud, oil, grease or any other coating which may reduce or

destroy the bond between the concrete and steel. A light film of rust may not be regarded as harmful but steel shall not be visibly pitted by rust.

(b) Fibers Steel: The diameter/equivalent diameter of steel fibers where used, shall not be greater than 0.75 mm. The aspect ratio shall be in the range of 50 to 80. The minimum volume of fibers shall be 0.5 percent of the volume of concrete.

The reinforced concrete manhole cover and frame shall be designed in accordance with the provisions of IS 456. Clear cover to reinforcement shall not be less than 15 mm.

1.9.2 Shapes and Dimensions: Shape, dimensions and tolerance of pre-cast concrete manhole covers and frames shall conform to IS 12592. Outside dimension of cover at top shall match with corresponding frame so that the maximum clearance at top between the frame and the cover all round the periphery is not more than 5 mm and the top surface of the frame and covers, is in level within a tolerance of +5 mm.

For facility of removing the cover from the frame, suitable taper matching with taper given for the frame shall be provided to the periphery of the cover.

1.9.3 Lifting Device: The minimum diameter of mild steel rod used as lifting device shall be 12 mm for light and medium duty covers and 16 mm for heavy and extra heavy duty covers. The lifting device shall be protected from corrosion by hot galvanising or epoxy coating or any other suitable treatment.

1.9.4 Finishing & Coating: To prevent any possible damage from corrosion of steel the underside of the covers shall be treated with anticorrosive paint. The top surface of the covers shall be given a chequered finish. In order to protect the edges of the covers from possible damage at the time of lifting and handling it is necessary that the manhole covers shall be cast with a protective mild steel sheet of minimum 2.5 mm thickness around the periphery of the covers. Exposed surface of mild steel sheet shall be given suitable treatment with anticorrosive paint or coating. To prevent the top outer edge of frame from possible damages, it shall be protected by 25 mm X 3 mm mild steel flat as part of the frame.

1.9.5 Physical Requirements

(a) General: All units shall be sound and free from cracks and other defects which interface with the proper placing of the unit or impair the strength or performance of the units. Minor chipping at the edge/surface resulting from the customary methods of handling during delivery shall not be deemed for rejecting.

(b) Load Test: The breaking load of individual units when tested in accordance with the method described in IS 12592 shall be not less than the values specified in Table

Grade of cover	*Type*	*Load in Tonnes*	*Diameter of blocks in mm*
EHD - 35	Circular , Square or Rectangular	35	300
HD - 20	Circular , Square or Rectangular	20	300
MD - 10	Circular or Rectangular	10	300
LD - 2.5	Circular , Square or Rectangular	2.5	300

1.9.6 Fixing: The frames of manhole shall be firmly embedded to correct alignment and level in RCC slab or plain concrete as the case may be on the top of masonry which shall be paid as extra unless specified otherwise.

1.9.7 Measurements: The manhole covers shall be enumerated under relevant items.

1.9.8 Rates: The rate shall include the cost of materials and labour involved in all the operation described above except fixing of frames and covers which shall be paid as extra unless specified otherwise in the item.

1.9.9 Foot Rests: Foot rests shall be of 20 mm M.S. square or round bars as specified.

GENERAL REQUIREMENTS

The work shall be executed on Item rate basis. Details and drawings given in Tender document are to be followed by the successful bidder. The bidder shall undertake confirmatory survey for accuracy and completeness of data.

Scope of work mentioned is for indicative and exhaustive purpose. In addition the contractor shall be responsible for executing all items required for completing the tendered works as per direction of Engineer-in-charge.

a. The contractor will have to construct according to the layout plan and detailed architectural drawings approved by HDMC.
b. The structural drawing shall be approved by HDMC. If any modification in design/ drawing as per R & B guideline is needed, due to site conditions, the agency shall do/ redo itself

without any extra cost. The decision of the Municipal Commissioner shall be final and binding. No claim what so ever will be entertained in this regard.

c. Agency has to obtain labour license from Respective Department.
d. Fire safety norms shall be followed as per Standards.
e. Setting of testing laboratory at site, equipped with apparatus needed for testing during construction. All the required tests as instructed by Engineer-In-Charge shall be carried out.
f. After completion of Contract period, the recharge trenches and pits will become the property of the HDSCL. The Contractor shall handover the recharge trenches and pits in Good working conditions complete to the satisfaction of Authority.
g. HDSCL reserves the right to inspect any such recharge trenches and pits at any time during the contract period.
h. Taking all precautionary measure to safeguard against any accident for the contractors employees, general public, supervisory staff of HDMC by providing necessary safety equipments, helmets and MS sheet barricading etc. at work site. The site has to be kept clean all the time of all debris, rubbish, dirt & surplus/waste material.

OTHER REQUIREMENTS

a. All the successful Contractors will have to ensure meeting of the design criteria.
b. Any deviation from the proposed design needs to be approved by the HDSCL.

TESTING AND INSPECTION

a. Third Party inspection
b. The charges for third party inspection, if any, would initially be borne by the Contractor.
c. Site tests
d. After erection at site, all components, equipment as described shall be tested to prove satisfactory performance and /or fulfillment of functional requirements without showing any sign of defect as individual equipment and as well as a system.
e. Water Quality Monitoring - The monitoring of water quality during the implementation of artificial recharge schemes is essential to maintain the quality standards for specified groundwater standards. In case of recharge pits with shaft, the composition of native water in the aquifer and the recharged water is important to prevent clogging of well and aquifer due to excessive precipitation of salts.

DELIVERY/COMMISSIONING

a. The commissioning of all the Recharge Pit and Trenches is 3 months (90 days) from the date of the confirmed Letter of intent or handing over of site whichever is later.
b. In case of non-operation of Recharge Pits and trenches beyond the stipulated days as approved by HDSCL, the contract is liable for termination.

SCOPE OF HDMC

a. HDMC will provide details pertaining to nearest Source of water, further arrangement including required plumbing works from source to Recharge Pit and trenches shall be borne by the Contractor.
b. HDMC will charge for water required during construction for the Recharge Pit and trenches on commercial rates.

CONSTRUCTION REQUIREMENTS FOR RECHARGE PIT AND TRENCHES
General

a. The Contractor shall design Recharge Pit and trenches in such a way that material considered for design and construction shall be as specified in this document.
b. Specifications and design of the Recharge Pit and trenches shall be provided by the Contractor for each and every location before start of work and only after obtaining clearance from HDSCL, Recharge Pit and trenches should be constructed at respective locations.
c. The Contractor will maintain a **safe, clean and hygienic environment in and around trenches and pit.**
d. Provided that the Contractor shall ensure that the technology chosen is
   - Appropriate to the site and ground situation
   - Has a precedent for use in a project of similar nature and size
   - Is supported by the technology/service provider for design, supply, and implementation.

4.0 TECHNICAL SPECIFICATIONS FOR STEEL WORK

4.1.0 FABRICATION OF STRUCTURAL STEEL

SCOPE OF WORK

This specification covers the general requirements for supply of all steel items where specified, fabrication, inspection, testing and delivery at site of all fabricated structural steel items. This specification also covers design of all connections and substituted members, preparation of all shop fabrication drawings, inspection of fabricated items.

The scope of work also includes, but is not limited to proper stacking and storage of fabricated materials, transport from place of storage to place of erection, wherever required. All the works shall be carried as per approved QA procedures.

4.2.0 APPLICABLE CODES STANDARDS AND SPECIFICATIONS

The pertinent clauses of the following Indian Codes, Standards and Specification (latest editions including all applicable official amendments, reaffirmations and revisions) shall apply to the material and workmanship covered by this specification. In the event of the conflict of certain requirements between this specification and the codes referred herein, this specification shall govern.

It is not the intent to specify herein all the codes and standards required for the satisfactory completion of work. The list of codes and standards indicates certain primary codes and standards and not all the codes required for the work under the contract. It is understood that all the pertinent codes and standards shall form the part of this specification whether explicitly indicated or not.

IS 800	General Construction in Steel –Code of Practice
IS 803	Code Of Practice For Design, Fabrication And Erection Of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks.
IS 806	Code Of Practice For Use Of Steel Tubes In General Building Construction
IS 808	Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections
IS 813	Scheme of symbols for welding
IS 814	Covered Electrodes for Manual Metal Arc Welding of Carbon And Carbon Manganese Steel-Specification
IS 816	Code of Practice for use of Metal Arc Welding for General Construction in Mild Steel
IS 822	Code of Procedure for Inspection of Welds
IS 1024	Code of practice for use of welding in bridges and structures Subjected to dynamic loading
IS 1161	Steel Tubes for structural purposes-Specification
IS 1182	Recommended Practice for Radiographic examination of Fusion Welded Butt Joints in Steel Plates.
IS 1239	Steel Tubes, Tubular and Other Wrought Steel Fittings-
IS 1239	Mild steel tubes, tubular and other wrought steel fittings-Part
IS 1363	Hexagon Head Bolts, Screws and Nuts of Product Grade ‘C’
IS 1367	Technical Supply Conditions for Threaded Fasteners (All Parts)
IS 1395	Low and medium alloy steel covered electrodes for manual metal Arc welding
IS 1852	Rolling and Cutting Tolerances for Hot Rolled Steel Products(4th Rev)
IS 2062	Hot Rolled low, medium and High tensile structural steel
IS 2595	Code of Practice for Radiographic Testing
IS 3502	Steel Chequered Plates-Specification.
IS 3600:	Method of testing fusion welded joints and weld metal in steel (All parts)
IS 3658	Code of Practice for Liquid Penetrate Flaw Detection
IS 3757	Specification for High Strength Structural Bolts
IS 4000	Code of Practice High strength bolts in Steel Structures
IS 4260	Recommended practice for ultrasonic testing of butt welds in Ferritic steel.
IS 4353	Submerged arc welding of mild steel and low alloy steels – Recommendations
IS 5334	Magnetic Particle Flaw Detection of Welds-Code of Practice
IS 6639	Specification for Hexagon Bolts for Steel structures
IS 7215	Tolerances for Fabrication of Steel Structures.
IS 9595	Metal Arc Welding of Carbon and Carbon Manganese Steels-Recommendations
IS 12778	Hot rolled parallel flanged section for beams, columns

SP:6(1) Structural Steel Sections.
AWS D1.1 Structural Welding Code: Steel

REGULATORY REQUIREMENTS:

The work covered in this specification, shall comply with all relevant government and local laws, regulations and standards. For subjects not covered by regulations, codes, standards or specifications, the materials and construction shall be based on good engineering practice, subject to approval by OWNER.

4.3 STEEL MATERIALS

Steel materials shall comply with the specifications laid down under clause 2.0 and/or as called for on the design drawings. All materials used shall be new, unused and free from defects.

4.4 STEEL SUPPLY – BY OWNER

4.4.1. The CONTRACTOR shall use steel supplied by the OWNER judiciously and to the best advantage so as to minimize splicing and wastage. All steel materials remaining after completion of the work, whether in the form of balance pieces or unutilized prime steel, shall be returned to the OWNER's stores by the CONTRACTOR at his own cost. Reconciliation of steel supplied and wastage will be as specified in the Contract.

4.4.2. Structural steel materials will be issued in sizes as received from manufacturer / suppliers within the project area at the departmental stores free of cost or at the rates specified in the Contract. The CONTRACTOR shall make necessary arrangements for carriage, loading, unloading of all materials to work site at his own cost within the rates quoted and agreed for the job.

4.4.3. On receiving each consignment of steel from the OWNER the CONTRACTOR shall acknowledge in writing the receipt thereof giving full particulars of sections, sizes, quantities, grade and quality. Should there be any damage or distortion of the materials in transit, the CONTRACTOR shall immediately report the matter to the ENGINEER in writing.

4.4.4. The CONTRACTOR shall take proper care of the steel supplied by the OWNER and protect them from weathering and damage. Any such materials rendered unserviceable or damaged while in the CONTRACTOR's custody shall be replaced by the CONTRACTOR at his own cost as determined by the ENGINEER.

4.4.5. In cases where after receipt of visibly good tested quality steel from the OWNER, defects such as laminations, seams, tears, fins etc are discovered during fabrication, the work on such sections shall be stopped immediately and the matter shall be brought to the notice of OWNER who shall arrange for replacing the affected sections, if necessary.

4.4.6. CONTRACTOR shall use the materials as issued by the OWNER to fabricate the structures as required. No extra claim on account of extra welding and / or cutting resulted

due to non-conformity of sizes with the drawings issued will be entertained.

4.4.7. Steel required for the work will be issued to the CONTRACTOR on the basis of approved fabrication drawings and drawings released for construction.

4.4.8. Steel will be issued to the CONTRACTOR on the basis of standard sectional weights and measured lengths rounded off to nearest 5mm with Unit weights given in BIS 808. For sections and weights not covered in IS:808, unit weights as given by the manufacturers shall be considered for calculation of weight. The same unit weight shall be used in the BOM included in fabrication drawings.

4.5. STEEL SUPPLY – BY CONTRACTOR.

4.5.1 All steel and other material shall be procured and supplied by the CONTRACTOR, from the reputed manufacturers as mentioned in tender document. Steel proposed to be procured from other manufacturers shall have prior approval from the OWNER before placement of procurement order. However, OWNER reserves the right to accept or reject material from other manufacturers. Materials from re-rollers will not be accepted. Steel procured shall conform to the applicable codes & standards mentioned in clause 2.0.

4.5.2 CONTRACTOR shall use materials for fabrication as specified in the approved drawings. All materials supplied by the CONTRACTOR shall be in sound condition, of recent manufacture, free from defects such as mill scales, slag intrusions, laminations, pitting, flaky, rust etc. and be of full weight and thickness as specified.

4.5.3 CONTRACTOR shall furnish the mill / manufacturer's test reports, along with the materials and satisfactorily demonstrates the specific grade and quality. Material test certificate shall be original.

4.5.4 All materials required for the work shall be correlated with manufactures test certificates. In the absence of test certificates, CONTRACTOR shall test materials through reputed laboratory approved by ENGINEER for establishing quality, at CONTRACTOR's cost and as directed by the ENGINEER.

4.5.5 Material supplied against this Test Certificates (TC) should have identification stamped or stenciled on them. All such identification markings shall be authenticated by the inspection agency, which has inspected and approved the material.

4.5.6 The CONTRACTOR shall furnish to the ENGINEER duplicate copies of all purchase order copies covering the material ordered by him for the project under reference and also test reports.

4.5.7 The ENGINEER shall have the right to test random samples to prove authenticity of The

test certificates produced by the CONTRACTOR at the CONTRACTOR's cost. Any material found not meeting the required specification would be rejected.

4.5.8 Whenever the CONTRACTOR desires to substitute structural members / shapes, plates for the sizes shown on the drawings, for want of availability of requisite materials, such substitutions shall be made only after authorization in writing by the ENGINEER. ENGINEER may also direct that substitution be made, when he considers such substitution to be necessary.

4.6 DRAWINGS.

4.6.1 ENGINEER'S DRAWINGS (OWNER'S DRAWING)

4.6.1.1 Engineer will issue to CONTRACTOR such drawings and data as specified in Contract which may include, depending on Contract:

a) Preliminary Drawings and Data along with Tender / Enquiry.
b) Interface particulars with other Contracts and
c) Detailed engineering design drawings in OWNER's Scope.

4.6.1.2 Design drawings will be furnished to the CONTRACTOR and all drawings so furnished shall form a part of this specification. These design drawings prepared by the ENGINEER will show all the, levels, forces on members where necessary, size and orientation of each member, location/size of openings, to enable the CONTRACTOR to prepare drawings for fabrication and erection. It shall be clearly understood that ENGINEER's drawings are design drawings and are not intended to show connection details, thickness of gussets, cuts, notches, bends and other such details.

4.6.1.3 Drawings of structures and systems engineered by ENGINEER or Others will be made available to CONTRACTOR, progressively before commencement of respective parts of works correlating with actual progress of works ensuring that there is no delay for want of drawings. CONTRACTOR shall intimate in writing, his projected date of requirement of drawings. The Schedule of release of drawings shall be mutually agreed to, based on project schedules, unless such dates of drawing release are specified in Contract.

4.6.1.4 Engineer reserves the right to make changes, revisions to drawings, even after release for preparation of shop drawings, to reflect additional data/details received and updated requirements. Revisions to drawings and any new drawings made to include additional work by the OWNER shall be considered as part of this specification and contract without additional cost implication to the OWNER. The OWNER shall not entertain any extra claims on this account.

4.6.1.5 In case of variations in drawings and specifications, the decision of the ENGINEER shall be final. Should the CONTRACTOR find discrepancies in the information furnished by

the Engineer, he shall refer these to the ENGINEER before proceeding with such work.

4.6.1.6 Unless otherwise specified, the drawings and specifications are intended to include everything obviously requisite and necessary for proper and entire completion of the work and shall be carried out accordingly for completeness as required.

4.7 CONTRACTOR'S DRAWINGS (FABRICATION DRAWINGS)

4.7.1 Fabrication drawings shall be prepared by the CONTRACTOR or through an agency approved by ENGINEER at his own cost based on the ENGINEER's Design drawing "Released for Construction" and their subsequent revisions. All the drawings for the entire work shall be prepared in metric units. The drawings shall preferably be of one standard size and the details shown there in shall be clear and legible. Drawings shall be prepared in computer tools and the details shall be drawn to the minimum scale as specified under.

a) Marking Plan : 1:75
b) Joint Details : 1:5; 1:10; 1:15
c) Elevations: 1:20

4.7.2 CONTRACTOR shall not commence detailing unless ENGINEER's design drawings are officially released for preparation of shop drawings. The CONTRACTOR shall be responsible for the correctness of all fabrication drawings. Fabrication drawings shall be revised by the CONTRACTOR to reflect all revisions in design drawings as and when such revisions are made by the ENGINEER.

4.7.3 Key plan prepared by the CONTRACTOR shall indicate the fabrication / erection marking of each members and a table showing the corresponding fabrication drawing number where these members are detailed. Also each drawing prepared by CONTRACTOR shall indicate corresponding ENGINEER's design drawing number with revisions.

4.7.4 Each member shall be detailed separately unless members are identical in all respects with no deviation whatsoever. Shop detail drawings shall show all shearing, punching, drilling, bevel cutting, bending, and all welding in complete detail. All connections and splices shall be designed and detailed by the CONTRACTOR and clearly shown on the drawings. Bill of material shall show number, size, length, weight and assembly work of each erection piece. Bill of material for each drawing shall include fasteners/bolts, nuts, washers and other accessories complete with specification, size, length, numbers, etc for each erection mark and proper identification for each joint. Bill of material shall be prepared erection mark wise, showing weight of each component part and total weight of each erection mark. All revisions after initial issue of a drawing shall be clearly indicated with issue number and date of revision.

4.7.5 Each drawing prepared by the CONTRACTOR shall clearly indicate Names of OWNER, ENGINEER, CONTRACTOR, Project Title, Title of drawing, Scale, Notes, Details of

revisions carried out etc; All titles, noting, markings and writings on the drawing shall be in English and all dimensions shall be in metric units. Before the commencement of preparation of fabrication drawings, CONTRACTOR shall discuss with the ENGINEER any specific requirement to be followed for fabrication drawing preparation.

4.7.6 No detailed shop drawings will be accepted by the ENGINEER unless they are complete and checked and approved by CONTRACTOR's qualified Structural ENGINEER and accompanied by an erection plan showing the location of all pieces detailed.

4.7.7 CONTRACTOR should check for erection clearance and ensure that detailing of connections is carefully planned to obtain ease in erection of structures including field-welded connection and bolting. Field connections/splices may be welded or bolted type as specified in design drawings.

4.7.8 CONTRACTOR shall submit design calculations for each and every connection detail proposed by him and also for any substitution for members, desired by him and approved by the ENGINEER. Fabrication drawings not accompanied by calculation for connection details are liable for rejection.

4.7.9 Each lot of drawings sent by CONTRACTOR for approval shall contain a limited number of drawings and shall be in an order and manner which follows erection sequence or as required by ENGINEER based on priorities allocated. ENGINEER will return one copy of CONTRACTOR's drawing marked with ENGINEER's approval/comments. CONTRACTOR shall furnish the ENGINEER the required number of prints of all approved drawings for field use and record purpose.

4.7.10 In addition to standard engineering practice in detailing the following special requirements shall be strictly followed while detailing.

a) All butt welds shall be full penetration butt weld.
b) In the case of main columns fabricated out of plates, the weld connecting flanges and web to the base plate shall be double vee butt welds.
c) At column bases, wing plates shall be connected to the column flanges by full strength single vee butt weld.
d) In the case of column, the thickness of the continuous fillet weld between flanges and web shall be a minimum of ½ the web thickness, unless a thicker size weld is specified in the design drawings.
e) Shop splice location for flanges and web of columns shall be staggered by at least 500 mm such that only one full strength butt weld exist in one horizontal plane. Full strength butt weld for flanges shall be of single vee type and full strength butt weld for web shall be of double vee type.
f) Where the thickness of plates changes, in the case of flange plates, outside surface shall be kept flush. The thicker plate shall be chamfered to slope of 1 horizontal to 5 vertical so that at the location of weld thickness of plate will be same on either side of weld. In the case of webs at the location where the plate thickness changes, the plates will be kept symmetrical to the vertical

axis: the thicker plates shall be given a chamfer on both sides such that at the location of butt welds, thickness of plate on either side will be equal.

g) Similarly where the width of the flange plate changes, the wider plate shall be tapered with a slope 1 horizontal to 5 vertical.

h) Site splicing may be by welding or by means of high tensile bolts. In the case of welded connection, efficiency of field butt weld shall be considered as 50% and cover plate shall be designed for 50% of the tensile strength of the plates spliced.

i) In the case of framing beams, the weld between flange and web shall be calculated based on standard formula considering the shear force as the full shear capacity of the web. Continuous weld shall be provided keeping size of weld uniform for the full length of girder.However, is no case the size of weld shall be less than half the web thickness.

j) Weld between flanges and web both for column as well as beams, shall be made using automatic welding machines, with proper sequence of welds to avoid warping.

k) Connection of bracings /tie beams to column shall follow the details given in the design drawings. Where such details are not given, the connection shall be designed for 50% of the tensile strength of the member unless design drawings indicate a higher load in the member.

The maximum size of the weld shall be less than or equal to the thickness of the rolled section at the location of connection.

l) Weld between flanges and web both for column as well as beams, shall be made using automatic welding machines, with proper sequence of welds to avoid warping.

m) Thickness of gusset plates shall be at least equal to the thickness of member connected and shall have adequate cross section to transfer the force at the point. If the members are connected on either side of gusset, thickness of gusset shall be more than sum of thickness of fillet weld on either side of gusset.

4.7.11 ENGINEER may review / approve the fabrication drawing at his option some, all or none of the fabrication drawings. Wherever such review is carried out the same shall be restricted to the following.

a) Review/ approval of the size of members, dimensions and general arrangement but shall not constitute approval of the connections between members and other details.

b) Correctness of overall dimensions, centre to centre distance, elevations. Important / typical connection details (adequacy of number of bolts / weld length for few connections only will be checked), working points for bracing members and orientation and sizes / sections of members.

c) Sequence of erection in the light of project requirements.

d) Whether the fabrication drawings broadly conform to details shown on design drawings and comply with technical specifications, general notes, any specific notes made on design drawings and generally with the requirement of good engineering practice.

4.7.12 It shall be clearly noted by the CONTRACTOR that even where review is done by the ENGINEER, the following shall be the sole responsibility of the CONTRACTOR.

a) Provision for erection.

b) Marking of members.

c) Cutting Lengths of members

d) Matching of Joints and holes

e) Provision kept in the member for all other interconnected members
f) Bill of materials.
g) Gusset sizes.
h) Connections

4.7.13 Approval by ENGINEER of any of the fabrication drawings shall not relieve the CONTRACTOR from the responsibility for correctness of engineering, design of connections, workmanship, and fit of parts, details, material, errors or omissions of any and all work shown thereon. ENGINEER's approval shall not invalidate any claim for damages of any kind for incorrectly detailed / fabricated steel, notwithstanding any approval of such drawings by ENGINEER.

4.7.14 On completion of fabrication and erection, the CONTRACTOR shall update his fabrication drawings, incorporating all site changes and substitutions and shall submit two (2) sets of hard copies of such "as built " drawings to OWNER for record purpose. The CONTRACTOR shall also furnish two sets of soft copies of all final approved Contractor's drawings in the form of CDs.

4.7.15 Time consumed by the CONTRACTOR in securing approval of drawings should not be added to the time allowed for completion of contract. A period of two (2) weeks from the dates of receipt of drawings by the ENGINEER should be anticipated for this item of procedure in the schedule.

4.7.16 All these fabrication drawings submitted by the CONTRACTOR will remain the property of the OWNER. OWNER reserves the right to use them in any manner whatsoever.

4.8. FABRICATION

4.8.1 GENERAL

4.8.1.1 Fabrication shall not be started until CONTRACTOR has received copies of such drawings upon which ENGINEER has endorsed his approval. Any work done prior to approval of CONTRACTOR's fabrication drawings will be at the CONTRACTOR's risk. The CONTRACTOR shall make such changes in the design when so directed, which are considered necessary to make the structures conform to the provisions and intent of the specifications, without any additional cost to the OWNER.

4.8.1.2 All workmanship and finish shall be of the best quality and shall conform to good engineering practice and the best-approved method of fabrication. All materials shall be finished straight and shall be machined / ground smooth, true and square where so specified.

4.8.1.3 All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Standard

fabrication clearances as detailed in the American Institute of Steel Construction Manual / BIS Codes shall generally be followed unless otherwise directed / approved.

4.8.1.4 Materials at the shop shall be kept clean and protected from weather. Cutting, punching, drilling, welding and fabrication tolerances shall be generally as per relevant Codes and Standards. In addition the CONTRACTOR shall strictly adhere to the following.

a) All care should be taken to avoid undue welding distortions.
b) Complete layout shall be prepared and got approved by the ENGINEER before actual fabrications are started. If needed mock-ups may also be prepared.
c) All fit ups shall be got approved from the ENGINEER.

4.8.2 CONNECTIONS

4.8.2.1 All shop connections shall be welded unless otherwise specified in ENGINEER's design drawing. Field connections can be either welded or bolted and as shown in design drawings. Bolts used for erection shall conform to IS-6639 and as specified in the design drawings. Bolts used for permanent connections shall be high strength tensile bolts and shall conform to grade 'C' as per IS:1363 and property class 8.8 (minimum) as per IS:1367 or as indicated in design drawings.

4.8.2.2 All connections shall be designed for forces indicated on the design drawings or as specified elsewhere in the specification/standard drawing if not given in the design drawings. The CONTRACTOR shall be responsible for selection of standard connections from AISC Manual of Steel Construction or any other standards approved by ENGINEER.

4.8.2.3 All connections shall be designed and detailed as per guidelines given in IS800 code.

4.8.2.4 In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. In case of high strength friction grip bolts, hardened washers are used under the nuts or the bolt heads whichever are turned to tighten the bolts. The length of the bolt shall be such that at least one thread of the bolt projects beyond the nut, except in case of high strength friction grip bolts where this projection shall be at least three times the pitch ofthe thread.

4.8.2.5 In all cases where bearing is critical, the unthreaded portion of bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

4.8.2.6 Not more than one shop splice shall be provided to make up the full length of a member. Shop splices to make the full member lengths shall be of full penetration butt welded type and radiographically tested.

4.8.2.7 Transportation or the CONTRACTOR's erection methods may require additional splices not shown on the drawings. The CONTRACTOR shall be responsible for the design and detailing of such splices or joints, and shall submit these for the ENGINEER's approval.

4.8.2.8 All bolts, nuts, screws, washers, electrodes, etc. shall be supplied / brought to site 10% in excess of the requirement in each category and size. Rates shall cover the cost of this extra quantity and no additional payment will be made for this extra quantity supplied.

4.8.2.9 All members likely to collect rain water shall have drain holes provided.

4.8.3 STRAIGHTENING

4.8.3.1 Rolled material, before being worked, shall be straightened, unless otherwise specified. If straightening or flattening is necessary, it shall be done by methods that will not injure the material. Long plates shall be straightened by passing through a mandrel or leveling rolls and structural shapes by the use of mechanical or hydraulic bar/section straightening machines. Heating or forging shall not be resorted to without the prior approval of the ENGINEER in writing. In case of site fabrication, CONTRACTOR shall obtain ENGINEER's approval in writing on the straightening method proposed to be adopted before commencing the work.

4.8.3.2 Checking of the straightness of the structural members like angles, channels, beams etc. shall be done by using the thread. For checking of the straightness of the column sections piano wire shall be used. The sections, which are twisted beyond repairs, shall not be used for fabrication. Heating or hammering shall not be permitted. After removal of bends structural members shall be submitted for inspection and approval of ENGINEER.

4.8.4 CUTTING

4.8.4.1 Cutting may be done by shearing, cropping, sawing or machine flame cutting. All re-entrant corners shall be shaped notch free to a radius of at least 12-mm. Sheared or cropped edges shall be dressed to a neat workmanlike finish and shall be free from distortion and burrs.

4.8.4.2 Hand flame cutting shall be undertaken, only if so permitted by the ENGINEER and shall only be carried out by an expert in such work. Hand flame cut edges shall be ground smooth and straight.

4.8.4.3 Edges of flange cover plates and plates used to form any sections shall be ground smooth.

4.8.5 PUNCHING AND DRILLING

4.8.5.1 Holes in secondary members such as Purlins, grits, lacing bars etc. may be punched full size through material not over 12 mm thick. Holes should be clean cut, without burr or ragged edges. Holes for all other connections shall be drilled accurately and the burrs removed effectively. Where several parts are to be connected to very close tolerances such parts shall be first assembled, tightly clamped together and drilled through.

4.8.5.2 Sub-punching may be permitted before assembly, provided the holes are punched 3 mm smaller in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall not in such cases exceed 16 mm.

4.8.5.3 When match drilling is carried out in one operation through two or more separate parts, these parts shall be separated after drilling and the burrs removed.

4.8.5.4 Holes for turned and fitted bolts shall be drilled to a slightly smaller diameter and reamed to a diameter equal to the nominal diameter of the shank or barrel subject to tolerance specified in IS: 919.

4.8.5.5 Where reamed members are taken apart for transporting or handling, the respective pieces reamed together shall be so marked that they may be reassembled in the same position in the final setting up. No interchange of reamed parts will be permitted. Poor matching, over drilling and ovality in holes shall be a cause for rejection. Burning holes with gas is strictly prohibited.

4.8.5.6 Holes may be required to be drilled by the CONTRACTOR at no extra cost at site for installing equipment or steel furnished by other agencies. The information for this will be supplied to the CONTRACTOR by the ENGINEER before or after erection of the steel. Holes should be by drilling or other machining process and not by gas cutting sets.

4.8.6 ROLLING AND FORMING

Plates,Channels, Rolled Steel joists etc., for circular bins, bunkers, hoppers, gantry girders, etc., shall be accurately laid off and rolled or formed to required profile/ shape as called for on the drawings. Adjacent sections shall be match-marked to facilitate accurate assembly, welding and erection in the field.

4.8.7 GRINDING:

Column ends bearing on each other, resting on base plates, compression joints designed for bearing, base plates coming in contact with column end and cap plate shall be ground smooth to ensure 90% contact with local gap not exceeding 0.10 mm (filler gauge shall be used to check this gap). Bottom edge of knife edge support (bearing stiffener) for crane girder and top of cap plates where the knife edge supports rest shall also be accurately ground as abobe. All ground surfaces shall be protected from dirt and mechanical damages till the assembly is completed. However the underside of base plate bearing on grout need not be machined.

4.8.8 WELDING

4.8.8.1 Before the start of the work, welding procedure shall be submitted to ENGINEER for approval. Welding shall be entrusted to only qualified and experienced welders who shall be periodically tested and graded as per relevant standards.

4.8.8.2 Welding procedure specification (WPS) shall be established and Qualification of weld procedure (QWP) shall be done as per approved standards. Welders employed shall also be qualified as per above standards prior to taking up fabrication. CONTRACTOR shall obtain approval from ENGINEER before the start of the work.

4.8.8.3 Following pre-qualified welding process shall be employed for fabrication, erection and repair and the same shall have the approval of ENGINEER before adopting the welding process on the job.

a) Submerged Arc Welding (SAW).
b) Shield Metal Arc Welding (SMAW).
c) Gas Metal Arc Welding (GMAW).
d) Gas Tungsten Arc Welding (GTAW)

4.8.8.4 All welds shall be free from defects like blowholes, lack of penetration, undercutting, cracks etc. All welds shall be cleaned of slag or flux and show sections, smoothness of weld metal, featheredges without overlap and freedom from porosity.

4.8.8.5 50mm on either side of the surfaces on which weld metal is to be deposited shall be smooth, uniform, free from fins, tears,burrs,cracks and absolutely free from grease, paint, loose scale, moisture or any other substance which would adversely affect quality and strength of weld.

4.8.8.6 Machining, thermal cutting or grinding may be employed for joint preparation or removal of unacceptable work or metal. The weld edges shall be smooth & regular surface, free from cracks & notches. Flame cut material above 50mm thick shall be pre-heated as per relevant standards prior to flame cutting and shall be subjected to ENGINEER's approval.

4.8.8.7 All weld fit-up shall comply with tolerances specified in the relevant standards. The parts to be joined by fillet welds shall be brought into close contact as practicable and within the tolerable limits as per relevant codes & standards. 6.8.8 All tack welds shall be made using qualified procedure and qualified welders. Any preheat requirement specified in the welding procedure shall also apply to tack welds. All tack welds shall be examined visually for defects and if found defective, shall be removed and re-welded. Throat thickness, leg length and length of tack weld shall be as per IS:9595.

4.8.8.9 Welding of temporary attachment/fixtures to retain fit up is permitted in case the parts have a nominal thickness of at least 10 mm. Temporary attachments are welded at the

minimum distance of at least 50 mm from the weld seam. Welding of temporary attachments/fixtures into the joint slot is not allowed. All temporary fixtures shall be removed after welding, by grinding them to weaken the welded portion and hammering thereafter followed by grinding the portion of any weld remaining on the base metal. A dye check at the discretion of the quality surveyor shall be done to detect any crack/defect at the point of fixture temporary weld.

4.8.8.10 It is not allowed to turn over and carry over heavy assemblies in tacking condition in order to control the geometric dimensions to the requirements of the drawings. The work shall be positioned for flat welding wherever practicable and overhead weld shall be avoided as far as possible.

4.8.8.11 In the joints of the parts with dissimilar thickness smooth transition of one part to the other must be provided by way of the gradual decreasing of the thickness of the thicker part with the slope of the surface not exceeding 15 degree.

4.8.8.12 Welding shall not be done when the surface of the members are wet or exposed to rain or high wind velocities unless the welding operator and the work are properly protected.

4.8.8.13 In joints connected only by fillet welds, the minimum size of fillet weld to be used shall be as per IS 9595-1996.

4.8.8.14 Welds shall be defect free and surfaces shall be thoroughly cleaned to remove all visible weld defects and extra material.

4.8.8.15 For all built up sections such as Columns, Crane Girders etc welding between web and flange plates shall be carried out by SAW process. Especially for butt welds of Crane girders full penetration of weld between top of web plate and top flange shall be ensured. Welding shall be continuous and shall be on both sides of the connecting member. One side fillet weld is not acceptable.

4.8.8.16 In general all welding shall be performed as per the recommendation specified in IS:9595-1996.

4.8.8.17 Pre-heating and Post weld Heat treatment shall be carried out as per the acceptable standards and procedure and shall have prior approval from the ENGINEER. The pre-heat and inter pass temperature shall be checked just prior to initiating the arc for each pass. The weld joint details and procedure for Pre-heating and Post heating shall be submitted by the CONTRACTOR for approval from ENGINEER.

4.8.9 WELDING CONSUMABLES.

4.8.9.1 Electrodes, filler wires and flux used for welding shall be from approved manufacturers/Suppliers. CONTRACTOR shall submit the list of Electrode manufacturers proposed to be procured to the ENGINEER for approval. The CONTRACTOR shall furnish certification that electrode or electrode flux combination will meet the requirements of classification. The classification and size of electrode, arc length, voltage & amperage shall be suited to type and thickness of material, type of groove, welding positions and other circumstances attending work.

4.8.9.2 Only low hydrogen electrodes shall be used for welding. All electrodes having low hydrogen covering shall conform to relevant acceptable standards. These electrodes shall be purchased in hermetically sealed containers or baked by the user as recommended by electrode manufacturer. Electrode flux coating shall be sound and unbroken. Broken or damaged coating shall cause the electrodes to be discarded. Before welding, the electrodes shall de dried in a holding oven at 120OC at least for one (1) hour or as per manufacturer's recommendations. Only limited quantity shall be issued to the welders. The electrodes shall be kept in "carry ovens" and shall not be exposed to the atmosphere.

4.8.9.3 Welding plants and accessories shall have capacity adequate for welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality. CONTRACTOR shall furnish and obtain approval from ENGINEER the details of equipment he proposes to deploy for the works. All the electrical plant in connection with the welding operation shall be properly and adequately earthed and adequate means of measuring the current shall be provided. Proper safety rules shall be strictly followed.

4.9 TESTING, INSPECTION AND REPORTS

4.9.1 GENERAL.

4.9.1.1 On award of work, the CONTRACTOR shall submit to ENGINEER, his Field Quality Plan (FQP), outlining the types, details and extent of inspection he proposes to execute, covered in the rates quoted for various items of work.

4.9.1.2 CONTRACTOR shall give due notice to ENGINEER in advance of the materials or workmanship getting ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for ENGINEER's approval / inspection. The fact that certain material has been accepted at CONTRACTOR's shop shall not invalidate final rejection at site by ENGINEER if it fails to conform to the requirements of these specifications, be in proper Condition.

4.9.1.3 No material shall be painted or dispatched to site without the inspection and approval by ENGINEER unless such inspection is waived in writing by the ENGINEER.

4.9.1.4 Shop inspection by ENGINEER or submission of test certificates and acceptance thereof

by ENGINEER shall not relieve CONTRACTOR from the responsibility of furnishing material conforming to the requirements of these specifications, nor shall it invalidate any claim which the ENGINEER may make because of defective or unsatisfactory material or workmanship.

4.9.1.5 CONTRACTOR shall provide all the testing and inspection services and facilities for shop work except where otherwise specified. CONTRACTOR's inspection work shall be under the control of competent Chief Inspector whose primary responsibility is inspection (reporting to Management) and not to production department.

4.9.1.6 For fabrication work carried out in the field, the same standard of supervision and quality control shall be maintained as in shop fabricated work. The inspection and testing shall be conducted in a manner satisfactory to ENGINEER. The inspection and testing on structural steel members shall be as set forth below:

4.9.2 MATERIAL TESTING.

4.9.2.1 All materials conforming to a particular Indian or any other standard as called for shall be tested as required by such standard. Proof in the form of certified test reports or mill certificates indicating that the required tests have been carried out as per specification at the source is acceptable.

4.9.2.2 If mill test reports are not available for any steel materials, the same shall be got tested by CONTRACTOR to ENGINEER's satisfaction to demonstrate conformity with the relevant specification at his own cost.

4.9.2.3 Raw material with cracks, seams, laps, lamination and heavy pitting are not acceptable. Ultrasonic testing of plates above 50 mm thick shall be carried out for the soundness of material.

4.9.2.4 Engineer has option to specify additional inspection or testing as he deems necessary and the additional cost of such testing shall be borne by the CONTRACTOR.

4.9.2.5 The CONTRACTOR shall maintain records of all inspection and tests, which shall be made freely available to the ENGINEER and shall be submitted to the ENGINEER on completion of each stage of work.

4.9.3 TESTS ON WELDS

4.9.3.1 All welds shall be tested for flaws by any of the methods described under. The choice of the method adopted shall be determined by the OWNER. Following methods are generally recommended for the quality control of welded joints:

4.9.3.2 Magnetic Particle Test(MPT): All fillet welds in general structural steel work shall have their final passes fully tested by MPT. However, for fillet welds of size 10mm and above and /or critical areas, the root and final passes shall be tested using MPT. The ENGINEER shall however decide the requirements of this additional testing. For Complete penetration butt welds, the root and final passes shall be tested using MPT. All MPT shall be as per relevant acceptable standards. Defects if found, shall be repaired and retested. MPT shall be carried out using alternating current only. Direct current may be used with the permission of the ENGINEER. The cost of demagnetizing after testing is deemed to be included in the quoted rates of the CONTRACTOR.

4.9.3.3 Dye Penetrant Test (DPT): MPT may be substituted by Dye Penetrant Inspection where the former is not feasible due to configuration. The testing should be in accordance with relevant acceptable standards.

4.9.3.4 Radio-graphic Inspection (RT): All completed full penetration butt welds to a length of about 10% shall be radio-graphed as per ENGINEER's directive in accordance with the relevant acceptable standards. In case of crane girders 100 percent of the splicing shall be inspected by RT. In the case of hoppers of coal bunkers at least 10% of the circumferential as well as seam welds shall be inspected by RT.

4.9.3.5 Ultrasonic Testing (UT): Wherever built up sections for crane runway girders are fabricated, the T-joints of the sections shall be subjected to ultrasonic testing. 100 percent length of the seam as well as circumferential welds of hoppers of coal bunkers shall be inspected by UT.

4.9.3.6 Acceptance Standard: The acceptable standards for various weld tests shall be as per ASME Sec VIII- Div I or relevant acceptable standards.

4.9.4 INSPECTION OF WELDS.

4.9.4.1 Welding shall be carried out as per approved WPS and QWS by qualified welders.

4.9.4.2 All welds shall be inspected for flaws by any of the methods described under clause 7.3 the choice of the method adopted shall be determined by the ENGINEER.

4.9.4.3 The correction of defective welds shall be carried out as directed by the ENGINEER without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means as prescribed by the ENGINEER shall be used to ensure that the whole of the crack and material up to 25 mm beyond each end of the crack has been removed. Cost of all such tests and operations incidental to correction shall be to the CONTRACTOR's account.

4.9.4.4 CONTRACTOR shall perform the following minimum tests on welds if not covered in

clause 7.3.2 to 7.3.5 above, with no cost implication to the OWNER. CONTRACTOR's quoted rate is deemed to have included the cost of such tests.

SL NO	Location & Type of weld	Type of Test	Extent of test	Remarks
1	All fillet welds in general other than those covered under the Sl no 2 ,3,5,7 & 8	DPT	1% of fillet weld with minimum of one test on each member / joint	
2	Fillet welds for plate thickness greater than 25 mm and fillet size more than 10mm	MPT / DPT	10%	
3	Flame cut edges of plates more than 38 mm for fillet weld.	MPT / DPT	100%	
4	Flame cut edges of plates greater than 25 mm for butt welds,	MPT / DPT	100%	
5	Fillet welds between tension flanges and webs	MPT / DPT	100%	
6	Full penetration butt welds	DPT	100 %	DPT shall be carried out after back gouging
7	Fillet Weld greater than 12 mm on flame cut edges of low alloy steel	MPT	100%	
8	Fillet Welds for built up girders, columns and other heavy structures for penetration.	Macroetchtest	One (1) test Per structure for penetration	
9	Butt welds of thickness greater than 25 mm and less than 32 mm	MPT / DPT	100%	

10	Butt welds of thickness greater than 32 mm	RT	100%	
11	Butt welds of rolled sections having depth greater than 600 mm	RT	100%	

4.9.4.5 In addition to the minimum tests to be conducted by the CONTRACTOR, ENGINEER reserves his right to direct the CONTRACTOR to conduct additional tests. The extent, type and location of test shall be decided by the ENGINEER. These additional tests shall be conducted by the CONTRACTOR or through an approved agency in presence of the ENGINEER. If the test fails, the cost of that test shall not be payable to the CONTRACTOR. The tests which when successful will be paid for at the rates specified in the schedule.

4.9.4.6 WELD DEFECTS AND ACCEPTABLE CRITERIA

Type of defect	Acceptance Criteria	Remarks
Cracks	Not acceptable	
Incomplete or lack of Fusion	Not acceptable	
Mis-alignment of butt welds	0.25 x T (maximum of 3 mm)	T: Thickness of thinner plate
Reinforcement	Max reinforcement of 2 mm for t < 10 mm. 3 mm for t > 10mm < 15 mm. 4 mm for 15 mm and greater	
Undercut	0.25 mm deep max	
Sharp edges	Min radius of 2 mm	

4.9.4.7 WELD REPAIRS

Whenever weld repair is required, CONTRACTOR shall give prior intimation to the ENGINEER and obtain permission before the repair is taken up. When a defect is detected in a weld, it shall be removed by cutting / grinding and smooth blending of the area with parent metal without sharp edges, corners. If welding is required, the same shall be done using the

qualified procedure / welder and stage inspection as per the original weld. Correction of defect in the same portion of the weld shall not be allowed more than two (2) times. Portion of the welding seams, which have been subjected to repair, must be indicated in the weld inspection reports.

4.10.0 INSPECTION AND TESTS ON STRUCTURAL STEEL FABRICATED MEMBERS

Inspection and tests on Structural Steel Fabricated Members shall be as set forth below:

4.10.1 All the fabricated parts of Structural Steel members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment and surface finish are in accordance with the requirements shown on the approved CONTRACTOR's shop drawings and/or ENGINEER's drawings.

4.10.2 Fit ups shall be examined by the quality surveyor as per the approved QA plan prior to welding the joint. All welds shall be inspected for flaws by the method described under the Clause 7.4 (Inspection Of welds).

4.10.3 The dimensions of the fit ups shall be maintained as specified in the fabrication drawings.

4.10.4 Dimensions of all the assemblies and sub-assemblies shall be as per fabrication drawings within the tolerances specified in IS 7215.

4.10.5 TOLERANCES

The dimensional and weight tolerance for rolled shapes shall be in accordance with IS:1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerances for fabrication of structural steel shall be as per IS:7215.

4.11 TEST FAILURE

4.11.1 In the event of any failure of welding, structural steel members to meet inspection or test requirements, the CONTRACTOR shall notify the ENGINEER or his authorised representative. A design concession request has to be made and got approved from the ENGINEER or his representative before repair is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by ENGINEER.

4.11.2 CONTRACTOR shall maintain records of all inspection and testing which shall be made available to the ENGINEER or his authorised representative, for three years from the date of completion of the contract.

4.11.3 The ENGINEER has the right to specify additional testing as he deems necessary, and the additional cost of such testing shall be borne by the OWNER only in case of successful testing.

4.12 SHOP MATCHING

For structures like bunkers, tanks, etc. shop assembly is essential. For other steel work, such as columns along with the tie beams/bracings may have to be shop assembled to ensure satisfactory fabrication, obtaining of adequate bearing areas etc. if so desired by the ENGINEER. All these shop assemblies shall be carried out by CONTRACTOR at no extra cost to the OWNER.

4.13 DRILLING HOLES FOR OTHER WORKS

As a part of this Contract, holes in members required for installing equipment or steel furnished by other manufacturers or other CONTRACTORs shall be drilled by the CONTRACTOR at no extra cost to the OWNER . The information for such extra holes will be supplied by the ENGINEER.

4.14 MARKING OF MEMBERS

4.14.1 After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible.

4.14.2 All erection marks shall be on the outer surface of all sections and near one end, but clear of bolt holes. The marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location.

4.14.3 Erection marks on like pieces shall be in identical locations. Members having lengths of 7.0 m or more shall have the erection mark at both ends.

4.15.0 ERRORS

Any error in shop fabrication which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the ENGINEER as defective workmanship. In case ENGINEER rejects such material or defective workmanship, the same shall be replaced by the materials and workmanship conforming to the

ENGINEER’s requirements by CONTRACTOR free of cost at site.

4.16.0 QUALITY SURVEILLANCE

4.16.1 GENERAL.

4.16.1.1 The ENGINEER shall subject all works and materials covered by this specification to Inspection.

4.16.1.2 The CONTRACTOR shall provide free access in his shop during working hours for the inspection staff, designated by the Engineer, at all phases of the work and assist them where necessary in conducting the inspection. The CONTRACTOR shall expeditiously furnish all gauges, instruments and other necessary measuring equipment required for inspection of the work in the shop. The shop inspection by the inspector is intended to ensure that the material and workmanship are in accordance with this specification, but it will not relieve the CONTRACTOR of any of his responsibilities for the product. The inspector's inspection will include, but not be limited to, the following:

4.16.2 MATERIAL

The inspector will ascertain that only materials conforming to the requirements of this specification are used.

4.16.3 DIMENSION AND TOLERANCES

The ENGINEER will ensure and check that the structural members conform to the dimensions and tolerances as set out on the drawings and as required by the specification.

4.16.4 WELDING PROCEDURE

The ENGINEER will witness the welding and testing of any procedure qualification tests that are required by this specification. The ENGINEER will also check that welding procedure (including the electrode, flux, current, arc voltage, speed of travel) used are in accordance with the approved welding procedures.

4.16.5 WELDING EQUIPMENT

The ENGINEER will check the welding equipment to be used for the work to ensure that it is in such condition as to enable qualified welders to follow the procedures.

4.16.6 WELDER AND WELDING OPERATOR QUALIFICATIONS

4.16.6.1 The ENGINEER will permit welding to be performed only by welders and welding operators who are qualified by tests in accordance with relevant standards

4.16.6.2 When the quality of a welder or welding operators' work, appears to be below the requirements, the ENGINEER may require testing of his qualifications by necessary tests.

4.16.7 WELDS

4.16.7.1 The ENGINEER will ascertain that the sizes, length and the location of all welds conform to the requirements of this specification and the approved fabrication drawings. Temporary welds used for the works shall be removed and ground flush with the original surface.

4.16.7.2 The ENGINEER will identify with a distinguishing mark of all parts of the joints that he has inspected and accepted.

4.16.7.3 The CONTRACTOR shall comply with all the demands of the ENGINEER to correct improper workmanship and to remove and replace, or correct as instructed, all welds found defective or deficient.

4.16.7.4 In the event of faulty welding or its removal for rewelding results in damage to the base metal in the judgment of the Engineer, or its retention is not in accordance with the intent of the plans and specification, the CONTRACTOR shall remove and replace the damaged materials at his own cost.

4.17.0 METHOD OF MEASUREMENT

4.17.1 For the purpose of payment, the weight of the actual completed structures shall be calculated from the approved drawings for different items of work. The CONTRACTOR shall submit to the OWNER relevant material list containing weight of each item.

4.17.2 No allowances will be permitted for bolts, nuts, washers, studs, screws etc, galvanizing, welding or for rolling margins. One tonne for the purpose of payment shall mean ONE METRIC TONNE i.e. 1000 Kg. Permanent bolts, however, will be considered for payment against the relevant item under schedule of items..

4.17.3 The weight of a member made out of standard rolled section such as beams, channels, angles, etc. shall be based on the standard IS:808 without deductions for holes, notches, bevel cuts, etc. Where a component consists of a cut rolled sections, the full weight of the rolled section shall be considered only if more than half the depth of the original section is used. Otherwise, only half the section unit weight shall be considered for calculation of the weight of the components. Deductions shall be made in the weight of gussets/plates for cuts and notches of 900 sq. cm. or larger.

4.17.4 For gussets/plates used in trusses, bracings, columns, beams, etc, the area shall be that of the minimum circumscribing rectangle except as stated in 16.3 above. The weight of any built-up members shall be based on the weight of each component.

5.14. PAINTING

5.14.1 After steel has been erected, all bare and abraded spots, field welds, bolt heads and nuts shall be spot painted. Before paint is applied, the surface shall be dry and free from dust, dirt, scale and grease.

5.15 METHOD OF MEASUREMENT

5.15.1 For the purpose of payment, the weight of the actual, completed structures shall be calculated from the approved fabrication drawings for different items of work. CONTRACTOR shall submit to OWNER relevant material list containing weight of each item.

5.15.2 No allowance will be permitted for weights of erection bolts, washers, screws etc. in calculating the weight of the completed structure. No allowances will be permitted for galvanizing, welding or for rolling margins. In the case of field connection with bolts, the bolts along with nuts and washer will be considered for payment against appropriate item in the schedule of prices. One tonne for the purpose of payment shall mean ONE METRIC TONNE i.e. 1000 Kg.

5.15.3 The weight of a member made out of standard rolled sections such as beams, channels, angles, etc. shall be based on the weight of the member given in IS 808, without deducting for holes, notches, bevel cuts, etc. Where a component consists of a cut joist or channel, the full weight of the rolled section shall be considered only if more than half the depth of the section is used. Otherwise only half the section unit weight shall be taken. Deductions shall be made in the weight of gussets/plates including chequered plates for skew cuts, notches and openings of 900 sq.cm. or larger.

5.15.4 For gussets/plates used in trusses, bracings, columns, beams etc. the area shall be that of the minimum circumscribing rectangle, except as stated in clause 15.3 above.

5.15.5 The weight of any built-up member shall be separated into the weight of each component.

5.15.6 Erection bolts installed by erector shall be left in position on completion of erection; however, no additional payment shall be made either for supply or use of such bolts. If erection bolts are removed after erection is complete, holes shall be plug welded and ground smooth. No extra payment shall be made for such plug welding.

5.16 CLEAN UP OF WORK SITE

During erection, the CONTRACTOR shall without any additional payment, at all times keep the working and storage areas used by him, free from accumulation of waste materials or rubbish. Before completion of erection, he shall remove or dispose of in a satisfactory manner all temporary structures, waste and debris and leave the premises in a condition satisfactory to OWNER/ENGINEER.

6.0 PAINTING OF STRUCTURAL STEEL

6.1. SCOPE

6.1.1. This specification covers the general requirements for shop and field painting for Structural Steel works using hot /cold rolled steel sections joined by using bolting and/or welding.

6.1.2. Briefly the scope of works covered under this specification are; i. Supply of all primers, paints and all other materials required for painting other than Owner's supply.

ii. Furnishing of all labor, materials, tools & equipment and the performance of all operations and incidentals necessary for surface preparation, painting, handling, storing, transporting, scaffolding etc.
iii. Testing of paints as per the relevant codes in the Standard Laboratory identified by the Owner and furnishing of required test certificates for Owner's approval.
iv. Repair work of damaged / pre-erection / fabrication shop primer and weld joints at field.
v. Inspection of painting system after its application to conform to the specification requirement.
vi. Any other requirement as required for satisfactory completion of specified work.

1.3. Reference shall be made to Data Sheet-A for Paint system and Data Sheet-B for the structures covered in the scope of works.

6.2. EXCLUSIONS

This specification excludes paintings of the following structures /equipment.

Mechanical & electrical equipment and parts.
i. Buried & Overhead piping works
ii. Storage tanks
iii. Insulated parts
iv. Any other items of work specifically excluded in the scope of works.

6.3. APPLICABLE CODES, STANDARDS

The pertinent clauses of the following Indian / International Codes, Standards and Specification (latest editions including all applicable official amendments, reaffirmations and revisions) shall apply to the material and workmanship covered by this specification. In the event of the conflict of certain requirements between this specification and the codes referred herein, this specification shall govern.
It is not the intent to specify herein all the codes and standards required for the satisfactory completion of work. The list of codes and standards indicates certain primary codes & standards and not all the codes required for the work under the contract. It is understood that all the pertinent codes and standards shall form the part of this specification whether explicitly indicated or not.

6.3.1. Indian Standard Codes

1. IS:5 Colours for ready mixed paints and Enamels

2. IS:101 Methods of sampling and test for paints, varnishes and related products (all parts & all sections).
3. IS:104 Ready mixed paint, brushing, zinc chrome, priming
4. IS:158 Ready Mixed paint, Brushing, Bituminous, Black, Lead free, Acid, Alkali and heat resisting.
5. IS:1303 Glossary of Terms relating to paints
6. IS:1477 Code of practice for painting of ferrous metals in Buildings.
7. IS:2932 Enamel, synthetic, exterior:(a) undercoating (b) finishing-Specification
8. IS: 9954 Pictorial Surface Preparation Standards for Painting of Steel Surfaces.
9. IS:13183 Aluminium paint, Heat resistant-specification.
10. IS:2074 Ready Mixed Paint, Air Drying, Red Oxide Zic Chrome, Priming -Specification.

3.2. International Standard Codes

i. SSPC Society for Protective Coatings (USA) Volt I & II
ii. NACE National Association of Corrosion Engineers, USA(NACE)
iii. ISO 8501 Preparation of Steel Substrates before application of paints and related products. Visual assessment of surface cleanliness.(Part 1&2)
iv. ISO 8502 Preparation of Steel Substrates before application of paints and related products-Tests for assessment of surface cleanliness .(Part 1-4)
v. ISO 8503 Preparation of Steel Substrates before application of paints and related products-Surface roughness characteristics of blast-cleaned steel substrates. Part 1& 2

6.4. HEALTH, SAFETY AND REGULATORY REQUIREMENTS

6.4.1. The work covered in this specification, shall comply with all relevant government and local laws, regulations and standards. For subjects not covered by regulations, codes, standards or specifications, the materials and construction shall be based on good engineering practice, subject to approval by Owner.

6.4.2. CONTRACTOR shall ensure that all health and safety regulations are observed for the erection of scaffolding and use of the selected paint material.

6.4.3. All necessary precautions shall be taken to ensure the safety of personal and property. Extreme caution shall be used when working with oil or oil-based paints, cleaning fluids etc., especially in close proximity to oxygen piping or oxygen equipment. Heavy concentrations of volatile or toxic fumes must be avoided and in confined areas, blowers or exhaust fans shall be used.

6.4.4. Rags and other waste material soiled with paints, thinners or solvents shall be kept in

tightly closed metal containers while on the jobsite and not in use. Legal disposal of waste materials outside plant site premises is Contractor's responsibility.

6.4.5. Lead being hazards material it is recommended to use lead free paint as per requirement of clause 3.6 of IS158.

6.5. SURFACE PREPARATION OF STEEL

One or more of the following methods of surface preparation shall be followed, depending on condition of steel surface and as specified in the data data sheet. ENGINEER reserve the right to instruct the type of surface preparation depending upon the condition of material. Recommended methods of surface preparation of steel briefly are as under.
a) Solvent Cleaning.
b) Manual or hand tool cleaning.
c) Mechanical or power tool cleaning.
d) Abrasive Blast cleaning.
It is necessary that the CONTRACTOR shall have to resort to any one or combination of the above method of surface preparation to achieve the required acceptable standard. Hence the rate quoted shall take into account for such preparation.

6.5.1. SOLVENT CLEANING

All contaminants like oil, grease removal shall be carried out either by special solvents or by degreasing agents. Application and cleaning of solvents shall be as per manufacturer's instructions and shall be in accordance with SSPCSP1.

6.5.2. MANUAL OR HAND TOOL CLEANING

This method of cleaning shall be used to remove all loose mill scale, loose rust, loose paint and other loose detrimental foreign matter by use of nonpowered hand tools. The minimum acceptable standards in case of manual or hand tool cleaning shall be in accordance with ISO 8501- St2 / SSPC-SP2.

6.5.3. MECHANICAL OR POWER TOOL CLEANING

This method of cleaning shall be used to remove all mill scale, rust, paint and other detrimental foreign matter by use of power assisted hand tools. The minimum acceptable standards in case of power tool cleaning shall be in accordance with ISO 8501- St3 / SSPC-SP3.
6.5.4. ABRASIVE BLAST CLEANING (SHOT BLASTING / GRIT BLASTING)
6.5.4.1. Shot / Grit blasting shall be resorted to only after removal of grease, oil and other contaminants as per SP-1. Special care shall be taken on weld areas to remove flux and spatter. Precautions shall be taken when grit or shot blasting of light gauge steel surfaces, to ensure that buckling does not occur due to continuous impingement of grit or steel shots under high velocity. Surface anchor profiles shall be measured by Testex tape – press-o-film and the
finished surfaces shall conform to the requirements of ISO 8501- Sa 2½ / SSPC-SP10.

6.5.4.2. Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceeding 85%.

6.5.5. TESTS ON SURFACE PREPARATIONS

The following inspection and tests shall be performed on the steel surfaces subjected to surface preparation. Test / inspection reports shall be submitted to ENGINEER for his approval and acceptance.

i. Visual examination of surface preparation with comparators.
ii. Profile check of the prepared surface with suitable "profilometer "eg.TESTEX method.

6.6. PAINT MATERIAL

6.6.1. PROCUREMENT

All types of paints required for the work shall be as per the requirement of relevant IS codes and procured from the reputed manufacturers. List of some of the manufacturers are as under. However contractor shall obtain the detailed list of approved paint manufacturers from the ENGINEER before initiating the procurement action.

i. Asian Paints (I) Ltd.
ii. Berger Paints Ltd.
iii. Cipy Polyurethane Pvt Ltd

6.6.2. STORAGE

The Paint material shall be stored strictly in accordance with the instructions of the paint manufacturer. In general painting materials should be stored in dry, cool, well ventilated and frost free area.

6.6.3. PACKING

All paints delivered to the fabrication shop / site shall be in original sealed container, as packed by the manufacturer. Paint containers shall clearly mark with paint manufacturer's name, batch number, date of manufacture, shelf life and a clear indication of the type and colour of the product.

6.6.4. MIXING

Paint shall be thoroughly mixed prior to application. Mixing shall be done in a well-ventilated, clean and dust -free area. Paint shall be mixed by rotating power mixers or rolling rigs, until a uniform consistency is achieved. Multiple pack paint materials shall be mixed in accordance with and under the conditions as specified by the paint manufacturer. Pot life as specified by the paint manufacturer shall be strictly followed.

6.6.5. THINNER AND SOLVENTS

Only additives, thinners, solvent etc as recommended by the paint manufacturer shall be used. A possible extension of the "pot life" by addition of thinners is prohibited.

6.6.6. TESTS ON PAINT

In order to ensure that the supplied paint meets the stipulations, samples of paint shall be tested in laboratories to establish quality of paint with respect to
i. Viscosity.
ii. Adhesion/ bond of paint in steel surfaces.
iii. Adhesion / simulated salt spray test.
iv. Chemical analysis (percentage of solids by weight)
v. Normal wear resistance as encountered during handling & erection
vi. Resistance against exposure to acid fumes etc.
Alternatively manufacturer's test certificates shall be furnished by the Painting CONTRACTOR in respect of above tests for ENGINEER's approval and acceptance. ENGINEER reserves the right to test the paint material either before the commencement of work or during the progress of work if in his opinion the paints supplied are of inferior quality and does not meet the codal requirements.

6.6.7. PAINT SAMPLE

Before buying the paint in bulk, it is recommended to obtain sample of paint and establish "Control Area of Painting". On control area surface preparation, painting shall be carried out in the presence of Engineer and the Manufacturer of paint.
6.8. FINISHING PAINT
Color /Shade of the finishing paint shall be as per the choice of the Owner and Contractor shall obtain prior approval before procurement action is initiated.

6.7. PAINT APPLICATION

Painting shall be carried out by any one or the combination of the following method of application to suit the site condition and the type of paint being used. Manufacturer's recommended method of application shall be strictly followed.
i. Brush Application.
ii. Roller Application.
iii. Spray Application.

6.7.1. BRUSH APPLICATION

Brush application of paint shall be in accordance with the following.
i. Brushes shall be of a style and quality that will enable proper application of paint
ii. Round, Oval or Wide flat brushes shall be used depending upon the surface irregularity, rough or pitted steel, large flat painting areas etc
iii. There shall be a minimum of brush marks left in the applied paint.
iv. Surfaces not accessible to brushes shall be painted by spray.
7.2. ROLLER APPLICATION
Suitable rollers of different nap length to suit varying surface roughness shall be used. Rollers are not generally recommended for application of primers. Roller application shall only be used if the first or priming coat of paint has been applied by brush or other means. Manufacturer's recommendation shall be strictly followed for roller applied paints.

6.7.3. SPRAY APPLICATION

6.7.3.1. Airless or pneumatic spray application shall be in accordance with the following

i. Airless spray application shall be as per steel structure paint Manual Vol 1& Vol 2 SSPC, USA.
ii. Spraying shall be carried out keeping the spray gun at the minimum suitable distance from the work piece and consistently at 90 0 to the surface being painted.
iii. Correct spray tips, air pressures etc as recommended by the equipment supplier shall be adopted.

6.7.3.2. Air spray application shall be in accordance with the following:

i. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges.
ii. Appropriate pressure and nozzles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
iii. Correct combination of air volume, air pressure and fluid flow to give good atomization shall be ensured to get a defect free painted surface.
iv. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
v. Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.
vi. Spray equipment shall be kept sufficiently clean so that dirt, dried paint and other foreign materials are not deposited in the paint film. Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.

6.7.3.3. Selection of type of spray application shall depend upon the type of paint coating being used. At all time paint manufacturer’s recommendation shall be strictly followed.

6.8. COATING PROCEDURE

6.8.1. COMPATIBILITY

General Compatibility between primer, intermediate and top coats, as applicable for individual painting system shall be established through the paint manufacturer supplying the paints. Primer and finishing paint for the entire project shall preferably be procured from the same manufacturer. Mixing of material from different manufacturers is strictly prohibited

6.8.2. Surface shall not be coated in rain, wind, when steel surface temperature is less than 50 C, or when the relative humidity is greater than 85%.

6.8.3. Applied paint system shall be allowed to cure at ambient and surface temperatures between 10 ° C and 60 ° C with relative humidity below 85%. All paint shall be air curing.

6.8.4. A suitable test area (approx 0.5 m2) shall be painted with agreed paint system. The test area shall be fully coated with all coats of the agreed coating system using the tools and equipment to be used for the actual coating work. The painted test area shall be maintained for the duration of the project. Painting on test piece shall be carried out such that all the coats shall be made visible for reference at all time.

6.8.5. Structural steel shall be preferably prime coated at shop and subsequent finish coats shall be carried out at site after the alignment and erection is complete. Portions of structural steel members to be embedded into the concrete shall not be painted.

6.8.6. Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly.

6.8.7. Surfaces inaccessible after erection, including top surfaces of floor beams supporting grating / chequered plate /RC Slabs shall receive one additional coat of finish paint over and above the number of coats specified prior to erection.

6.8.8. Each coat of paint material shall be applied as continuous film uniform thickness free of pores. Any spot or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

6.8.9. Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer’s instruction shall be strictly followed for intercoat intervals.

6.8.10. No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores or detrimentally affect the condition of the paint.

6.8.11. No drier shall be added to paint on the job unless specifically called for in the manufacturer's specification for the paint.

6.8.12. Paint shall be protected from rain, condensation, contamination, snow and freezing until dried to the fullest extent practicable.

6.8.13. Blast cleaned surface shall be coated with one coat of primer before surface degradation occurs but in no case later than 3hrs. Irrespective of the method of surface preparation, the first coat of primer shall be applied not later than 2- 3 hours after preparation and on dry surface.

6.8.14. When the successive coat of the same color is specified, alternate coat shall be tinted as far as practicable; sufficient to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life.

6.8.15. All field welded areas on shop painted item shall be mechanically cleaned (including the weld area proper, adjacent areas contaminated by weld spatter or fumes and areas where existing primer, intermediate / finishing paint is burnt). Subsequently, new primer and finishing coats of paint shall be applied as per painting specification.

6.8.16. Care shall be taken to protect adjacent equipment, piping, structures etc., from spillage and spatter during field painting by use of adequate temporary covers. If surfaces are accidentally spattered or sprayed, the paint shall be immediately and thoroughly removed. For cleaning of spillages an inert absorbent material shall be used

6.8.17. All structures shall receive appropriate number of primer, intermediate and finishing coats in order to achieve overall DFT as per the drawings / specifications/ data sheets.

6.9. PAINTING SYSTEM

The recommended painting system of all Structural Steel Works covering surface preparation, application of Primer coats, Intermediate coats (if specified) and Final coats to develop required minimum DFT shall be as per DATA SHEET-B.

6.10. REPAIR OF COATED SURFACE

6.10.1. Wherever shop primer painting is scratched, abraded or damaged, the surfaces shall be thoroughly cleaned using emery paper and power driven wire brush wherever warranted, and touched up with corresponding primer. Touching up paint shall be matched and blended to eliminate conspicuous marks.

6.10.2. If more than 30% area of the painted surface of an item requires repair, the entire surface shall be repainted. In such an event no extra payment will be permitted.

6.11. **TEST ON PAINTING SYSTEM**

Following inspection and tests shall be performed during and after the application of paint system.

i. Wet film thickness (WFT) spot checks shall be carried out during the course of painting operation to ensure that film thickness is being maintained.

ii. Dry film thickness (DFT) check of intermediate and final coating layers in accordance with the specification and /or paint manufacturer’s recommendation.

iii. Quality of adhesion between the coating system and the steel substrate and of the adhesion between the coatings layers shall not be less than those specified in the Codes / Standards.

iv. Porosity Check: Holiday detection test shall be carried out and all indications shall be repaired as per approved repair procedures.

6.12. FINAL INSPECTION

6.12.1. As part of the Quality Assurance, a final inspection in the presence of the representatives of OWNER and CONTRACTOR shall be conducted prior to the final acceptance of the paintwork. Part of this final inspection checks shall be

i. Visual check of the appearance
ii. Checks on DFT's of the total applied coating system
iii. Shade verification
iv. Holiday Testing.
v. Scratch Test
vi. Adhesion test.

6.12.2. As part of acceptance procedure, a report shall be prepared that shall include:

i. General:
 Names of the Painting Contractor and the responsible personal
 Scope of work
 Dates when the work was carried out.
 Copy of the work and quality plan
 Deviations from this Specification and/or the quality plan.
ii. Inspection equipment
 Type and calibration of instruments used.
iii. Surface Preparation
 Condition of surface before preparation
 Checks on the requirements as specified for cleaned surface.
iv. Coating application
 Information on coating systems being applied (i.e. product names, DFT's)
 Checks on requirements as specified for coating application
 Check on dry film thicknesses of the total coating system applied
v. Conditions
 Checks on humidity, dew point and substrate temperature.
vi. Inspection reports
 Copy of the inspection reports of the Contractor
 Inspection from an independent third party

6.13. DOCUMENTATION

Contractor shall keep records and furnish the following documents to the Owner
i. A written quality plan with procedure for qualification trials and for the actual work.

ii. Daily progress report with details of weather conditions, particular of applications, number of coats and type of material applied, anomalies, progress of work versus program.
iii. Results of measurement of temperatures, relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.
iv. Particulars of surface preparation and paint application during trials and during the work.
v. Details of non-compliance, rejects and repairs.
vi. Type of testing equipments and calibration.
vii. Code and batch numbers of paint materials used including shelf life.
viii. Visual examination of surface preparation compared with the standards.
ix. Profile check of the prepared surface with suitable "profilometer.
x. Dry film thickness check of intermediate and final coating layers, in accordance with the specification and/or paint manufacturer's recommendation
xi. Checks/ tests carried out as per clauses above.

6.14. GUARANTEE

6.14.1. The paint system shall provide sufficient protection of the underlying steel surface against the attack of the environment, other than mechanical damage, chemical spillage as result of operational activities or other unusual occurrences from the outside caused by others.

6.14.2. The CONTRACTOR is fully responsible for the quality of the work and for all related QA/QC activities as indicated in the specification.

6.14.3. The CONTRACTOR shall guarantee quality of their coating works for the period specified in Data Sheet-B and for the coating condition as specified below.

6.14.3.1. The guarantee period starts from the date of acceptance of CONTRACTOR's paint work.
6.14.3.2. Initial acceptance of any new coating work by OWNER will not release the CONTRACTOR of his obligation under this section until final inspection has been carried out and acceptance of the completed work has been agreed in writing.
6.14.3.3. These guarantee clauses regarding coating specifications are prevailing and supersede the warrantee requirements in General Conditions of Contract.

6.15. MEASUREMENT

6.15.1. Painting work shall not be measured separately, if primer painting and/or primer and finish painting are already included in the scope of item of structural steel works which include supply, fabrication, painting and erection of structural steel and work is measured on the weight basis for payment.
6.15.2. In cases where primer and/or finish painting work as specified is carried out on erected structural steel executed by a different agency, the method of measurement for painting shall be on the basis of tonnage of the steel erected. For this purpose, the

tonnage of erected steel as certified for payment to the different agency shall be considered as the basis and no measurement will be carried out separately.

DATA SHEET A
PAINTSYSTEM

Paint System	Surface Preparation	Primer Coat (µm)	Intermediate Coat (µm)	Top Coat (µm)	Dft (µm)
PS-1	St-2	Inorganic Zinc Phosphate		Synthetic Enamel	
		2x35=70		2x25=50	120
PS-2	Sa 2 ½	Inorganic Zinc Silicate		HB Epoxy Polyamide (pigmented)	
		1x75 =75		1x75=75	150
PS-3	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aromatic Polyurathane Acid Resistant	
		1x75 =75	1x75=75	1x50=50	200
PS-4	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	1x75=75	1x75=75	225
PS-5	Sa 2 ½	Inorganic Zinc Silicate		Aliphatic Polyurathene(UV Resistant)	
		1x75 =75		1x50=50	125
PS-6	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	1x75=75	1x75=75	225
PS-7	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aromatic Polyurathane Acid Resistant	
		1x75 =75	1x75=75	2x50=100	250
PS-8	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	1x75=75	2x75=150	300
PS-9	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aliphatic Polyurathene(UV Resistant)	
		1x75 =75	1x75=75	1x50=50	200
PS-10	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	1x75=75	2x75=150	300
PS-11	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aromatic Polyurathane Acid Resistant	
		1x75 =75	1x100=100	2x50=100	275
PS-12	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	2x75=150	2x75=150	375
PS-13	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aliphatic Polyurathene(UV Resistant)	
		1x75 =75	1x75=75	2x50=100	250
PS-14	Sa 2 ½	Inorganic Zinc Silicate or Epoxy Zinc Rich		Heat resistant -Silicon Based aluminium paint	
		1x75=75		1x40=40	115

DATA SHEET-B
Recommended Painting System

Sl No	Structures in the scope of work	Recommended Painting System & surface preparation as per Data Sheet-A	Minimum Guarantee Period in Years.
1.	Station Building structures.		
2.	Mill & Bunker bay Structures		
3.	Boiler structures		
4.	ESP Structures.		
5.	Coal Handling Structures		
6.	Ash Handling Structures		
7.	DM Plant structures		
8.	Pipe & cable Racks		
9.	Steel Chimney		
10.	Misc. Open Structures		
11.	Misc. covered building such as Workshop, Store, Sheds etc.		
	Other Buildings included in the scope of work.		

ANNEX - 1
PAINT SYSTEM SELECTION GUIDE

Durability of Paint System	Suitable for areas depencing on atmospheric condition..	Recommended for Structures	Paint System	Surface Preparation	Primer Coat (µm)	Intermediate Coat (µm)	Top Coat (µm)	Total Df. (µm)
Very low durability of 2 -5 yrs	Minimum pairting system required for structures irrespective of atmospheric condition: **Imp Note**: This system not to be recommended unless insisted upon by client insists	Station Building structures Boiler Supporting structures Mill & Burker Bay structures Coal Handling structures. ESP Structures Pipe & cable Racks. Misc Open Structures Misc Covered Structures **(Not suitable for DM Plant & Steel Chimney)**	PS-1	St-2	Inorganic Zinc Phosphate 2x35=70		Synthetic Enamel 2x25=50	120
Medium Durability (5-10 yrs)	Suitable for Normal Inland Atmosphere	Station Building structures Boiler Supporting structures Mill & Burker Bay structures ESP Structures Misc Covered Structures	PS-2	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75		HB Epoxy Polyamide (Pigmented) 1x75=75	150
		DM Plant Structures	PS-3	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	Aromatic Polyurathane Acid Resistant 1x50=50	200
		Coal Handling structures. Ash Handling Structures	PS-4	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	HB Epoxy Polyamide (Pigmented) 1x75=75	225
		Pipe & cable Racks. Misc Open Structures	PS-5	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75		Aliphatic Polyurathene(UV Resistant) 1x50=50	125
Medium Durability (5-10 yrs)	Suitable for Normal Coastal & Polluted Inland Atmosphere	Station Building structures Boiler Supporting structures Mill & Burker Bay structures ESP Structures Misc Covered Structures	PS-6	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	HB Epoxy Polyamide (Pigmented) 1x75=50	225
		DM Plant Structures	PS-7	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	Aromatic Polyurathane Acid Resistant 2x50=100	250
		Coal Handling structures. Ash Handling Structures	PS-8	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	HB Epoxy Polyamide (Pigmented) 2x75=150	300
		Pipe & cable Racks. Misc Open Structures	PS-9	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	Aliphatic Polyurathene(UV Resistant) 1x50=50	200
Medium Durability (5-10 yrs)	Suitable for Polluted Coastal Atmosphere	Station Building structures Boiler Supporting structures Mill & Burker Bay structures ESP Structures Misc Covered Structures	PS-10	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	HB Epoxy Polyamide (Pigmented) 2x75=150	300
		DM Plant Structures	PS-11	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x100=100	Aromatic Polyurathane Acid Resistant 2x50=100	275
		Coal Handling structures. Ash Handling Structures	PS-12	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 2x75=150	HB Epoxy Polyamide (Pigmented) 2x75=150	375
		Pipe & cable Racks. Misc Open Structures	PS-13	Sa 2 ½	Inorganic Zinc Silicate 1x75 =75	HB MIO Epoxy 1x75=75	Aliphatic Polyurathene(UV Resistant) 2x50=100	250
Medium Durability (5-10 yrs)	Exclusively for Steel chimney irrespective of atmospheric condition	Steel Chimneys Temperature range 30°C to 200°C	PS-14	Sa 2 ½	Inorganic Zinc Silicate or Epoxy Zinc Rich 1x75=75		Heat resistant -Silicon Based aluminium paint 1x40=40	115

SPECIFICATIONS AND STANDARDS FOR ELECTRICAL WORKS

General

The proposed underground distribution system shall be designed so as to replace the existing overhead distribution system ensuring:

a) Safety to Personnel and equipment during both operation and maintenance¬.

b) Reliability & Continuity of Service.

c) Minimal fire risk with fail safe feature.

d) Ease & flexibility of maintenance and operation.

e) Adequate provision for future expansion and modification.

f) Maximum inter-changeability of equipment.

g) Suitability for applicable environmental factors.

h) Service Condition

All the components of the electrical system shall be sized to suit the maximum load under the most severe operating conditions. Accordingly, the maximum simultaneous consumption of power, required by continuously operating loads shall be considered and an additional margin shall be taken into account for intermittent service loads, if any. The amount of electrical power consumed by each area shall be calculated for its operation at the design capacity.

The equipment shall be designed and manufactured in accordance with the best engineering practices and shall be suitable for the intended purpose.

Applicable Codes and Standard

The design, material, construction, manufacture, inspection, installation, testing and performance of electrical equipments & systems should conform to the latest applicable Central Electrical Authority (CEA) guidelines, all currently applicable IS, IEC and IEEE standards, Central PWD (CPWD) Specifications, Odisha PWD Specifications, National Building Code, National Lighting Code, National and International codes of practice, statutes, regulations and safety codes in the locality where the equipment will be installed.

DETAILED ELECTRICAL TECHNICAL SPECIFICATIAONS

1. HV DISTRIBUTION BOARD

The scope of this specification design, manufacture, testing at manufacturer's works,

supply, packing, forwarding and delivery from place of storage/ manufacturer's works to erection site including transit insurance, assistance for testing, installation, commissioning and performance demonstration at site of outdoor type 11 kV Distribution Board and its accessories with short time current rating of not less than 25kA for 1sec.

CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of DB shall comply with all currently applicable standards, statutes, regulations and safety codes in the locality where the Equipment will be installed. The Equipment shall comply with the latest editions of the Codes and Standards.

The HV Isolator other associated accessories shall conform to the latest revisions and amendments thereof, but not limited to, the following standards.

IEC62271-102 - Alternating current Dis-connector (Load break isolators) and earthing switch.

EC 62 271-1 / IEC 60694 - Panel design, SF6/Vacuum Circuit Breakers.

IEC 60265 - High voltage switches.

IEC 60273/IS :2099 - Characteristics of Indoor & Outdoor post insulators

IEC 60265 - High voltage switches

IEC 60529/IS 13947(Part-1) - Degree of protection provided by enclosures

All codes and standards referred to in this specification shall be understood to be the latest version on the date of offer made by the Bidder unless otherwise indicated.

SYSTEM PARTICULARS

- *Nominal System Voltage:* *11 kV*
- *Highest System Voltage:* *12 kV*
- *Frequency:* *50Hz ±3%*
- *No. of Phases:* *3 Phase*
- *Neutral Grounding:* *Solidly Grounded*
- *Fault level* *25kA for 1 sec*
- *Max Ambient Temperature for design and temperature rise shall be 50ºC.*
- *Bus rating:* *630A*
- *Bus bar material:* *EC grade Copper*
- *Breaker type:* *Fuse Switch Unit isolator*

The switchgear shall be metal enclosed, outdoor type with switch fuse unit and isolator. Design and construction shall be such as to allow extension at either end.

All the HV design must ensure conformity to IEC-60298.

The cable glands shall be of double compression type brass glands. Gland plate shall be of 3mm minimum thickness. For Single core cables the Gland plate shall be of Al material.

Gaskets shall be EPDM Type. Hardware shall be stainless steel. Paint shall be two epoxy coats over 2 coats of primer. Epoxy painting may be powder epoxy coated or spray painted epoxy.

Aluminium etched 11 kV Caution boards written in three languages (English, Hindi, Oriya) shall be riveted on the panel as well as on the Doors of the HT DB. Stickers are not acceptable.

The Distribution Board shall have provision for installation of FRTU for future integration.

Additional canopy for rain protection shall be provided as an integral part of feeder pillar distribution box.

HV Switchgear

(a) The switchgear should be fixed type, Vacuum circuit breakers with O/C & E/F relay and corresponding auxiliary equipments and accessories.

(b) The Vacuum circuit breaker, Bus bars should be mounted inside a sealed for life, cast resin / stainless steel tank. The operating mechanism of the switches and breakers shall be outside the SF6 tank and accessible from front.

(c) The tank should be filled with SF6 gas at an adequate pressure. The degree of protection for gas tank shall be IP67. There shall be provision for filling the SF6 gas at site. Moreover the Cast Resin / Stainless Steel Gas Tank shall confirm to the sealed pressure system criteria (a system for which no handling of gas is required throughout service life of approximate 30 years) and ensure the gas leakage to 0.1 % per year as per IEC.

(d) It shall provide full insulation, making the switchgear insensitive to the environment. Thus assembled, the active parts of the switchgear unit shall be maintenance free.

(e) The tank shall be totally metal enclosed, vermin and dust proof suitable for tropical climate use as detailed in the specification. The switchgear & switchboard shall be designed so that the position of different devices is visible to the operator on the front of the switchboard & operations are visible as well. The switchboard shall be designed so as to prevent access to all live parts during operation without the use of tools. RMU should be tested for internal arc fault.

(f) Circuit Breaker:

Circuit breaker shall be Vacuum Circuit Breaker (VCB). These shall be triple pole, single throw and suitable for local / remote operation.

Circuit Breaker shall be provided with operating mechanism, self powered Static relay (Over current & Earth Fault Protection) with associated CTs for control and protection of Distribution Transformer. Relay should have facility to display the maximum loaded phase current also. Relay should also have facility to trip the breaker from remote commands without shunt trip coil.

An integral cable earthing switch with full making capacity shall also be provided with Circuit Breaker. Earthing switches shall be mechanically interlocked with the associated breakers to prevent accidental earthing of live circuit or busbars.

Circuit Breaker shall be provided with the following accessories, unless otherwise specified:

- Mechanical ON/OFF/EARTH Indication
- Mechanical charge/discharge indicator
- Auxiliary contacts 2NO and 2NC
- Tripped on fault indicator
- “Live Cable” LED Indicators through Capacitor Voltage Dividers mounted on the bushings.

(g) Ratings of HV Circuit Breakers, Current Transformers & relay settings shall be selected considering the ambient conditions. The bus bars, Vacuum Circuit Breaker shall have adequate continuous rating as per the requirement and in accordance with relevant IS / IEC standard.

(h) The complete switchgear shall be suitable for breaking capacity as specified in the datasheet and/ or relevant standards.

(i) Busbars shall be of copper and complete with all connections to the switch or breaker. Continuous rating of Copper busbars shall be adequate considering all derating factors. The busbars should be fully encapsulated by SF6 gas inside the tank.

(j) The circuit breaker shall be fitted with static type self powered relay inside the front cover to avoid any tampering. The same shall be used in conjunction with suitable CT’s and Tripping Coil for fault tripping of the Circuit Breakers. CT’s shall be mounted on bushing of breaker. CT’s mounted on cable inside cable compartment are also acceptable.

(k) Each Cable compartment shall be provided with three bushings of adequate sizes to terminate the incoming / outgoing, HT cables. Cable compartment shall be front access, Arc proof and interlocked with the respective earthing switches. From safety point of view, it should not be possible to open the cable box unless the earth switch is ON.

(l) There shall be enough height from the base of the mounted switchgear so that the cables can be bent and taken vertically up to the bushings. The Cable termination shall be done by Heat shrinkable Termination method so that adequate clearances shall be maintained between phases for Termination. Cable Termination boots shall be supplied by the switchgear manufacturer.

(m) The moving contacts of the earthing switch shall be visible in the closed position through transparent covers.

(n) Suitable padlocking arrangements shall be provided as stated below:

- Circuit Breaker manual operating handle in the “OFF” position.
- Each feeder Panel operating handle in ‘Closed’ ‘Open” or ‘Earth’ position.
- Each isolator operating handle in ‘Closed’, ‘ Open’, or ‘Earth’ position.

FITTINGS AND ACCESSORIES

The DB shall be provided with following fittings and accessories:

- Rating & diagram plate
- 2 Earthing terminals
- Cable box with HV plug-in connectors
- Base Channel
- MS supports for mounting of DB at minimum 300mm above HFL

2. LT PANELS

The scope of supply covers design, manufacture, testing and supply of LT Panels.

LT panel shall be CPRI /Independent international test house tested for all the tests as per IEC 61439-1 & 2.

LT Panel shall also be tested of design as per Seismic Zone II of IEC 60068-3-3.

Panel shall be rated for Impulse withstanding capability equal to or greater than the switchgears inside the panel.

The metal enclosed switchgear shall be designed to operate continuously with reference of ambient temperature of 50ºC without any de-ration.

The equipment shall be designed and manufactured in accordance with the best engineering practice and shall be such that has been proved to be suitable for the intended outdoor purpose.

Provision for interlocking of LV Incomer breaker with HV side breaker shall be provided such that if the HV breaker trips then the LV breaker will trip and it shall not be possible to close the LV breaker unless the HV side breaker is closed.

The Panel shall be outdoor type having incoming sectionalisation and outgoing switchgears as specified. The design shall be cubical type. The degree of enclosure protection shall be IP55 for outdoor as per IS: 13947 (Part-I). Additional canopy for rain protection shall be provided as an integral part of feeder pillar distribution box.

CONSTRUCTIONAL REQUIREMENTS:

All panel boards shall be free standing, metal enclosed, single front, fabricated with 2mm CRCA sheet steel for all doors, partitions and covers and 2 mm CRCA sheet steel for load bearing sections including all ACB feeders. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels.

The gasket shall be suitable to withstand all weathers for long tenure of service. All hardware shall be HD Galvanized or stainless steel.

All LT panels shall conform to FORM 3B as per IS 61439.

For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

Each door & cover shall have adequate reinforcement of suitable ribs & stiffeners. All such door shall open at min 1050. All feeders and cable alleys shall have hinged type door with panel locks. All bus-bar covers and other panel covers shall be screw fixed. Cable alleys and bus-bar chamber shall have minimum width of 300mm.

All doors shall be with concealed type hinges and captive screws. Rear doors of panels requiring rear access shall be provided with removable hinged doors. Side covers of panels shall be with removable panels.

All doors shall be provided with durable and easy fitting locks with special keys to ensure opening by authorized personnel. Rubber grommets shall be provided at the cable entry.

All mounting accessories like base channels, cross angles if required, nuts, bolts etc. shall be supplied by the vendor. The panel shall be mounted at a height of more than 300mm from HFL. Necessary RCC foundation for the panel erection shall be in contractors scope.

All the panels shall have uniform height. The operating height of all the panels shall

not be less than 300mm and not more than 1900mm. Panel height should not be more than 2450mm.

All the panel boards shall have cable entry from bottom. Split gland plate of 2mm thick shall be supplied for termination of power, control and instrumentation cables sized as per the required no. of cable mentioned in the SLDs and 20% spare space for future addition.

BUS-BARS:

a) Bus-bar of the panels shall be rated for Continuous current at site conditions.

b) All bus-bars shall be electrolytic grade copper or aluminium. BIDDER shall specify the purity and conductivity of the bus bar along with the BID.

c) All the bus bars shall be sleeved with heat shrinkable black colour PVC sleeve or better insulation with coloured polyester tapes for phase identification at regular intervals/ locations. Make and Type test reports carried out at accredited laboratory, of such sleeves shall be submitted during testing.

d) BIDDER shall submit all calculations & documental proof of the adequacy of the bus bar sizes to meet the continuous and short time current ratings specified for reference during procurement/ manufacturing.

e) Vertical bus-bars shall have S.C. rating same as main bus bar and shall be suitable for all connected load of vertical section.

f) BIDDER shall ensure that incoming feeder shall be suitably designed for terminating the required no. of runs of 1.1kV grade XLPE insulated armoured cables with 20% spare capacity. BIDDER shall consider the necessary arrangement (dummy panel, adapter panel, rear extension etc.) if required, for terminating the cables within the limits specified above.

g) The bus-bars shall be designed considering the following criteria:

- Current density of 0.8A/sq mm maximum for aluminium and 1.6A/Sq mm for copper.
- Sleeves made of insulating material on all bus bars.
- Bus bars carrying rated current continuously at Design Ambient Temperature shall be considered as 50ºC and temperature rise shall be considered as per latest relevant standard.
- Configuration of bus bars and Proximity effect
- Bus bars shall withstand the short time rating of the panel.

h) Bus bar supports shall only be SMC irrespective of bus bar size. The span between the two insulators shall be as per the approved TYPE TEST REPORT for short time rating. Joint positions and insulators shall be properly adjusted so that they don’t interfere. Bus bar bending shall be carried out on appropriate machines designated for the same rather than doing manually.

i) Neutral bus-bars of the panel boards shall be rated equal to the size of phase bus.

j) All bus-bar shall be treated with anti-oxide paste wherever bi-metallic contact is required.

k) The material and spacing of the busbar support should be same as per the type tested assembly.

EARTHING:

a) Earth bus bars of Aluminium material shall be run all along the panel, extended out at both ends of value equal to the rated symmetrical short circuit rating of the associated switchboard/ panel. The same shall be properly supported to withstand stresses induced by the rated symmetrical short circuit current.

b) Earthing bus-bar shall be terminated at both ends of the switchgear to suit the connections to earthing conductor. The locations where the bus are protruding out of the panel boards, CONTRACTOR shall ensure that proper ingress protections are provided at all such locations.

c) All doors and detachable components inside the feeder are required to be earthed individually with green (with yellow band) colour PVC insulated multi stranded copper conductor wire of size 4 sq.mm duly crimped with ring type lugs and are to be looped & connected to horizontal earth bus.

d) Earthing bus shall be run continuously in panel drawn out suitably considering respective cable entry inside the panel.

e) Separate Al earth bus shall be provided at each cable alley for all the panels.

POWER WIRING (INSIDE THE FEEDER):

a) All power wiring for rating upto and including 63A shall be carried out with 1.1kV grade coloured HFFR/ FRLS PVC insulated, coloured for phase identification, multi stranded copper wires duly crimped with ring type lugs.

b) Power connections for rating above 63A shall be done with AL bus bars (machine bend for proper profile) insulated with black heat shrinkable sleeves with phase identification coloured tapes duly supported on SMC insulators and placed with required minimum clearance of 25mm between phases and between phase to ground/ neutral. Such bus when brought out of the feeder for cable connections shall be sufficient enough and profiled suitable for termination of the number of LT cables as indicated above.

CONTROL WIRING (FOR PANEL AND FEEDERS):

a) All panel Control wiring shall be done by 1.1kV grade HFFR/FRLS PVC insulated multi-stranded copper wire. CT circuit wiring shall be done with minimum 2.5 Sq.mm size wire of above specification. Control and Potential circuits shall be wired with minimum 1.5 sq. mm size wires of above specifications. Wires shall be gray coloured with suitable crimp able copper lugs. CT's & PT's wiring shall be colour coded for multi-phase identifications (R-Y-B-N).

GENERAL REQUIREMENTS:

a) DP MCB shall be provided for all control circuits where the fault level is less than 10kA. Else the control supply shall be tapped through a control transformer of adequate capacity supplied with MCCB/ MPCB/ SFU of adequate short time rating. Independent DP MCBs shall be provided for each circuit such that tripping due to fault in one circuit should not affect other functions adversely.

b) Self explanatory Wiring diagrams with terminal and wire numbers, component numbers shall be provided on the inner face of the door of each feeder. Drawing set in the panel shall be laminated.

c) All labels for identification of feeders as well as internal and external components as per legends provided By EMPLOYER shall be on white acrylic sheet with black engraving. These labels shall be fixed by screws/rivets and shall not be pasted.

d) Aluminium etched 415V Caution boards written in two languages (English, Hindi) shall be riveted on the panel at locations where live bus bars are present and need isolation before any access to it. In case secondary covers have been provided inside the panel, then caution boards shall be also marked on these boards in addition to the external covers. Stickers are not acceptable.

e) Selector/control switches shall have an 'Off' position. The 'Off' position shall not be wired in any circuit and shall be utilised to disconnect (or bypass) power supply to control circuit for any maintenance work.

f) All electrical panels (internal components & arrangement) shall have finger touch protection, for human safety viz. working on one component shall not cause shock to the personnel due to any other live component in the panel. Also, the terminal live parts shall not be accessible by fingers (finger cannot come in contact with live parts of the terminals).

g) No openings/ holes meant for fixing hardware shall be left open. All the hardware (esp. screws, nuts, bolts, and washers) shall be in all appropriate positions & properly tightened.

h) Phase separators, shrouds, falling tool barriers shall be suitably provided. Any additional requirements as observed at any stage upto handing-over shall be provided (for safety and ease of maintenance) without any cost implication to the EMPLOYER.

i) All PVC/engineering plastic based items (including but not limited to conduits, casing-capping, trough, trunk, enclosures, covers, plugs, etc) shall be with FR properties.

j) Lifting hooks/eyes shall be provided in each shipping section of the equipment and shall be removable type. The equipment shall be given tropical and fungicidal treatment.

k) Insulation mat of suitable standard width shall be provided in front of the HV and LV panels.

l) Atleast one 230V, 1Ph, Space heater shall be provided for each vertical section of the switchboard. Each Space heater shall be provided with an isolating switch, a thermostat and dedicated MCB protection of appropriate rating. Heater shall be mounted at bottom of the panel with cover to avoid accidental contact of heater with skin.

m) 230V 1Ph, Panel illumination (11W CFL/ LED fixture with lamp, limit switch and isolation switch) along with 1 no. 5/15A 5 pin socket with switch shall be provided for each vertical section. Bare holder with open lamp is not acceptable.

n) Adequate space shall be provided for terminating the outgoing cables.

EQUIPMENT REQUIREMENT:

a) MCCB:

- All the panels shall have MCCBs upto 630Amp. All MCCBs shall be rated for 415V, 3 Ph, 50Hz.
- All MCCB shall be microprocessor based. MCCB shall have O/C, S/C Protection. Wherever MCCBs are used as incomer these shall be provided with earth fault & time delay or as specified in SLD. MCCBs of suitable Icu=Ics=100% ratings.
- There should be earth fault indication on panel door.
- Rated operational voltage will be 415V AC with +/-10% variation.
- All MCCBs shall be with Utilisation Category "A".
- All the MCCBs shall invariably be Current Limiting type, features like Double Break, Positive Isolation functions shall be Integral feature of the device and shall provide a cut off in, < 10 ms for prospective currents during faults. All MCCBs shall be provided with rotary handle with door interlock and extension links/ spreaders with proper shrouds. No live part accessible even after opening the front cover.

b) ACB:

- From 800 A onwards ACBs shall normally be used. These should have 50 kA (Icu=Ics=Icw) Short Circuit Current rating with microprocessor based overload, short circuit and earth fault protection at 415 volts, 50 Hz.
- The air circuit-breakers (ACBs) used in low-voltage installations shall be designed, built and tested in compliance with the standards of the IEC 947-2 & EN 60947/ IS 19947 (Part-II) : 1993.
- Rated operational voltage Ue should be 690 V.
- The rated insulation voltage shall be equal to or greater than 1000 V.
- Overload protection shall have adjustable setting from 50% to 100% of the ACB’s rating.
- The ACB release shall be self-powered, requiring no external power supply. For it to operate, it is sufficient for one phase to be loaded at 20% of the rated current of the current transformer.
- Power loss in breakers should also be watched for selection.
- Utilization category-B

- Releases are also available with LCD display which displays all three phase current & neutral current, running voltage, average voltage and maximum voltage. These releases will also display maintenance date like no. of operations, & fault history (last 10 trips and type of fault). To protect the load and cables from repetitive over temperature protection. In case of BMS connectivity through Ethernet communication, the release shall enable the user ON, OFF, Trip status communication.
- Individual fault indication LED's (OL,SC & EF) backed by lithium battery to give indications even when the CB is off and electrical fault trip (OL& SC) alarm indication on panel shall be available on trip units for easy & faster identification of cause of fault.
- ACB with microprocessor based trip release with adjustable (O/C, S/C & E/F Protection) with adjustable current & time delay & %loading bar graph for each phase.
- For Distinct Fault Indication, required voltage supply shall be derived from the existing control supply by BIDDER. No separate charges shall be asked for later during execution.
- All instrument transformers shall be cast resin type and shall have insulation of class B or better.
- Indicating lamps shall be of the Multi chip LED type with low watt consumption.
- Each incomer shall be provided with a Multi Function Meter displaying all electrical parameters like (but not limited to) current, voltage, kW, kVA, KVAr, kWH, MD, PF, Hz, (THD measurement only in main PCC incomer) etc. and shall have provision for remote communication with SCADA/ BMS..
- The switchgear shall be complete with all equipment such as CT, VT, switches etc. duly wired up to terminal blocks. Terminal blocks shall be located at suitable place for easy access. CT shorting, isolating terminals shall be provided for CTs and isolating terminals shall be provided for VT connections. Twenty (20) percent spare terminals shall be provided in each cubicle. Ring type lugs suitable for termination of 2.5 sq mm copper wires shall be used.

3. CABLES AND CABLE CARRIER SYSTEM

SCOPE

This specification also covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's/his SUB-VENDOR's works and delivery to site of HT Cables 11 kV and LT Cables, Cabling Accessories, etc.

APPLICABLE CODES & STANDARDS

The design, construction, manufacture and performance of the equipment/components shall conform to latest applicable standards as on date of submission of the bid and comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment/components will be installed.

Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

Unless otherwise specified, equipment shall conform to the latest applicable standards for cables IS 1554, 7098, 8130, 5831, 3975, IEC 60183, 60227, 60502, 60885, 10418.

TECHNICAL SPECIFICATION FOR CABLES & CABLE TERMINATION

The various types of cables covered in this specification shall meet the following requirements:

XLPE Insulated HV Power Cables

The conductors shall be screened by extruded semi-conducting compound and XLPE insulated. The cores shall be screened by extruded semi-conducting compound in combination with non-magnetic metallic tape (copper tape preferred).The inner sheath over laid up cores and outer sheath over the armour shall be extruded black PVC compound type ST-2. Core identification shall be by printed numerals. The construction, performance and testing of the cable shall comply with IS 7098-Part 2 (Cross Linked Polyethylene Insulated PVC Sheathed Cables for working voltages from 3.3kV upto and including 11kV).

1100 V Grade XLPE Insulated Power Cables

The cable shall be extruded XLPE insulated. The inner sheath over laid up cores and outer sheath over the armour shall be extruded PVC compound type ST-2. Core identification shall be by printed numerals. The construction, performance and testing of the cable shall comply with IS 7098-Part1 (Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100 V).

1100 V grade PVC insulated Power / control cables

The cables shall be insulated with extruded PVC compound type C, provided with inner sheath and outer sheath of extruded black PVC compound type ST-2.

The construction, performance and testing of the cable shall comply with IS 1554 - Part 1 (PVC insulated heavy duty electric cables for working voltages upto and including 1100 V).

1100 V Grade Lighting/Misc./Light duty unarmoured cables

Cables shall be insulated with extruded PVC type-C. Outer sheath shall be extruded black PVC type ST-2. The sheathed cables shall be weather proof suitable for indoor/outdoor use. Twin and multicore cables shall be laid up and filled with thermoplastic material, bound by plastic tape and provided with outer sheath.

The construction, performance and testing of the cable shall comply with IS 694

(PVC insulated cables for working voltages upto and including 1100 V).

For all LT power and control cables, double compression glands with aluminium lugs for Aluminium cables and tinned Copper lugs for Copper cables shall be used in indoor and outdoor application.

The termination shall be inclusive of miscellaneous items such as clamps, cleats, cable tags, cable markers etc.

In general cable installation works shall be carried out in accordance with IS 1255 – 1983, latest version. At road crossings, the depth of the Pipe shall be minimum 1m else proper concrete encasing shall be provided.

For Underground cables, cable marker shall project 150mm above ground and shall be spaced at an interval of 30 metres, and at every change in direction. They shall be located on both side of road and drain crossings on finished surface like foot path etc. Top of cable marker/joint marker shall be sloped, to avoid accumulation of water/dust on marker. The marking shall be accomplished with a separate colour tiles/ paver block for highlighting the route of the cable.

Cable tags shall be provided on all cables both at feeder pillar end as well as on each pole (just before entering the equipment enclosure).

Cable Glands

a) Double compression type cable glands shall be used for the termination of all the power and control cables. Cable glands shall be brass casting, machine finished and Nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene.
b) For single core cables, gland shall be with brass ring.
c) Cable glands shall be with metric threads.
d) Cable glands shall be conical (& not flange type).

Cable Lugs

a) Cable lugs shall be of tinned Copper, solder less crimping type for Cu cables & Al lugs for the Al cables.
b) The current rating of the lugs shall be same as that of the respective cable conductors.
c) Ring type cable terminations shall be used.
d) Insulated lugs are not acceptable for any cable terminations.
e) Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
f) Double hole extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.

g) Fork terminals shall be used for luminaires & decorative switch/ socket. Pin terminals may be acceptable during execution only in case other terminals/ lugs cannot be accommodated.

h) Reducer / wire pin terminals shall be avoided for MCB terminations. MCB terminations shall be with 'long palm terminals.

i) All terminations in Feeder Pillars / enclosure for earthing & neutral busbars / terminals shall be with ring type terminals.

j) All earthing terminations shall be with ring type lugs only.

k) All control & interlock cable terminations shall be with ring type lugs.

l) Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs [This shall especially be ensured for Al cable terminations & any bimetallic terminations (Cu cable termination using tinned Copper lugs)].

m) If termination is done with crimping tool employing crimping die then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned and special jelly applied over it to prevent further oxidation.

The cable carrier system covers the supply of cable racks, cable trays and its supporting accessories hardware and their installation. It shall be the responsibility of the Contractor to complete the cabling system in all respects.

Cable trays shall be of Galvanised Steel and of perforated type, complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware as required. All hardware (i.e. bolts, nuts, screws, washers, etc.) shall be hot dip galvanised. (galvanisation thickness not less than 70 microns).

Each 2.5 metre section of all types of cable trays and all elbows, tees, crosses, etc. shall be provided with two side coupler plates and associated bolts, nuts and washers.

REQUIREMENT OF SPECIAL SHEATH FOR FRLS CABLE

Tests and Test Equipment

Cables shall be subjected to routine and acceptance tests in accordance with standards specified Test methods shall conform to IS 10810 (Methods of Test for Cables). Type tests and optional tests according to applicable standards shall be conducted on cables as specified. Contractor shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratory traceable to National Standards. Outer sheath for FRLS/FS cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The Contractors shall have proper test apparatus to conduct all the relevant tests as per the applicable Standards mentioned herein.

Test for flame Retardance

a) Oxygen Index

The critical oxygen index value shall be minimum 29 when tested at 27 +/-2 deg.C as per ASTM-D-2863 and the temperature index value shall be minimum 250oC at oxygen index of 21 when tested as per NES 715.

b) Flammability

- Cables shall pass test under fire conditions as per IS-10810- Part-53.
- Cables shall also pass tests as per IS-10810 Part- 61 & Part-62.
- Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

Test for smoke generation

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The maximum smoke density rating shall not be more than 60% when tested as per ASTM-D-2843.

Tests for acid gas generation

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than 20% by weight.

Tests for Resistance To Ultra Violet Radiation

This test shall be carried out as per DIN 53387. The retention values of tensile strength and ultimate elongation after the tests shall be minimum 60% of tensile strength and ultimate elongation before test.

Tests for water absorption

Outer sheathes shall be subjected to tests for water absorption as per IS 10810. When additional characteristics are required, the tests shall be as agreed to between Employer and VENDOR before the placement of order.

4. LIGHTING WORK

GENERAL REQUIREMENTS

The Lighting system includes the following items.

- Lighting fixtures complete with Lamps and accessories (lumen per watt shall be indicated)
- Lighting system equipment (ISI make)

- Lighting fixture supports, street lighting poles
- Feeder pillars with dimming control features
- Multi core cables for street lighting
- PVC Conduits
- Load balancing of lighting system shall be made.

DESIGN

The lighting system design shall comply with the acceptable norms and the best engineering practices. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

The value of the ratio of spacing (S) to mounting height (H) shall be commensurate with the type of fittings selected and uniformity of illumination.

The lighting design shall be as per lighting requirements of A2 category road with double arm decorative / ornamental type poles with double arm.

APPLICABLE CODES & STANDARDS

All standards and codes of practice referred to below shall be the latest edition including all official amendments and revisions.

- General safety requirements for luminaires : IS 1913
- Luminaires for street lighting : IS 10322(Part-5, S 3)
- General lighting LED and LED Modules : IS 16101
- Self ballast LED lamps for general lighting services: IS 16102 (Part-1 & 2)
- LED modules for general lighting : IS 16103(Part-1 & 2)
- Safety of lamp control gear : IS 15885 (Part-2/sec-13)
- DC or AC supplied electronic control gear for LED modules : IS 16104
- Method of measurement of lumen maintenance

  of solid state light (LED) sources : IS 16105

- Method of electrical and photometric

  measurements of solid state light (LED) products : IS 16106

- Luminaries performance : IS 16107 (Part 1 &2)

- Photo biological safety of lamps and lamp system: IS 16108

LED LUMINAIRES

LED luminaires shall be used for street lighting. Luminaires shall be installed to permit ease of maintenance. The Contractor shall provide all equipment necessary to carry out maintenance on the lighting installation and demonstrate its operation to the satisfaction of the Engineer.

MCB (DP For single phase MCB and 4P for three phases MCB DB) and DP RCCBs for each phase shall be provided at the incomer of Lighting panels and SP MCB for outgoing feeders.

LIGHTING SYSTEM

The illuminance level for road lighting in India is governed by IS 1944 (Part 1& 2): 1970/ Code of practice for lighting of public thoroughfare.

The layout for street lighting system will be planned in such a way that uniformity ratio as required by IS: 1944 is maintained.

All the Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading .i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN 40-3:2000, pr EN-40-3-3.

All pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations .i.e. from inside and outside.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Aesthetic appearance - All the grooves and carvings of the pole unit shall be free from any kind of distortion for a pleasing aesthetic appearance.

The poles and bracket shall be hot dip galvanized as per is 2629/ IS 2633/ IS 4759 standard with average coating thickness of 75 micron. The galvanizing shall be done in single dipping.

Top Mountings -The galvanized mounting bracket shall be supplied along with the Poles for Installation of the luminaries.

The pole manufacturing & galvanizing unit shall be ISO 9001: 2000 & ISO 14001 certified to ensure consistent quality & environmental protection.

Electrical connections - Four way connectors shall be provided along with Slide lock suitable for connecting 1.1 kV grade, 4 core Al cable. It shall also in house 1 no. 6A DP MCB, 2.5 mm² connectors for looping with 2.5 mm² Copper wires for connecting to the luminaries through 1.1 kV grade, 3Cx2.5 mm² PVC insulated copper conductor flexible un-armoured Cable from the terminal block to the fixture within the pole. All the cables laid through the pipe shall be without any joint.

Two nos. earth boxes shall be provided at the bottom of the pole (diagonally opposite) suitable for connecting 25x6 mm GI earth strip or 6SWG GI wire for earthing of the poles.

Two nos. 50 mm NB HDPE Sleeves of suitable length shall be provided through the foundation upto the Junction Box for entry of power cable.

The BIDDER shall carry out all the relevant tests and inspection in the presence of the EMPLOYER or Third Party Agency, as may be selected by the EMPLOYER, before the dispatch of the poles at no extra cost to the EMPLOYER.

The BIDDER shall inform the EMPLOYER at least FIFTEEN (15) days in advance, about the manufacturing programme so that arrangement can be made for inspection. EMPLOYER reserves the right to waive the inspection at any stage.

All the material/equipment/accessories shall be supplied with manufacturer's test certificates.

BIDDER shall submit the Proposed Product Catalogue, Detail Data sheet, spare parts list and drawing of Pole & Bracket along with the BID for each product quoted.

BIDDER shall arrange for all the tools and equipments.

M20 concrete foundations shall be provided for all the poles. Approx dimension of the foundation for evaluation purpose is 600X600X1700 mm. However, BIDDERs shall design as per the stability requirement and Soil bearing Capacity of each location. The Poles shall be bolted on a pre-cast foundation with minimum four foundation bolts for greater rigidity.

APPLICABLE STANDARDS

Sr.No.	**Brief Title**	**IS/IEC Code**
1.1	Testing procedure of photometric testing for LED luminaires	LM 79

Sr.No.	Brief Title	IS/IEC Code
1.2	Testing procedure on the lifespan of LEDs	LM 80
1.3	National Lighting Code	SP72
1.4	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources	IS:16105
1.5	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products	IS:16106
1.6	Limits of Harmonic Current Emissions	IS 14700-3-2
1.7	DC or AC supplied electronic control gear for LED modules performance requirements	IEC 62384
1.8	Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules	IEC 61347-2-13
1.9	Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test	IEC 60068-2-38
1.10	Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission-– (equipment input current ≤ 16 A per phase)	IEC 61000-3-2
1.11	EMC Immunity requirement	IEC 61547
1.12	LED modules for general Lighting-Safety requirements	IEC 62031
1.13	Classification of degree of protections provided by enclosures (IP Codes)	IEC 60529
1.14	Fixed general purpose luminaries	IEC 60598-2-1

Sr.No.	Brief Title	IS/IEC Code
1.15	General Lighting - LEDs and LED modules – Terms and Definitions	IS:16101 / IEC TS 62504
1.16	LED Modules for General Lighting Part 1 Safety Requirements	IS:16103(Part1)
1.17	LED Modules for General Lighting Part 2 Performance Requirements	IS:16103(Part2)
1.18	Safety of Lamp Control Gear, Part 2 Particular Requirements Section 13 D.C. or A.C. Supplied Electronic Control gear for Led Modules	IS:15885(Part2/Sec13)

ENVIRONMENTAL CONDITION

The average atmospheric condition during the year is mentioned below. The equipment shall be designed to work in such environmental conditions:

Maximum ambient air temperature: 50° C

Max. Relative humidity: 90%

Average Rainfall: 55 inches

Atmosphere: Dusty and Heavy chemical smoke at times in certain areas.

The equipment shall be suitable to sustain and work in the humid and corrosive atmosphere of the city.

LUMINAIRE DESCRIPTION

The Luminaires shall have a sturdy and corrosion resistant high pressure Die cast Aluminium housing with weatherproof gasket for lamp and control gear accessories. The Housing shall be Epoxy coated, without any cracks or thorough holes, made in a single piece of die-cast LM6 aluminium alloy. The luminaries shall be totally enclosed, dust tight and water proof.

Heat sink used should be aluminium extrusion having high conductivity. The dimensions of luminaries shall be optimum and adequate to permit sufficient heat dissipation, through the body itself, so as to prevent abnormal temperature rise inside the lantern and consequential damage to the cover and gasket materials, LEDs, lenses and electronic drivers. Heat sink must be thermally connected to

MCPCB/ LED light source.

The Luminaries Housing shall be suitable for termination of Cable with Double Compression Cable Glands.

Housing protection: IP-66. If the LEDs and LED Driver are in different compartments, then the two compartments must be individually IP-66. For achieving IP-66, proper gaskets should be provided. Test certificate of NABL accredited laboratory is to be submitted for the luminaire model/rating offered.

Luminaires should conform to the photometric Distribution / requirements of Cut-Off / Semi Cut – off light distribution and optics as classified in IS 1944.

Suitable number of LED lamps shall be used in the luminaries. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing.

The Luminaries shall be provided with high tensile heat resistant toughened glass or UV resistant polycarbonate cover fixed with stainless Steel screws.

An extruded silicon loop gasket shall be provided in the lantern body to ensure a weather proof seal between the cover and the metal housing to exclude the entry of dust, water, insects, etc. Luminaries should conform to degree of protection of IP 66 or above. Felt gasket will not be accepted.

Year of Manufacture, Batch No., Serial Number or Identification No. Luminaries Manufacturer's Name / Logo, Wattage and Frequency should be embossed on the housing.

LED luminaries, should conform to the various National / International standards for safety & performance. Manufacturer should provide test reports as per LM 79 & LM80. Lumen maintenance report as per LM 80 guidelines shall be submitted for the LEDs used along with the BID.

Luminaries should conform to the IS standards for Safety & Performance and test certificates as per IS 16107 should be provided by the manufacturer. In case of luminaries are imported, the BIDDER shall conform to test parameters as per UL or equivalent standards.

The electrical component of the LED and LED driver must be suitably enclosed in sealed unit to function in environment conditions mentioned earlier.

All the connecting wires inside the Luminaries shall be low smoke halogen free, fire retardant cable.

Adequate protection against Overloading, Short Circuit, Over Voltage, over temperature, Under Voltage, String Open shall be provided within the Luminaries.

Design of the thermal management shall be done in such a way that it shall not

affect the properties of the diffuser.

The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/ PAS 62612 depending on the type of luminary.

All the material used in the luminaries shall not contain any toxic material/ metal like mercury; shall be halogen free and fire retardant confirming to relevant standards.

The Manufacturer shall have all the relevant testing facilities certified by an accredited laboratory and shall be offered for inspection to the EMPLOYER for verification of the required parameters and tests. BIDDER shall confirm the same in the BID.

The control gear shall comply to the provisions of IEC 61347-2-13, IEC 62031 and IEC 62384 as appropriate.

The lighting fixtures offered shall comply with the following requirements:

LUMINAIRE DATASHEET

Sr. No.	**Parameter**	**Requirement / Value**
1.	Type	LED Luminaries complete with all accessories
2.	Rated Voltage	230 V
3.	Expected Frequency	50 Hz +/- 3%
4.	Operating Voltage Range	140 V to 270 V but luminaires shall be tested for 100V to 300 V AC
5.	Power Factor	> 0.92
6.	Operating Temperature Range	0 Deg C to 50 Deg C
7.	Working Humidity	10% - 90% RH
8.	Driver Type	Constant Current based Electronic Driver

Sr. No.	Parameter	Requirement / Value
9.	Driver Efficiency	> 85%
10.	Driver Life	>20000 hrs.
11.	Protection required in Driver module	
a.	Short Circuit	Yes
b.	Over Voltage	Yes
c.	Over Temperature	Yes
d.	Under Voltage	Yes
e.	String Open Protection	Yes
12.	Luminaire IP Protection	Minimum IP-65 and above
13.	Minimum Surge Protection	>4 KV
14.	THD	<10%
15.	Rated Minimum LED Life (L70)	>50000 Burning Hours
16.	Rated Minimum Driver Life	20000 Burning Hours
17.	CRI	As per Standard mentioned in Design Criteria
18.	Junction temperature rise	< 85 Deg C
19.	Solder point temperature	< 70 Deg C

Sr. No.	Parameter	Requirement / Value
20.	Maximum temperature rise for Driver	<30 Deg C at 50 Deg C ambient
21.	Make of LED	Cree / Nichia/ Philips / Osram
22.	Make of Driver	Cree / Nichia/ Philips / Osram
23.	Operating Hours	Dusk to Dawn (max 12 Hrs.)
24.	Luminous Efficacy	> 135 Lumens/watt (at operating current(design) and Tj = 85 deg C)
25.	System Efficacy	>100lm/W
26.	Colour Temperature	5000K – 6000K
27.	Illumination Regulation	<5%
28.	Material used for following	
a.	Housing	Single housing, Side entry, Corrosion free High Pressure Aluminum die cast/extruded Aluminium, grey color corrosion resistant polyester powder coating, with separate optical and control gear compartments, fixing arrangement –Maintenance friendly.
b.	Heat Sink	Aluminium extrusion
c.	Clip / Fasteners	Stainless steel.
d.	Diffuser	Toughened glass/ UV stabilized Poly carbonate material
29.	Maximum temperature of Heat sink	<70 Deg C

Sr. No.	Parameter	Requirement / Value
30.	IK protection of Optic Cover	>IK07
31.	Wires used Inside Luminaries	Cu conductor, low smoke halogen free, fire retardant e-beam cable
32.	Cable gland IP protection	IP 66

TESTING OF LUMINAIRE

The Routine test on each of the offered Luminaire shall be carried out by the BIDDER before dispatch. Following tests shall be carried out as routine tests by the BIDDER for the offered Luminaries:

(a) Visual and Dimensional check

(b) Checking of documents of purchase of LED

(c) Insulation resistance test

(d) HV test

(e) Reverse polarity

The Acceptance test shall be carried out by EMPLOYER or EMPLOYER's Representative on a sample of the lot offered for Acceptance. The Lot shall be different from the lot from which the Type test samples have been drawn. The cost of the testing shall be borne by the BIDDER. Following tests shall be carried out as Acceptance tests by the BIDDER for the offered Luminaries:

(a) Visual and Dimensional check

(b) Checking of documents of purchase of LED

(c) Insulation resistance test

(d) HV test

(e) Over voltage protection

(f) Surge protection

(g) Reverse polarity

(h) Lux measurement

Following Type tests reports shall be provided by the BIDDER for the offered Luminaires along with the BID;

(a) Resistance to humidity

(b) Insulation resistance test

(c) HV test

(d) Over voltage protection

(e) Surge protection

(f) Reverse polarity

(g) Temperature rise Test

(h) Ra (Colour Rendering Index) measurement test

(i) Lux measurement

(j) Fire retardant Test

(k) Test for IP 66 protection

(l) Endurance Test,

(m) Life Test

(n) Photometric Measurements Test Report (IES LM 79)

(o) LED Lumen Maintenance Test Report (IES LM 80)

(p) Vibration test as per ANSI

(q) Drop Test

DRAWINGS AND DATA

All Drawings, data, technical particulars, calculations, detailed literature, catalogues, test certificates etc shall be submitted along with the bid/ after award of contract as specified in Bid Document.

FEEDER PILLAR BOX

Feeder Pillar shall be provided to cater to street light poles located between two major junctions. The feeder pillar-box shall be metal enclosed, double door

construction, free standing type made out of 2.5mm CRCA sheet steel, epoxy painted with minimum 80 microns thickness of paint and IP-55 weather protected. Additional canopy for rain protection shall be provided as an integral part of feeder pillar distribution box. All hardware shall be hot dip galvanized.

Tolerance on dimension shall be +0 to +3mm.

The feeder pillar box shall be complete with incomer MCCB with earth fault protection or MCB+RCCB (30mA), as per requirement, MCB for lighting control and a 3 pin 5/15A socket along with 15A MCB. MCB and RCCB shall be separate unit. It shall have diming and controlling feature for the connected street light poles.

Indication lamps for indication of incoming power supply healthy for feeder pillar incomer shall be provided. Feeder pillar shall also have provision to receive emergency power supply for AOL.

Adequately rated space heater with MCB, thermostat shall be provided for the feeder pillars.

Feeder pillar shall have adequate space to receive incoming and outgoing cable terminations for 415V, TPN supply loop-in and loop-out arrangement.

The feeder pillar-box shall be complete with double compression nickel- plated brass cable glands and tinned copper lugs.

The feeder pillar shall have two numbers external earthing terminals.

The feeder pillar-box shall be installed on a raised concrete foundation block and foundation shall be up to the level of minimum 300mm above HFL.

The feeder pillar shall be flameproof type when installed in hazardous area.

The proposed street lighting shall have smart lighting control features such as dimming, switching off, etc either on a pre-programmed basis or manually. The dimming feature shall be available for individual street lighting poles with the facility of dimming luminaries up to 30%. Necessary storage and hardware for controlling from the Command Control Centre shall be in the existing contractor scope.

Completion and Post Completion Activities

Mechanical completion is said to occur, when all erection/installation and commissioning of all electrical works and minor civil works under the scope of the Contractor are completed to the satisfaction of the Client’s Representative with

a) All installation alignment checks.

b) All panels and equipment erected, grouted, with all cabling and wiring,

terminations, routing, clamping, dressing, tagging, and ferruling duly completed including continuity and megger testing, and all installation checks.

At the stage of Mechanical completion, the Contractor shall ensure that all physical, aesthetic and workmanship aspects are totally completed, and the plant is fit and sound for undertaking pre-commissioning checks followed by commissioning.

Upon achieving mechanical completion, the Contractor shall notify the Client of such mechanical completion upon which the Client shall proceed with the checking of the works.

The Client may inform the Contractor regarding deficiencies for rectification by the Contractor within a jointly agreed period before the pre-commissioning checks could be undertaken. Alternately the Client, when the defects are of minor nature may undertake the pre-commissioning checks, permitting the Contractor to concurrently undertake rectification of such defects. Rectification of all defects, so notified by the Client, to his satisfaction shall be a prerequisite to issue of Taking over Certificate.

Testing and Commissioning

The Contractor shall carry out commissioning tests in the presence of the Client's representative. The evaluation of test results and decision passed by the Client's representative regarding the test results will be final and binding on the Contractor. Any additional tests or repetition of tests to establish satisfactory operation of any equipment shall be carried out by the Contractor, if so desired by the Client's representative at no extra cost.

The completion checks and commissioning tests to be carried out shall include, but not be limited to, those described in subsequent paragraphs, as applicable to the individual equipment/system.

All checks and tests shall be as per the Manufacturer's drawing manuals, relevant codes of installation and commissioning checklists described in subsequent paragraphs.

Among other commissioning tests, the following shall be carried out at site after completion of installation. Contractor shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards / International Standards. All tests to be carried out in the presence of Client's representatives.

a) Switchboard: Power frequency high voltage test, IR test, operation tests

b) Cables

• All new LT cables shall be megger tested before terminating / jointing. After

terminations / joints shall be megger tested by 1000V megger.

• All HT cables shall be megger tested before terminating / jointing. After terminations / joints shall be megger tested by 5000V megger.

• Cable core shall be tested for

- Continuity

    - Absence of cross phasing

    - Insulation resistance to earth

    - Insulation resistance between conductors

c) Earthing System

Continuity of all conductors and joints shall be checked. The Client's representatives may ask for earth continuity tests, earth resistance measurements and other tests, which in his opinion are necessary, to prove that the system is in accordance with design, specification, code of practice and CEA Regulations 2010. Earth resistance value should be not greater than one (1) ohm or as per local regulatory requirements, the stringent one to be applicable.

The Contractor shall carry out insulation resistance tests by a megger of following rating

Control circuits up to 220 V 500 V megger

Power circuits up to 1.1 kV 1000 V megger

In general, the following checks shall be carried out on all the equipment/systems, as applicable.

a) Name plate details according to approved drawings/ specifications

b) Any physical damage or defect and cleanliness

c) Tightness of all bolts, clamps and connections

d) Oil leakages and oil level

e) Condition of accessories and their completeness

f) Clearances

g) Earthing connections

h) Correctness of installation with respect to approved drawings/specifications

i) Lubrication of moving parts

j) Alignment

k) Correctness and condition of connections

Commissioning Tests

The following commissioning tests are to be carried out on all the equipment/systems, as applicable and as desired by EMPLOYER/ STATUTORY requirements.

a) Insulation resistance measurement of equipment, accessories, cabling/wiring etc.

b) Dielectric tests on equipment, accessories, cabling/ wires etc.

c) Continuity tests

d) Calibration of indicators, meters, relays, etc.

e) Control and interlock checks

f) Settings of equipment and accessories

g) Checking of accuracy/error

h) Checking of operating characteristics, pick-up voltages and currents, etc.

i) Operational and functional tests on equipment, accessories, control schemes, alarm/trip/indication circuits, etc.

j) Operational Checks for all the equipments for Auto and Manual mode.

k) Measurement of guaranteed/approved design values including lighting levels, earth resistance measurement, etc.

l) Complete commissioning checks of the system

Specific Tests to be carried out for various Equipments are as follows;

HT Distribution Board

a) Check of electrical wiring.

b) Tests on auxiliary and control circuits.

c) Check of electrical operation of safety (interlocking, automatic changeover, Local / Remote operations in test as well as service position including all electrical

interlocks etc).

d) Check of mechanical operations (insertion and withdrawal of removable parts, locks and interlocks system, operation of safety shutters, Anti pumping device operation etc.).

e) Protection system operation stability and sensitivity by primary injection testing method including testing of metering circuits

f) Check of setting of all protective and measurement devices (e.g. protection relays, smart devices, etc.).

g) IR values of power and control circuits

h) Panel indication, annunciation, space heater circuits

i) Spare contact for customer use

LT Switchgear Panels

a) Check of electrical wiring.

b) IR Values of power circuits & control circuits

c) Tests on auxiliary and control circuits.

d) Check of electrical operation of safety (interlocking, automatic changeover, Remote closing / Tripping circuits etc…).

e) Check of mechanical operations (insertion and withdrawal of removable parts, locks and interlocks system, operation of safety shutters, charging - closing - tripping of breaker etc..).

f) Check of setting of all protective and measurement devices (e.g. protection relays, smart devices, Secondary injection testing of protective relays/releases, Trip circuit healthiness and tripping through relays/ release etc...).

g) Indication / Annunciation / Panel space heater circuit / Space contacts for customer use

h) CT testing for polarity, ratio, IR values and magnetization for class PS characteristics

i) PT testing for ratio, IR values

j) Testing of modules for DOL/ Star-Delta/ATS/ Soft Starter starting or any other starting method as per the schematic drawings applicable.

HV & LV power cable, control cable & cable accessories

a) IR Values before Hipot

b) Hi Pot test for MV & HV cables.

c) IR Values after Hipot

Earthing System

a) Earthing resistance of each electrode

b) Earth continuity check.

c) Overall resistance of earthing installation.

List of vendors

Sr. No.	Material/ Equipment	Vendor
1.	Switchgear / Switchboard MV	Siemens ABB Schneider Electric
2.	Static Power Meter & Logger (Trivector Meter)	As per DISCOM Company
3.	Protection Relays (Numeric / Electro mechanic Type)/ Auxiliary relays)	Schneider Electric Siemens Alstom GE
4.	Potential & control Transformer (CT/PT)	Automatic Electric Precise Kappa Pragati
5.	Current Transformer (Cast Resin Epoxy Coated)	Automatic Electric Gilbert & Maxwell Kappa Pragati
6.	Electronic Digital Meter (A/V/PF/HZ/KWH) /MFM with LCD/LED Display.	Schneider Siemens AE Socomec L & T Rishabh
7.	HRC Fuse and Fuse Fitting	ABB GE Siemens

		L&T
8.	ACB / MCCB/ Contactors	ABB Schneider Siemens L&T
9.	Change over switch (automatic/ manual)	HPL Hager Socomec GE
10.	Thermister relay	Alstom/ Minilec/ Siemens
11.	Push Buttons	ABB L&T Schneider Siemens BCH
12.	MFP Panels - Totally Type Tested Assembly (TTA) Other LT Panels – Non TTA (As Per IEC61439- 1 & 2). To be sourced directly from OEM or authorized licensed partner.	Advance Panels & switchgears (P) Ltd. Adlec Power Pvt Ltd. Control & Switchgears Anant Power
13.	Switches, Time Delay Relay	Schneider Siemens Hager Legrand
14.	Indicating Lamps	Siemens Schneider ABB L&T BCH Esbee
15.	HT Power & Control Cables	Universal NICCO KEI KEC International Finolex CCI
16.	LT Power & Control Cables	Universal NICCO KEI KEC International Finolex

		CCI LAPP India
17.	HT/ LT Jointing Kit & Termination Kit	Birla-3M Raychem M seal
18.	Termination (Lugs)/ Cable Glands(Double compression)	Commet Dowell Jainson
19.	Selector Switches	Kaycee ABB Siemens Schneider
20.	Alarm Annunciators (solid state type with LED illumination) / Facia Annunciator	Industrial Instruments & Controls Minilec Alstom ICA
21.	Cable Management Systems-Raceways/Floor Boxes, Cable trays	Legrand OBO-Betterman MEM
22.	Cable tray hangers and Supports	Gripple Hilti
23.	Metal Clad Plug & Socket (Industrial)	Legrand Schneider Neptune (Balls)
24.	MCB/RCCB/ SPD/RCBO/ MPCB	Schneider Siemens ABB L & T
25.	Distribution Boards(MCB DBs)	Legrand Schneider Siemens ABB L & T
26.	Fire Sealant & Fire Retardant Paint	ndia Ltd. I at
27.	Fire Barriers / Sealing	Brattberg Roxtec Signum Navell Multikil

28.	Water barriers/sealing system	Roxtec Rayflate (Tyco Electronics)
29.	Terminal Blocks /connectors	Jainson Elmex Connect well Wago
30.	Single Phase Preventers	Minilec Siemens Schneider Electric L&T
31.	Water Tight Polycarbonate Boxes	Hensel Legrand Phraser

SPECIFICATIONS AND STANDARDS FOR OFC WORKS

OFC Trench must be aligned according to permission granted by authority/ agency. However following guidelines must be adhered to:

a) OFC Duct Trench must be done strictly within limits of the Road ROW.
b) Specified trench depth (1.20 Meter) has to be maintained always in all types of Soil from the NGL (Normal Ground Level). If such Depth is not feasible at any stage of deployment like on bridge or culvert then a proper protection must given to duct provisioned for OFC.
c) However in certain exceptional site conditions like hills or hard strata it may not be feasible to dig up to specified depth. In such cases, duct may be laid at lesser depth as per specification with DWC pipe/GI pipe/ PCC concreting individually as per specification in Annexure - A.
d) Bottom of trench shall be uniform and should follow contour of ground. Width of excavated trench sufficient to lay requisite number of HDPE Ducts and GI / DWC pipes and also concreting, wherever required.
e) HDPE duct(s) shall be laid in straight line, both laterally/ horizontally as well as vertically except at locations where it has to necessarily take a bend because of

change in alignment or gradient of trench. Minimum bending radius of two meters shall be maintained throughout.

f) Alignment of trench will be decided in consultation with RSCL site-In charge/Road/Town Planner.

g) Manholes (Joint & Loop Pit Chambers) should be installed at every 200 meters interval.

h) Covers of Manholes should be in two parts for easier installations and maintenance activities and Manholes cover must have for handle bar & name marking engraved. (Detailed drawing attached)

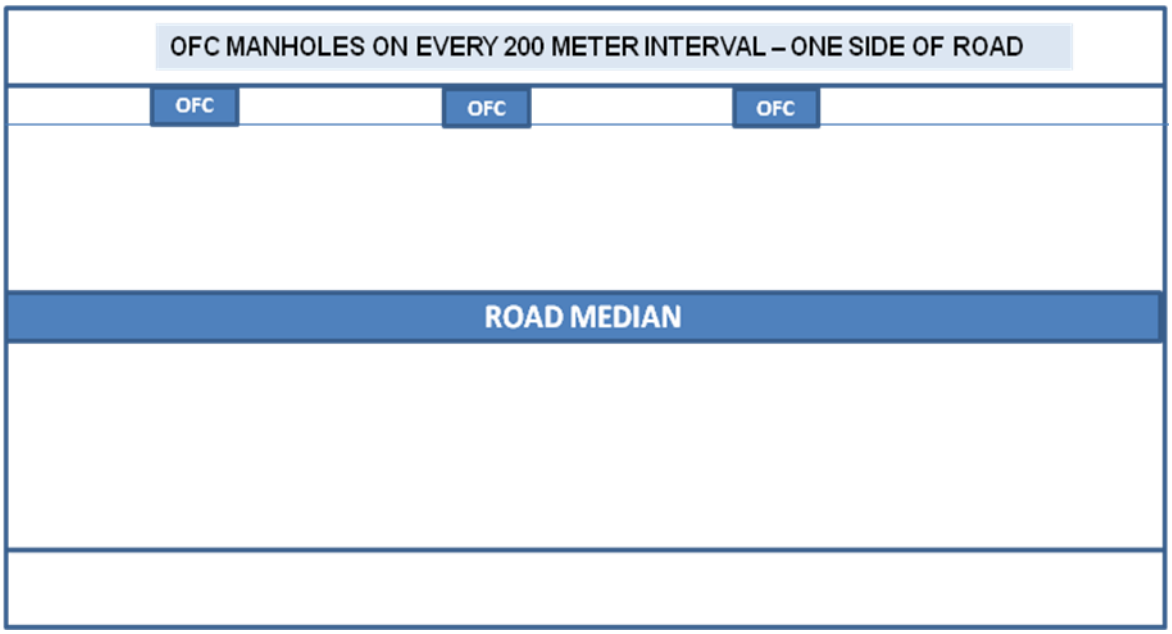

Figure 1 : OFC DUCT LOCATIONS ON ROAD

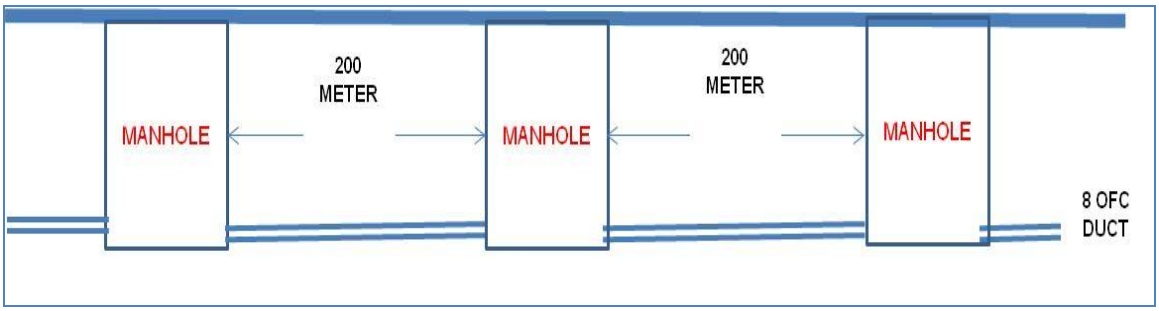

Figure 2: MANHOLES UNDERGROUND ELEVATION VIEW

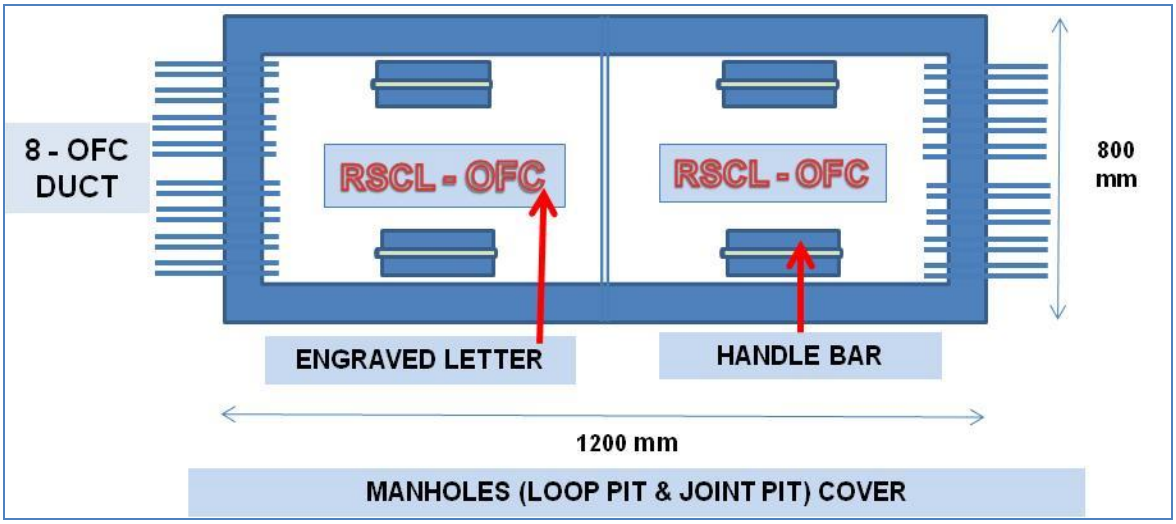

Figure 3: MANHOLES TOP VIEW (COVER IS TWO PARTS)

BRIDGE / CULVERT CROSSING

The work involves laying of HDPE ducts through GI/DWC pipes laid on the bridge. DWC pipes are to be used at such locations where sun rays and rain water don't fall on them. Either one of the following methods will be employed or same will be decided during first route survey of site engineer/route in charge/regional manager and Contractor representative.

a) On Arch type bridges where depth up to 300 mm is not possible to dig, make a trench in bridge tar road of 150-mm width and lay DWC duct as

per IS14930. Concreting 1:2:4 will be done over the DWC pipe up to the road level.

b) Leave the cable loop on each side of the culverts as specified. In case there are more than one culvert over 500 m span, 20-30 m OFC coils to be kept at 500M or as per RSCL engineer but not more than 2 locations in 1 Km length.

c) Loop pit marker will be installed at Loop Pit &

ROUTE MARKERS

a) Physical Route Markers should be done as per specifications.

b) Physical RM should be placed at every 200 Meter on route and every corner turning, crossing, culvert, JP, LP locations.

ROUTE SPECIFICATIONS (CIVIL)

ITEMS	ROUTE MARKER	
	Features	Minimum Configuration Requirements
Material	Reinforcement Details	T10 mm dia. MS Rod (4 No./Marker) stirrups dia. T8 mm at 100 mm C/C. both directions
	Concrete Mix	1:2:4
	Size of metal to be used	10 mm (Min)
Route Marker Dimension	Height	1250 mm
	Width x Depth (Top)	150 mm x 100 mm
	Width x Depth (Bottom)	250 mm x 150 mm
Labeling	As per attached Route Marker Diagram. All lettering should be embossed in concrete surface and painted with appropriate colors.	
Painting	Paint Quality	Synthetic Enamel
	Paint Approved	Asian or Equivalent
	Color of Normal Route Marker	Orange - British Color Standard (06-E-55 Orange)
	Color of Normal Splice Marker	Yellow -British Color Standard (10-E-51 Yellow)
	Color of Normal Loop Marker	Green - British Color Standard (14-E-56 Green)

ITEMS	ROUTE MARKER	
	Features	Minimum Configuration Requirements
Physical Observation	Curing of Route Marker	Shall be kept under curing for minimum 14 days before supply to side.
	Visual Inspection	Shall be free from crack and damages before installation
	Surface	Surface of the marker shall be smooth and shiny

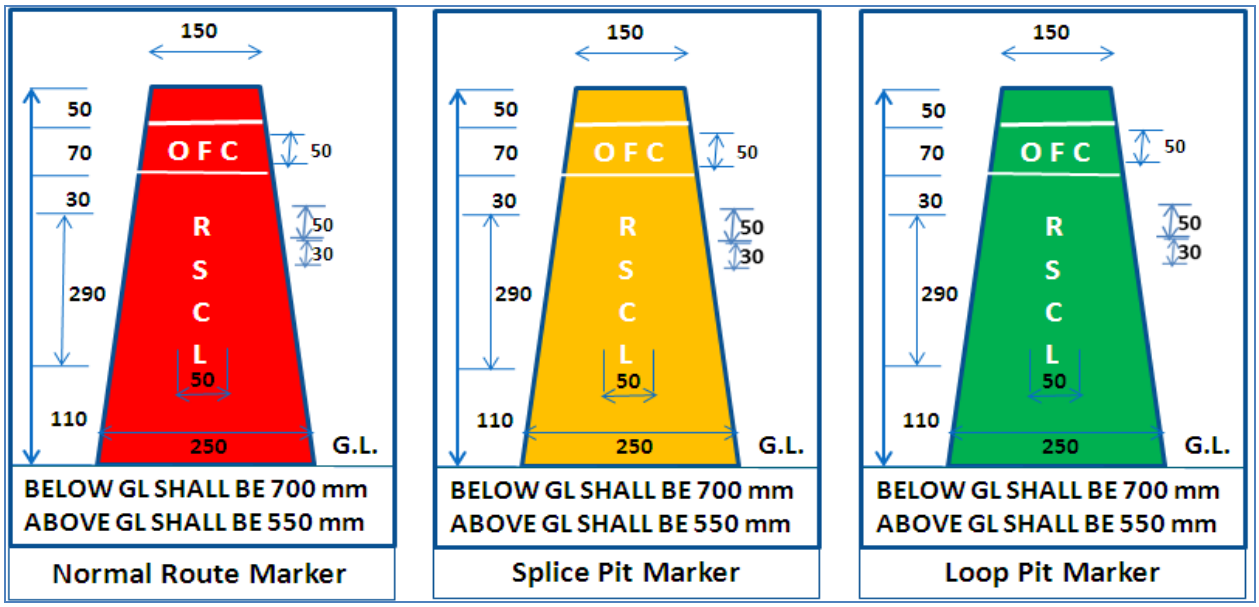

Figure 4 : Route Markers

SPECIFICATIONS OF OFC DUCT LAYING

- Depth - 1200 mm
- Counts of OFC Duct to be laid – 8 Numbers
- If depth is not achievable in Open Trench (If separate from electrical trench) & HDD methods then protections should be as per annexure - A

SPECIFICATIONS OF JOINT-PIT & LOOP-PIT CHAMBERS

- Height: 1200mm
- Wall Thickness:- 150 mm (with Iron rod 10mm reinforcement in both directions at 100mm distance)
- Length x Width (Rectangular):- 1200 x 800 mm
- Lid: - Split Type 150 mm thick, with Iron rod 10mm reinforcement in both directions at 100mm distance.

- Lid (cover) Should be pre-cast in 3mm thick GI Sheet tray to avoid distortion & corner/casting damage by travelling of vehicles (Dimension as per the lid size)

SPECIFICATIONS OF HDPE DUCTS

ITEMS	HDPE DUCT	
	Features	Minimum Configuration Requirements
HDPE DUCT	ISI Standards	1. IS: 4984 - 1995 - Specification for High Density Polyethylene Pipes for Water Supplies. 2. IS: 7328 - 1992 - High-density polyethylene materials for moulding and extrusion. 3. IS: 2530 - 1963 - Methods for Tests for polyethylene moulding materials and polyethylene compounds. 4. ASTM: D-638, Type-IV Specimens 6993 - Test Method for Environmental Stress-Cracking Ethylene Plastics.
	Size	40 mm outer dia & 32 mm internal dia
	Service Life	50 Years
	Color	Orange & Yellow(Reserved for RSCL) & Rest 6 Duct for to lease private & govt. operators (Red, Green, Blue, Gray Brown, Black)
	Materials	The material used in the manufacture of ducts shall contain suitable UV-Stabilizers in required proportions such that ultra violet rays do not affect the ducts

ANNEXURES – A (DEPTH)

Deviation Type	Variation of depth in mm		Type of protection
Type 'A'	1200	1000	Backfilling and compaction if found less depth in AT
Type 'B'	1000	800	DWC as per IS 14930 " Duraline"
Type 'C'	600	600	DWC with all around covering with 1:2:4 PCC size 300mm WX300mm H. In case of surface hard rock (from the top of NGL) only DWC pipe will be used with Stone Pitching
Type 'D'	600	400	DWC with all around covering with Chicken mesh sieve (Murga Jali) and then with 1:2:4 PCC size 300mm WX300 mm H with 80mm PCC bed if surface uneven due to HR and sharp edges of stones to avoid damage of ducts

ANNEXURES – B (JP-LP SPECIFICATIONS AND PRE INSTALLATION CHECK LIST)

Pre- Installation Check-List of Joint Pit & Loop Pit		
Material	Reinforcement Details	10 mm Dia MS Steel Rod at 100 mm C/C on both direction
	Concrete Mix	1:2:4
	Size of Metal in RCC	20 mm
Dimension of RCC Chamber	Height of Chamber	1200 mm for all type
	Inner Dia of Chamber	800*1200 mm for all type
	Thickness of Chamber	150 mm (In all directions)
Dimension of Chamber's LID	Diameter of LID	1200*800 mm
	Thickness of LID	150 mm for all type
	Lift Handle	Two no. separated from the centre equally on the top of the LID for lifting purpose.
Dimension of Clamp & Accessories for Holding Joint Closure inside the RCC Chamber	Clamp Material	Galvanized Iron Strip
	Design	Refer Drawing
Dimension of Duct Entries	Duct Entry	Full Circle "O" cut in bottom of chamber wall
	Sealing of Duct Entry	Any open space must be properly sealed with RCC
Physical Check	Curing of JP & LP Chambers	Chambers shall be kept for curing for minimum 14 days before installation & supply to site
	Workmanship	Shall be free from any cracks and damages before installation
	Surfaces	Surface of the chambers shall be smooth and shiny.
	Lift Handle	Check whether the handles are firmly bonded with concrete lid
	Duct Entry Points	Duct entries surface shall be free from sharp edges

ANNEXURES – C (JP- LP POST- INSTALLATION CHECK LIST)

Post-Installation Check-List of Joint Pit & Loop Pit		
Installation	Depth from top to LID of Chambers	0.0 mm from NGL (Normal Ground Level)
	Placements	RCC chambers are to be installed at centre of the trench & duct
	Duct Entries	Full Circle "O" cut in bottom of chamber wall
Bottom RCC/PCC	Dimensions of Concrete	150 mm thick Bottom base of chamber shall be pre-cast as like cover of chambers.
	Workmanship	Shall be free from any cracks and damages before installation
Simple Plug & END Plug	Cable Duct	Simple Plugs are to be installed at end of every duct entering to Chambers
	Spare Duct	End Plugs are to be installed at end of every duct entering to Chambers

SCHEDULE - E
(See Clauses 2.1 and 14.2)

MAINTENANCE REQUIREMENTS

1 Maintenance Requirements

1.1 The Contractor shall, at all times maintain the Project in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.

1.2 The Contractor shall repair or rectify any Defect or deficiency set forth in Paragraph 2 of this Schedule-E within the time limit specified therein and any failure in this behalf shall constitute non-fulfillment of the Maintenance obligations by the Contractor. Upon occurrence of any breach hereunder, the Authority shall be entitled to effect reduction in monthly lump sum payment as set forth in Clause 14.6 of this Agreement, without prejudice to the rights of the Authority under this Agreement, including Termination thereof.

1.3 All Materials, works and construction operations shall conform to the MORTH Specifications for Road and Bridge Works, and the relevant IRC publications. Where the specifications for a work are not given, Good Industry Practice shall be adopted.

Specify all the relevant documents

2 Repair/rectification of Defects and deficiencies

The obligations of the Contractor in respect of Maintenance Requirements shall include repair and rectification of the Defects and deficiencies specified in Annex - I of this Schedule-E within the time limit set forth therein.

3 Other Defects and deficiencies

In respect of any Defect or deficiency not specified in Annex - I of this Schedule-E, the Authority's Engineer may, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Specifications and Standards, and any deviation or deterioration beyond the permissible limit shall be repaired or rectified by the Contractor within the time limit specified by the Authority's Engineer.

4 Extension of time limit

Notwithstanding anything to the contrary specified in this Schedule-E, if the nature and extent of any Defect or deficiency justifies more time for its repair or rectification than the time specified herein, the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Authority's Engineer and

conveyed to the Contractor and the Authority with reasons thereof.

5 Emergency repairs/restoration

Notwithstanding anything to the contrary contained in this Schedule-E, if any Defect, deficiency or deterioration in the Project poses a hazard to safety or risk of damage to property, the Contractor shall promptly take all reasonable measures for eliminating or minimizing such danger.

6 Daily inspection by the Contractor

The Contractor shall, through its engineer, undertake a daily visual inspection of the Project and maintain a record thereof in a register to be kept in such form and manner as the Authority's Engineer may specify. Such record shall be kept in safe custody of the Contractor and shall be open to inspection by the Authority and the Authority's Engineer at any time during office hours.

7. Pre-monsoon inspection / Post-monsoon inspection

The Contractor shall carry out a detailed pre-monsoon inspection of all bridges, culverts and drainage system before [1st June] every year in accordance with the guidelines contained in IRC: SP35. Report of this inspection together with details of proposed maintenance works as required on the basis of this inspection shall be sent to the Authority's Engineer before the [10th June] every year. The Contractor shall complete the required repairs before the onset of the monsoon and send to the Authority's Engineer a compliance report. Post monsoon inspection shall be done by the [30th September] and the inspection report together with details of any damages observed and proposed action to remedy the same shall be sent to the Authority's Engineer.

8. Repairs on account of natural calamities

All damages occurring to the Project on account of a Force Majeure Event or default or neglect of the Authority shall be undertaken by the Authority at its own cost. The Authority may instruct the Contractor to undertake the repairs at the rates agreed between the Parties.

Annex - I
(Schedule-E)

Repair/rectification of Defects and deficiencies

The Contractor shall repair and rectify the Defects and deficiencies specified in this Annex-I of Schedule-E within the time limit set forth in the table below.

Nature of Defect or deficiency		**Time limit for repair/rectification**
ROADS		
(a)	**Carriageway and paved shoulders**	
(i)	Breach or blockade	Temporary restoration of traffic within 24 hours; permanent restoration within 15 (fifteen) days
(ii)	Roughness value exceeding 2,200 mm in a stretch of 1 km (as measured by a calibrated bump integrator)	120 (one hundred and twenty) days
(iii)	Pot holes	24 hours
(iv)	Any cracks in road surface	15 (fifteen) days
(v)	Any depressions, rutting exceeding 10 mm in road surface	30 (thirty) days
(vi)	Bleeding/skidding	7 (seven) days
(vii)	Any other defect/distress on the road	15 (fifteen) days
(viii)	Damage to pavement edges	15 (fifteen) days
(ix)	Removal of debris, dead animals	6 hours
(b)	**Granular earth shoulders, side slopes, drains and culverts**	
(i)	Variation by more than 1 % in the prescribed slope of camber/cross fall (shall not be less than the camber on the main carriageway)	7 (seven) days

Nature of Defect or deficiency		**Time limit for repair/rectification**
(ii)	Edge drop at shoulders exceeding 40 mm	7 (seven) days
(iii)	Variation by more than 15% in the prescribed side (embankment) slopes	30 (thirty) days
(iv)	Rain cuts/gullies in slope	7 (seven) days
(v)	Damage to or silting of culverts and side drains	7 (seven) days
(vi)	Desilting of drains in urban/semi-urban areas	24 hours
(vii)	Railing, parapets, crash barriers	7 (seven) days (Restore immediately if causing safety hazard)
(c)	**Road side furniture including road sign and pavement marking**	
(i)	Damage to shape or position, poor visibility or loss of retro-reflectivity	48 hours
(ii)	Painting of km stone, railing, parapets, crash barriers	As and when required/Once every year
(iii)	Damaged/missing road signs requiring replacement	7 (seven) days
(iv)	Damage to road mark ups	7 (seven) days
(d)	**Road lighting**	
(i)	Any major failure of the system	24 hours
(ii)	Faults and minor failures	8 hours
(e)	**Trees and plantation**	
(i)	Obstruction in a minimum head-room of 5 m above carriageway or obstruction in visibility of road signs	24 hours
(ii)	Removal of fallen trees from carriageway	4 hours

(iii)	Deterioration in health of trees and bushes	Timely watering and treatment
Nature of Defect or deficiency		**Time limit for repair/rectification**
(iv)	Trees and bushes requiring replacement	30 (thirty) days
(v)	Removal of vegetation affecting sight line and road structures	15 (fifteen) days
(f)	**Rest area**	
(i)	Cleaning of toilets	Every 4 hours
(ii)	Defects in electrical, water and sanitary installations	24 hours
(g)	**[Toll Plaza]**	
(h)	**Other Project Facilities and Approach roads**	
(i)	Damage in approach roads, pedestrian facilities, truck lay-byes, bus-bays, bus-shelters, cattle crossings, [Traffic Aid Posts, Medical Aid Posts] and service roads	15 (fifteen) days
(ii)	Damaged vehicles or debris on the road	4 (four) hours
(iii)	Malfunctioning of the mobile crane	4 (four) hours
Bridges		
(a)	**Superstructure**	
(i)	Any damage, cracks, spalling/ scaling Temporary measures Permanent measures	within 48 hours within 15 (fifteen) days or as specified by the Authority's Engineer
(b)	**Foundations**	
(i)	Scouring and/or cavitation	15 (fifteen) days

(c)	**Piers, abutments, return walls and wing walls**	
(i)	Cracks and damages including settlement and tilting, spalling, scaling	30 (thirty) days
Nature of Defect or deficiency		**Time limit for repair/rectification**
(d)	**Bearings (metallic) of bridges**	
(i)	Deformation, damages, tilting or shifting of bearings	15 (fifteen) days Greasing of metallic bearings once in a year
(e)	**Joints**	
(i)	Malfunctioning of joints	15 (fifteen) days
(f)	**Other items**	
(i)	Deforming of pads in elastomeric bearings	7 (seven) days
(ii)	Gathering of dirt in bearings and joints; or clogging of spouts, weep holes and vent-holes	3 (three) days
(iii)	Damage or deterioration in kerbs, parapets, handrails and crash barriers	3 (three) days (immediately within 24 hours if posing danger to safety)
(iv)	Rain-cuts or erosion of banks of the side slopes of approaches	7 (seven) days
(v)	Damage to wearing coat	15 (fifteen) days
(vi)	Damage or deterioration in approach slabs, pitching, apron, toes, floor or guide bunds	30 (thirty) days
(vii)	Growth of vegetation affecting the structure or obstructing the waterway	15 (fifteen) days
(g)	**Hill Roads**	
(i)	Damage to retaining wall/breast wall	7 (seven) days
(ii)	Landslides requiring clearance	12 (twelve) hours
(iii)	Snow requiring clearance	24 (twenty four) hours

[Note: Where necessary, the Authority may modify the time limit for repair/rectification, or add to the nature of Defect or deficiency before issuing the bidding document, with the approval of the competent authority.]

SCHEDULE - F
(See Clause 3.1.7(a))

APPLICABLE PERMITS

1 Applicable Permits

1.1 The Contractor shall obtain, as required under the Applicable Laws, the following Applicable Permits:

(a) Permission of the State Government for extraction of boulders from quarry;

(b) Permission of Village Panchayats and Pollution Control Board for installation of crushers;

(c) Licence for use of explosives;

(d) Permission of the State Government for drawing water from river/reservoir;

(e) Licence from inspector of factories or other competent Authority for setting up batching plant;

(f) Clearance of Pollution Control Board for setting up batching plant;

(g) Clearance of Village Panchayats and Pollution Control Board for setting up asphalt plant;

(h) Permission of Village Panchayats and State Government for borrow earth; and

(i) Any other permits or clearances required under Applicable Laws.

1.2 Applicable Permits, as required, relating to environmental protection and conservation shall have been procured by the Authority in accordance with the provisions of this Agreement.

SCHEDULE – G

(See Clauses 7.1.1, 7.5.3 and 19.2)

FORM OF BANK GUARANTEE

Annex-I

(See Clause 7.1.1)

[Performance Security/Additional Performance Security]

Chief Executive Officer ,

Rourkela Smart City Ltd

Udit Nagar Rourkela 764012

WHEREAS:

(A) _____ [name and address of contractor] (hereinafter called the "**Contractor**") and Rourkela Smart City Ltd , Udit Nagar Rourkela 769012 [name and address of the authority], (hereinafter called the **"Authority"**) have entered into an agreement (hereinafter called the "**Agreement**") for the Redevelopment of road From Panposh Chowk to Ambedkar Chowk from 0.00 k.m to 3.62 k.m Section of MRO9 Road including streetscape , beatification , landscaping, intersection redesign, utility ducting and underground cabling in Rourkela Smart City Limited (ABD) under Smart Cities Mission through on Engineering, Procurement and Construction (the "**EPC**") basis, subject to and in accordance with the provisions of the Agreement

(B) The Agreement requires the Contractor to furnish a Performance Security for due and faithful performance of its obligations, under and in accordance with the Agreement, during the {Construction Period/ Defects Liability Period and Maintenance Period} (as defined in the Agreement) in a sum of Rs….. cr. (Rupees ……..….. crore) (the "**Guarantee Amount**").

(C) We, …….. through our branch at ……. (the "**Bank**") have agreed to furnish this bank guarantee (*hereinafter called the* **"Guarantee**") by way of Performance Security.

NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful performance of the Contractor's obligations during the {Construction Period/ Defects Liability Period and Maintenance Period} under and in accordance with the Agreement, and agrees and undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the

Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of General Manager in the Rourkela Smart City Ltd., that the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Agreement or to extend the time or period for the compliance with, fulfillment and/ or performance of all or any of the obligations of the Contractor contained in the Agreement or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other

guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Agreement or for the fulfillment, compliance and/or performance of all or any of the obligations of the Contractor under the Agreement.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Guarantee shall cease to be in force and effect on ****[$]. Unless a demand or claim under this Guarantee is made in writing before expiry of the Guarantee, the Bank shall be discharged from its liabilities hereunder.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorised to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.

11. This Guarantee shall come into force with immediate effect and shall remain in force and effect for up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

Signed and sealed this ……. day of …….., 20…… at ……..

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

[$] Insert date being 2 (two) years from the date of issuance of this Guarantee (in accordance with Clause 7.2 of the Agreement).

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.

(ii) The address, telephone number and other details of the head office of the Bank as well as of issuing branch should be mentioned on the covering letter of issuing branch.

Annex – II
(Schedule - G)
(See Clause 7.5.3)

Form for Guarantee for Withdrawal of Retention Money

Chief Executive Officer ,

Rourkela Smart City Ltd

Udit Nagar Rourkela 764012

WHEREAS:

(A) [name and address of contractor] (hereinafter called the "**Contractor**") has executed an agreement (hereinafter called the "Agreement") with the Rourkela Smart City Ltd , Udit Nagar Rourkela 769012 [name and address of the authority], (hereinafter called the "**Authority**") for the "Redevelopment of road from Panposh Chowk to Ambedkar Chowk from 0.00 k.m to 3.62 km Section of MRO9 Road including streetscape , beatification , landscaping, intersection redesign, utility ducting and underground cabling in Rourkela Smart City Limited (ABD) under Smart Cities Mission through on Engineering, Procurement and Construction (the "**EPC**")" basis, subject to and in accordance with the provisions of the Agreement.

(B) In accordance with Clause 7.5.3 of the Agreement, the Contractor may withdraw the retention money (hereinafter called the "**Retention Money**") after furnishing to the Authority a bank guarantee for an amount equal to the proposed withdrawal.

(C) We, …….. through our branch at ……. (the "**Bank**") have agreed to furnish this bank guarantee (hereinafter called the "**Guarantee**") for the amount of Rs. --------- cr. (Rs.----------crore) (the "**Guarantee Amount**").

NOW, THEREFORE, the Bank hereby unconditionally and irrevocably guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of General Manager in the Rourkela Smart City Ltd., that the Contractor has committed default in the due and faithful performance of all or any of its obligations for under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final, and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Retention Money and any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Retention Money.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee

shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Guarantee shall cease to be in force and effect 90 (ninety) days after the date of the Completion Certificate specified in Clause 12.4 of the Agreement.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorised to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.

11. This Guarantee shall come into force with immediate effect and shall remain in force and effect up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

Signed and sealed this ……. day of …….., 20…… at ……..

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.

(ii) The address, telephone number and other details of the head office of the Bank as well as of issuing branch should be mentioned on the covering letter

of issuing branch.

Annex – III
(Schedule - G)
(See Clause 19.2)

Form for Guarantee for Advance Payment

Chief Executive Officer ,

Rourkela Smart City Ltd

Udit Nagar Rourkela 764012

WHEREAS:

(A) [name and address of contractor] (hereinafter called the "**Contractor**") has executed an agreement (hereinafter called the "**Agreement**") with the [name and address of the authority], (hereinafter called the "**Authority**") for the construction of Redevelopment of road from Panposh Chowk to Ambedkar Chowk from 0.00 k.m to 3.62 km Section of MRO9 Road including streetscape , beatification , landscaping, intersection redesign, utility ducting and underground cabling in Rourkela Smart City Limited (ABD) under Smart Cities Mission on Engineering, Procurement and Construction (the "**EPC**") basis, subject to and in accordance with the provisions of the Agreement

(B) In accordance with Clause 19.2 of the Agreement, the Authority shall make to the Contractor an interest bearing (@ Bank Rate) advance payment (herein after called "**Advance Payment**") equal to 10% (ten per cent) of the Contract Price; and that the Advance Payment shall be made in two installments subject to the Contractor furnishing an irrevocable and unconditional guarantee by a scheduled bank for an amount equivalent to 110% (one hundred and ten percent) of such installment to remain effective till the complete and full repayment of the installment of the Advance Payment as security for compliance with its obligations in accordance with the Agreement. The amount of {first/second} installment of the Advance Payment is Rs. ------ cr. (Rupees ------ crore) and the amount of this Guarantee is Rs. ------- cr. (Rupees ------ crore) (the **"Guarantee Amount")**[$]**.**

[$] The Guarantee Amount should be equivalent to 110% of the value of the applicable instalment.

(C) We, …….. through our branch at ……. (the "**Bank"**) have agreed to furnish this bank guarantee (*hereinafter called the* **"Guarantee"**) for the Guarantee Amount.

NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful repayment on time of the aforesaid instalment of the Advance Payment under and in accordance with the Agreement, and agrees and undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of General Manager in the Rourkela Smart City Ltd., that the Contractor has committed default in the due and faithful performance of all or any of its obligations for the repayment of the instalment of the Advance Payment under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Advance Payment or to extend the time or period of its repayment or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions

contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Advance Payment.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Guarantee shall cease to be in force and effect on ****.[$] Unless a demand or claim under this Guarantee is made in writing on or before the aforesaid date, the Bank shall be discharged from its liabilities hereunder.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalf of the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorised to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.

11. This Guarantee shall come into force with immediate effect and shall remain in force and effect up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the

[$] Insert a date being 90 (ninety) days after the end of one year from the date of payment of the Advance payment to the Contractor (in accordance with Clause 19.2 of the Agreement).

Agreement.

Signed and sealed this ……. day of …….., 20…… at ……..

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.

(ii) The address, telephone number and other details of the head office of the Bank as well as of issuing branch should be mentioned on the covering letter of issuing branch.

3.

SCHEDULE - H

(See Clauses10.1.4 and 19.3)

Contract Price Weightages

Contract Price Weightages

1.1 The Contract Price for this Agreement is Rs. ******

1.2 Proportions of the Contract Price for different stages of Construction of the Smart Road shall be as specified below:

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage
1	2	3	4
Road works including foot path & cycle track	30.90	**Reconstruction of road, cycle track, widening of foot path & over laying** (1) Completion of all works up to top of Sub grade (2) Granular work (sub-base, base, shoulders) (3) Wet Mix Macadam (4) Dense Bituminous Macadam (DBM) (5) Bituminous Concrete (6) Road markings, paintings, signages etc. after completion of work (7) Bus Shelter	1.80 3.42 5.15 30.39 20.55 10.35 28.34
Landscaping work	15.00	(1) Softscaping works (plantation, ground covers, lawn, shrubs) (2) Hard scaping works (Paver block, benches, street furniture, (3) Roll-on Surfacing Material on cycle track & foot path	12.11 56.55 31.34
Underground duct	27.10	(1)Retro fitting in Existing trench (2) Pipe Laying (for electrical	25.00

		cables & OFC cables including manholes, chamber etc.) (3) Construction of new trench	40.00 35.00
Underground cabling works	25.00	(1) Laying of XLPE Cables in above facilities including other associated Works (Installation of 11kV DB, LT Feeder panels, etc) (2) Commissioning and restoration of existing power supply system	90.00 10.00
Drainage	2.00	**(1)** Disposal arrangement of gray & rain water from property to road side drain **(2)** Construction of new RCC drain in landscape area	25.00 75.00

Note: The above list is illustrative and may require modification as per the scope of the work.

1.3 Procedure of estimating the value of work done

1.3.1 Reconstruction of road, cycle track, widening of foot path & over laying.

Procedure for estimating the value of road work done shall be as follows:

Table 1.3.1

Stage of Payment	Percentage - weightage	Payment Procedure
(1) Completion of all works up to top of Sub grade	1.80	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of a stage in a length of not less than 10 (ten) percent of the total length.*
(2) Granular work (sub-base, base, shoulders)	3.42	
(3) Wet Mix Macadam	5.15	
(4) Dense Bituminous Macadam (DBM)	30.39	
(5) Bituminous Concrete	20.55	

Stage of Payment	Percentage - weightage	Payment Procedure
(6) Road markings, paintings, signages etc. after completion of work	10.35	
(7) Bus Shelter	28.34	Cost of completed bus shelters shall be determined pro rata with respect to the total number of bus shelters. Payment shall be made on the completion of number of culverts.

* For example, if the total length of bituminous work to be done is 100 km, the cost per km of bituminous work shall be determined as follows:

Cost per km = (P) X (weightage for road work) X (weightage for bituminous work) X (1/L)

Where P= Contract Price

L = Total length in km

Similarly, the rates per km for stages for other stages will be worked out.

1.3.2 Landscaping Work.

Procedure for estimating the value of landscaping work shall be as stated in table 1.3.2:

Table 1.3.2

Stage of Payment	Weightage	Payment Procedure
(1)Softscaping works (plantation, ground covers, lawn, shrubs)	12.11	Unit of measurement is Square meter area. Payment of each stage shall be made on pro rata basis on completion of a stage in a area of not less than 10 (ten) percent of the total area.
(2) Hard scaping works (Paver block, benches, street furniture,	56.55	
(3) Roll-on Surfacing Material on cycle track & foot path	31.34	

1.3.3 Under Ground ducting

Procedure for estimating the value of structure work shall be as stated in table 1.3.3:

Table 1.3.3

Stage of payment	Weightage	Payment procedure
(1)Retro fitting in Existing trench	25.00	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of a stage in all respect as per approved design in a length of not less than 10 (ten) percent of the total length.
(2) Pipe Laying (for electrical cables & OFC cables including manholes, chamber etc.)	40.00	
(3) Construction of new trench	35.00	

1.3.4 Underground Cabling

Procedure for estimating the value of structure work shall be as stated in table 1.3.4:

Table 1.3.4

Stage of payment	Weightage	Payment procedure
(1) Laying of XLPE Cables in above facilities including other associated Works (Installation of 11kV DB, LT Feeder panels, etc)	90.00	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of a stage in all respect as per approved design in a length of not less than 10 (ten) percent of the total length.
(2) Commissioning and restoration of existing power supply system	10.00	Payment shall be made on successful commissioning and restoration of existing power supply system after completion of stage-4

		activity of this table.

1.3.5 Drainage.

Procedure for estimating the value works done shall be as stated in table 1.3.4.

Table 1.3.5

Stage of Payment	Weightage	Payment Procedure
(1) Disposal arrangement of gray & rain water from property to road side drain	25.00	Unit of measurement is linear length. Payment of each stage shall be made on completion of all activities for a particular length as per approved design. Minimum measurement for stage billing will be for a length of not less than 10 (ten) percent of the total length.
(2) Construction of new RCC drain in landscape area	75.00	Unit of measurement is linear length. Payment of each stage shall be made on pro rata basis on completion of a stage in all respect as per approved design in a length of not less than 10 (ten) percent of the total length.

2. Procedure for payment for Maintenance

1.1 The cost for maintenance shall be as stated in Clause 14.1.1.

2.2 Payment for Maintenance shall be made in quarterly installments in accordance with the provisions of Clause 19.7.

SCHEDULE - I
(See Clause 10.2.4)

DRAWINGS

1. Drawings

In compliance of the obligations set forth in Clause 10.2 of this Agreement, the Contractor shall furnish to the Authority's Engineer, free of cost, all Drawings listed in Annex-I of this Schedule-I.

2. Additional Drawings

If the Authority's Engineer determines that for discharging its duties and functions under this Agreement, it requires any drawings other than those listed in Annex-I, it may by notice require the Contractor to prepare and furnish such drawings forthwith. Upon receiving a requisition to this effect, the Contractor shall promptly prepare and furnish such drawings to the Authority's Engineer, as if such drawings formed part of Annex-I of this Schedule-I.

Annex - I
(Schedule - I)

List of Drawings

On Award of work the Contractor shall submit the design and Drawing to the Authority Engineer free of cost under clause 10.2. Drawings mentioned in the list are indicative and for Information. Contractor shall not limit himself to the same but it is in scope of Contractor to submit all required design and drawings for review and approval as per Instruction from Authority Engineer.

Documents:

Sr. No.	Documents
1	Geotechnical Investigation Report
2	Topography Survey Layout
3	Civil / Structural Design Basis Report
4	Structural Design (Calculations) Report
5	Proposed Layout for shifting of utilities
6	Good for Construction Drawings as per Drawing List below
7	Lighting design calculations

Drawings:

Utility Drawings	
1	General Arrangement Drawing for underground utilities including storm water drainage channels, sewage, water, gas, electricity and OFC pipes.
2	Structural Layout and Details of Utility Trenches and Manholes
3	Typical Joinery Details
4	Typical Construction, Fabrication and Formwork Details
B	**Road Drawings**
5	General Arrangement Drawings showing all elements as per concept designs and technical specifications
6	Streetscape (Public Realm) Plan drawings from edge of carriageway to property edge for both sides at 1:200 scale
7	Road Levels
8	Typical ROW cross sections at every 50-100m depending on variability
9	Typical sections at zebra crossings, raised pedestrian crossings, junctions, property entry/exits
10	Detailed section for Re-carpeting works for roads
11	Typical details for Streetscape Paving designs, including raised

	crossing pavers, raised service lane paving, and pervious pavers.
13	Typical details for Medians and Kerb conditions
14	Typical details for Raised Pavement Markers, Road Markings, Road Delineators
15	Pedestrian Bridge Details
16	Typical details of painting of kerbs, medians, pedestrian refuge, flyover edge condition etc.
17	Typical details of ramps and tactile paving markers
C	**Typical Details / Shop Drawings**
18	Seating Bench Details – Types 1-4 – shop drawing
19	Concrete Bollard Details – shop drawing
21	Traffic Signage Details – shop drawing
22	Pedestrian Signage Details Types 1-4 p drawing
23	Garbage Bin Details – shop drawing
24	Bus Shelter Details – shop drawing
27	Lighting Pole Details – shop drawing
28	Landscaping Details including plantation of trees, transplantation of trees, bio-swale construction, planting shrubs and grass – plan, details and sections

LIST OF DRAWINGS / DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

Following drawings, calculations & schedules shall be submitted to Employer/ DISCOM for approval before procurement, fabrication and Installation of equipments at site:

S.N.	Deliverables
1.0	Single Line Diagram of Complete Electrical System based on the design criteria.
2.0	Cabling system
a.	Details of Installation of Cables in Trenches, on cable trays, racks directly buried etc., at all locations as specified including cable trays.
b.	11kV & 1.1kV Cable routing layout along with road cross sectional details.
c.	Bill of quantities of LT cables, lugs and glands & HT Termination Kits.
d.	11kV Cable termination and mounting Kit Layout drawing.
3.0	Earthing system
a)	Detail calculations of earthing network.
b)	Earthing notes including detail write up and drawings of earthing conductor layout, equipment & structural earthing, joints, cable earthing, instrument earthing.

S.N.	Deliverables
c)	Details such as material, sizes, etc. of the earth conductor and electrode pits
4.0	HT DB / LT Switchgear
a)	Design Calculations for Bus bar sizing, CT Sizing of all type etc. for each Switchboard along with a copy of relevant standard referred for the same
b)	Guaranteed Technical Parameters
c)	Equipment GA & Section drawings with dimensions, clearances, locations of components- CT, Terminals, etc. of each type of switchboard with component layouts like LV Compartment, etc with general notes
d)	Base frame and Foundation GA drawings with dimension and details
e)	Electrical Control drawing for all panels with general notes like sizes, type, Material details and other details
f)	Bill of material along with make, quantity, model no and ratings
g)	All the Type Test certificates to prove the compliance with the requirements and submit certificates before award of contract.
5.0	All civil drawings related to substation building & foundation of all the electrical items.
B)	**Calculations**
a)	Co-ordinated protection study with latest available version of ETAP software.
b)	HT & LT cable sizing
c)	Bus bar, breaker sizing calculations and other relevant sizing calculations for HT, LT distribution boards
C)	**Schedules**
a)	Cable Schedule
b)	Interconnection schedule
c)	Junction Box Schedule

All equipment/system sizing calculations/drawings shall be submitted to the Employer for approval whether specifically mentioned or not.

SCHEDULE - J
(See Clause 10.3.2)

PROJECT COMPLETION SCHEDULE

1 Project Completion Schedule

During Construction period, the Contractor shall comply with the requirements set forth in this Schedule-J for each of the Project Milestones and the **Scheduled Completion Date**. Within 15 (fifteen) days of the date of each Project Milestone, the Contractor shall notify the Authority of such compliance along with necessary particulars thereof.

2 Project Milestone-I

2.1 Project Milestone-I shall occur on the date falling on the 80th (eightieth) day from the Appointed Date (the "**Project Milestone-I**").

2.2 Prior to the occurrence of Project Milestone-I, the Contractor shall have commenced construction of the Smart Road and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 10% (ten per cent) of the Contract Price.

3 Project Milestone-II

3.1 Project Milestone-II shall occur on the date falling on the 160th (one hundred and sixtieth) day from the Appointed Date (the "**Project Milestone-II**").

3.2 Prior to the occurrence of Project Milestone-II, the Contractor shall have continued with construction of the Smart Road and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 30% (thirty per cent) of the Contract Price.

4 Project Milestone-III

4.1 Project Milestone-III shall occur on the date falling on the 250th (two hundred and fiftieth) day from the Appointed Date (the "**Project Milestone-III**").

4.2 Prior to the occurrence of Project Milestone-III, the Contractor shall have continued with construction of the Smart Road and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 60% (sixty per cent) of the Contract Price.

5 Scheduled Completion Date

5.1 The Scheduled Completion Date shall occur on the 365th (three hundred and fiftieth)day from the Appointed Date.

5.2 On or before the Scheduled Completion Date, the Contractor shall have completed construction in accordance with this Agreement.

6 Extension of time

Upon extension of any or all of the aforesaid Project Milestones or the Scheduled Completion Date, as the case may be, under and in accordance with the provisions of this Agreement, the Project Completion Schedule shall be deemed to have been amended accordingly.

SCHEDULE - K

(See Clause 12.1.2)

Tests on Completion

1 Schedule for Tests

1.1 The Contractor shall, no later than 30 (thirty) days prior to the likely completion of construction, notify the Authority's Engineer and the Authority of its intent to subject the Smart Road to Tests, and no later than 10 (ten) days prior to the actual date of Tests, furnish to the Authority's Engineer and the Authority detailed inventory and particulars of all works and equipment forming part of Works.

1.2 The Contractor shall notify the Authority's Engineer of its readiness to subject the Smart Road to Tests at any time after 10 (ten) days from the date of such notice, and upon receipt of such notice, the Authority's Engineer shall, in consultation with the Contractor, determine the date and time for each Test and notify the same to the Authority who may designate its representative to witness the Tests. The Authority's Engineer shall thereupon conduct the Tests itself or cause any of the Tests to be conducted in accordance with Article 12 and this Schedule-K.

2 Tests

2.1 Visual and physical test: The Authority's Engineer shall conduct a visual and physical check of construction to determine that all works and equipment forming part thereof conform to the provisions of this Agreement. ***The physical tests shall be decided by the Authority Engineer in accordance with relevant Codes.***

2.2 Riding quality test: Riding quality of each lane of the carriageway shall be checked with the help of a calibrated bump integrator and the maximum permissible roughness for purposes of this Test shall be [2,000 (two thousand)] mm for each kilometre.

2.3 Tests for bridges: All major and minor bridges shall be subjected to the rebound hammer and ultrasonic pulse velocity tests, to be conducted in accordance with the procedure described in Special Report No. 17: 1996 of the IRC Highway Research Board on Nondestructive Testing Techniques, at two spots in every span, to be chosen at random by the Authority's Engineer. Bridges with a span of 15 (fifteen) metres or more shall also be subjected to load testing.

2.4 Other tests: The Authority's Engineer may require the Contractor to carry out or cause to be carried additional tests, in accordance with Good Industry

Practice, for determining the compliance of the Smart Road with Specifications and Standards.

2.5 Environmental audit: The Authority's Engineer shall carry out a check to determine conformity of the Smart Road with the environmental requirements set forth in Applicable Laws and Applicable Permits.

2.6 Safety Audit: The Authority's Engineer shall carry out, or cause to be carried out, a safety audit to determine conformity of the Smart Road with the safety requirements and Good Industry Practice.

3 Agency for conducting Tests

All Tests set forth in this Schedule-K shall be conducted by the Authority's Engineer or such other agency or person as it may specify in consultation with the Authority.

4 Completion Certificate

Upon successful completion of Tests, the Authority's Engineer shall issue the Completion Certificate in accordance with the provisions of Article 12.

SCHEDULE - L
(See Clause 12.2 and 12.4)

PROVISIONAL CERTIFICATE

1 I, **Tata Consulting Engineers Ltd (Name of the Authority's Engineer), acting as the Authority's Engineer** (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated ……. (the **"Agreement"**), for construction of the road from Panposh Chowk to Ambedkar Chowk from 0.00 k.m to 3.62 k.m Section of MRO9 Road including streetscape , beatification , landscaping, intersection redesign, utility ducting and underground cabling in Rourkela Smart City Limited (ABD) under Smart Cities Mission (the **"Project "**) on Engineering, Procurement and Construction (EPC) basis through …… (Name of Contractor), hereby certify that the Tests in accordance with Article 12 of the Agreement have been undertaken to determine compliance of the Project with the provisions of the Agreement.

2 Works that are incomplete on account of Time Extension have been specified in the Punch List appended hereto, and the Contractor has agreed and accepted that it shall complete all such works in the time and manner set forth in the Agreement. In addition, certain minor works are incomplete and these are not likely to cause material inconvenience to the Users of the Project or affect their safety. The Contractor has agreed and accepted that as a condition of this Provisional Certificate, it shall complete such minor works within 30 (thirty) days hereof. These minor works have also been specified in the aforesaid Punch List.

3 In view of the foregoing, I am satisfied that the Project from km ** to km ** can be safely and reliably placed in service of the Users thereof, and in terms of the Agreement, the Project is hereby provisionally declared fit for entry into operation on this the …… day of …….. 20…...

ACCEPTED, SIGNED, SEALED AND DELIVERED	SIGNED, SEALED AND DELIVERED
For and on behalf of	For and on behalf of
CONTRACTOR by:	AUTHORITY's ENGINEER by:
(Signature)	(Signature)

COMPLETION CERTIFICATE

1 I, Tata Consulting Engineers Ltd (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated …… (the "**Agreement**"), for Redevelopment of road From Panposh Chowk to Ambedkar Chowk from 0.00 k.m to 3.62 k.m Section of MRO9 Road including streetscape , beatification , landscaping, intersection redesign, utility ducting and underground cabling in Rourkela Smart City Limited (ABD) under Smart Cities mission through on EPC Mode (the "**Project** ") on Engineering, Procurement and Construction (EPC) basis through ……. (Name of Contractor), hereby certify that the Tests in accordance with Article 12 of the Agreement have been successfully undertaken to determine compliance of the Project with the provisions of the Agreement, and I am satisfied that the Project can be safely and reliably placed in service of the Users thereof.

2 It is certified that, in terms of the aforesaid Agreement, all works forming part of Project have been completed, and the Project is hereby declared fit for entry into operation on this the …… day of …… 20…..

SIGNED, SEALED AND DELIVERED

For and on behalf of

the Authority's Engineer by:

(Signature)

(Name)

(Designation)

(Address)

SCHEDULE - M

(See Clauses 14.6, 15.2 and 19.7)

PAYMENT REDUCTION FOR NON-COMPLIANCE

1. Payment reduction for non-compliance with the Maintenance Requirements

1.1 Monthly lump sum payments for maintenance shall be reduced in the case of non-compliance with the Maintenance Requirements set forth in Schedule-E.

1.2 Any deduction made on account of non-compliance with the Maintenance Requirements shall not be paid even after compliance subsequently. The deductions shall continue to be made every month until compliance is done.

1.3 The Authority's Engineer shall calculate the amount of payment reduction on the basis of weightage in percentage assigned to non-conforming items as given in Paragraph 2.

2. Percentage reductions in lump sum payments

2.1 The following percentages shall govern the payment reduction:

Sr. No.	Item/Defect/Deficiency	Percentage
(a)	**Carriageway/Pavement**	
(i)	Potholes, cracks, other surface defects	15%
(ii)	Repairs of Edges, Rutting	5%
(b)	**Road, Embankment, Cuttings, Shoulders**	
(i)	Edge drop, inadequate crossfall, undulations, settlement, potholes, ponding, obstructions	10%
(ii)	Deficient slopes, raincuts, disturbed pitching, vegetation growth, pruning of trees	5%
(c)	**Bridges and Culverts**	
(i)	Desilting, cleaning. vegetation growth, damaged pitching, flooring, parapets, wearing course, footpaths, any damage to foundations	20%
S. No.	**Item/Defect/Deficiency**	**Percentage**
(ii)	Any Defects in superstructures, bearings and sub-structures	10%

(iii)	Painting, repairs/replacement kerbs, railings, parapets, guideposts/crash barriers	5%
(d)	**Roadside Drains**	
(i)	Cleaning and repair of drains	5%
(e)	**Road Furniture**	
(i)	Cleaning, painting, replacement of road signs, delineators, road markings, 200 m/km/5th km stones	5%
(f)	**Miscellaneous Items**	
(i)	Removal of dead animals, broken down/accidented vehicles, fallen trees, road blockades or malfunctioning of mobile crane	10%
(ii)	Any other Defects in accordance with paragraph 1.	5%
(g)	**Defects in Other Project Facilities**	5%

2.2 The amount to be deducted from monthly lump-sum payment for non compliance of particular item shall be calculated as under:

R=P/IOO x M x L1/L

Where P = Percentage of particular item/Defect/deficiency for deduction

M = Monthly lump-sum payment in accordance with the Bid

L1 = Non-complying length

L = Total length of the road,

R = Reduction (the amount to be deducted for non compliance for a particular item/Defect/deficiency

The total amount of reduction shall be arrived at by summation of reductions for such items/Defects/deficiency or non compliance.

For any Defect in a part of one kilometer, the non-conforming length shall be taken as one kilometer.

SCHEDULE - N
(See Clause 18.1.1)

SELECTION OF AUTHORITY'S ENGINEER

1 Selection of Authority's Engineer

1.1 The Progamme Management Consultant, M/s TATA Consulting Engineers Ltd engaged by Authority for the implementation of civil infrastructure projects in the Rourkela Smart City ABD area through Smart city Mission, will be the Authority Engineer. .

1.2 In the event of termination of the Technical Consultants appointed in accordance with the provisions of Paragraph 1.1, the Authority shall appoint another firm of Technical Consultants forthwith and may engage a government-owned entity in accordance with the provisions of Paragraph 3 of this Schedule-N.

2 Terms of Reference

The Terms of Reference for the Authority's Engineer (the "**TOR**") shall substantially conform with Annex 1 to this Schedule N.

3 Appointment of Government entity as Authority's Engineer

Notwithstanding anything to the contrary contained in this Schedule, the Authority may in its discretion appoint a government-owned entity /Government officer as the Authority's Engineer.

Annex – I *(Schedule - N)*

TERMS OF REFERENCE FOR AUTHORITY'S ENGINEER

1 Scope

1.1 These Terms of Reference (the "**TOR**") for the Authority's Engineer are being specified pursuant to the EPC Agreement dated ..... (the "**Agreement**), which has been entered into between the Rourkela Smart city Ltd. Udit Nagar Rourkela 769012 [name and address of the Authority] (the "Authority") and ..... (the "Contractor") for Redevelopment of road From Panposh Chowk to Ambedkar Chowk from 0.00 k.m to 3.62 k.m Section of MRO9 Road including streetscape , beatification , landscaping, intersection redesign, utility ducting and under ground cabling in Rourkela Smart City Limited (ABD) under Smart Cities mission through onin the State of Odishaon Engineering, Procurement, Construction (EPC) basis, and a copy of which is annexed hereto and marked as Annex-A to form part of this TOR.

1.2 The TOR shall apply to construction and maintenance of the Project.

2 Definitions and interpretation

2.1 The words and expressions beginning with or in capital letters and not defined herein but defined in the Agreement shall have, unless repugnant to the context, the meaning respectively assigned to them in the Agreement.

2.2 References to Articles, Clauses and Schedules in this TOR shall, except where the context otherwise requires, be deemed to be references to the Articles, Clauses and Schedules of the Agreement, and references to Paragraphs shall be deemed to be references to Paragraphs of this TOR.

2.3 The rules of interpretation stated in Clauses 1.2, 1.3 and 1.4 of the Agreement shall apply, *mutatis mutandis*, to this TOR.

3. General

3.1 The Authority's Engineer shall discharge its duties in a fair, impartial and efficient manner, consistent with the highest standards of professional integrity and Good Industry Practice.

3.2 The Authority's Engineer shall perform the duties and exercise the authority in accordance with the provisions of this Agreement, but subject to obtaining prior written approval of the Authority before determining:

(a) any Time Extension;

(b) any additional cost to be paid by the Authority to the Contractor;

(c) the Termination Payment; or

(d) any other matter which is not specified in (a), (b) or (c) above and which creates an obligation or liability on either Party for a sum exceeding Rs. 5,000,000 (Rs. fifty lakh).

3.3 The Authority's Engineer shall submit regular periodic reports, at least once every month, to the Authority in respect of its duties and functions under this Agreement. Such reports shall be submitted by the Authority's Engineer within 10 (ten) days of the beginning of every month.

3.4 The Authority's Engineer shall inform the Contractor of any delegation of its duties and responsibilities to its suitably qualified and experienced personnel; provided, however, that it shall not delegate the authority to refer any matter for the Authority's prior approval in accordance with the provisions of Clause 18.2.

3.5 The Authority's Engineer shall aid and advise the Authority on any proposal for Change of Scope under Article 13.

3.6 In the event of any disagreement between the Parties regarding the meaning, scope and nature of Good Industry Practice, as set forth in any provision of the Agreement, the Authority's Engineer shall specify such meaning, scope and nature by issuing a reasoned written statement relying on good industry practice and authentic literature.

4 Construction Period

4.1 During the Construction Period, the Authority's Engineer shall review the Drawings furnished by the Contractor along with supporting data, including the geo-technical and hydrological investigations, characteristics of materials from borrow areas and quarry sites, topographical surveys, and the recommendations of the Safety Consultant in accordance with the provisions of Clause 10.1.6. The Authority's Engineer shall complete such review and send its observations to the Authority and the Contractor within 15 (fifteen) days of receipt of such Drawings; provided, however that in case of a Major Bridge or Structure, the aforesaid period of 15 (fifteen) days may be extended upto 30 (thirty) days. In particular, such comments shall specify the conformity or otherwise of such Drawings with the Scope of the Project and Specifications and Standards.

4.2 The Authority's Engineer shall review any revised Drawings sent to it by the Contractor and furnish its comments within 10 (ten) days of receiving such Drawings.

4.3 The Authority's Engineer shall review the Quality Assurance Plan submitted by the Contractor and shall convey its comments to the Contractor within a period of 21 (twenty-one) days stating the modifications, if any, required thereto.

4.4 The Authority's Engineer shall complete the review of the methodology proposed to be adopted by the Contractor for executing the Works, and convey its comments to the Contractor within a period of 10 (ten) days from the date of receipt of the proposed methodology from the Contractor.

4.5 The Authority's Engineer shall grant written approval to the Contractor, where necessary, for interruption and diversion of the flow of traffic in the existing lane(s) of the Project for purposes of maintenance during the Construction Period in accordance with the provisions of Clause 10.4.

4.6 The Authority's Engineer shall review the monthly progress report furnished by the Contractor and send its comments thereon to the Authority and the Contractor within 7 (seven) days of receipt of such report.

4.7 The Authority's Engineer shall inspect the Construction Works and the Project and shall submit a monthly Inspection Report bringing out the results of inspections and the remedial action taken by the Contractor in respect of Defects or deficiencies. In particular, the Authority's Engineer shall include in its Inspection Report, the compliance of the recommendations made by the Safety Consultant.

4.8 The Authority's Engineer shall conduct the pre-construction review of manufacturer's test reports and standard samples of manufactured Materials, and such other Materials as the Authority's Engineer may require.

4.9 For determining that the Works conform to Specifications and Standards, the Authority's Engineer shall require the Contractor to carry out, or cause to be carried out, tests at such time and frequency and in such manner as specified in the Agreement and in accordance with Good Industry Practice for quality assurance. For purposes of this Paragraph 4.9, the tests specified in the IRC Special Publication-11 (Handbook of Quality Control for Construction of Roads and Runways) and the Specifications for Road and Bridge Works issued by MORTH (the "Quality Control Manuals") or any modification/substitution thereof shall be deemed to be tests conforming to Good Industry Practice for quality assurance.

4.10 The Authority's Engineer shall test check at least 20 (twenty) percent of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.

4.11 The timing of tests referred to in Paragraph 4.9, and the criteria for acceptance/ rejection of their results shall be determined by the Authority's Engineer in accordance with the Quality Control Manuals. The tests shall be undertaken on a random sample basis and shall be in addition to, and independent of, the tests that may be carried out by the Contractor for its own quality assurance in accordance with Good Industry Practice.

4.12 In the event that results of any tests conducted under Clause 11.10 establish any Defects or deficiencies in the Works, the Authority's Engineer shall require the Contractor to carry out remedial measures.

4.13 The Authority's Engineer may instruct the Contractor to execute any work which is urgently required for the safety of the Project, whether because of an accident, unforeseeable event or otherwise; provided that in case of any work required on account of a Force Majeure Event, the provisions of Clause 21.6 shall apply.

4.14 In the event that the Contractor fails to achieve any of the Project Milestones, the Authority's Engineer shall undertake a review of the progress of construction and identify potential delays, if any. If the Authority's Engineer shall determine that completion of the Project is not feasible within the time specified in the Agreement, it shall require the Contractor to indicate within 15 (fifteen) days the steps proposed to be taken to expedite progress, and the period within which the Project Completion Date shall be achieved. Upon receipt of a report from the Contractor, the Authority's Engineer shall review the same and send its comments to the Authority and the Contractor forthwith.

4.15 The Authority's Engineer shall obtain from the Contractor a copy of all the Contractor's quality control records and documents before the Completion Certificate is issued pursuant to Clause 12.4.

4.16 Authority's Engineer may recommend to the Authority suspension of the whole or part of the Works if the work threatens the safety of the Users and pedestrians. After the Contractor has carried out remedial measure, the Authority's Engineer shall inspect such remedial measures forthwith and make a report to the Authority recommending whether or not the suspension hereunder may be revoked.

4.17 In the event that the Contractor carries out any remedial measures to secure

the safety of suspended works and Users, and requires the Authority's Engineer to inspect such works, the Authority's Engineer shall inspect the suspended works within 3 (three) days of receiving such notice, and make a report to the Authority forthwith, recommending whether or not such suspension may be revoked by the Authority.

4.18 The Authority's Engineer shall carry out, or cause to be carried out, all the Tests specified in Schedule-K and issue a Completion Certificate or Provisional Certificate, as the case may be. For carrying out its functions under this Paragraph 4.18 and all matters incidental thereto, the Authority's Engineer shall act under and in accordance with the provisions of Article 12 and Schedule-K.

5. Maintenance Period

5.1 The Authority's Engineer shall aid and advise the Contractor in the preparation of its monthly Maintenance Programme and for this purpose carry out a joint monthly inspection with the Contractor.

5.2 The Authority's Engineer shall undertake regular inspections, at least once every month, to evaluate compliance with the Maintenance Requirements and submit a Maintenance Inspection Report to the Authority and the Contractor.

5.3 The Authority's Engineer shall specify the tests, if any, that the Contractor shall carry out, or cause to be carried out, for the purpose of determining that the Project is in conformity with the Maintenance Requirements. It shall monitor and review the results of such tests and the remedial measures, if any, taken by the Contractor in this behalf.

5.4 In respect of any defect or deficiency referred to in Paragraph 3 of Schedule-E, the Authority's Engineer shall, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Specifications and Standards and shall also specify the time limit for repair or rectification of any deviation or deterioration beyond the permissible limit.

5.5 The Authority's Engineer shall examine the request of the Contractor for closure of any lane(s) of the Project for undertaking maintenance/repair thereof, and shall grant permission with such modifications, as it may deem necessary, within 5 (five) days of receiving a request from the Contractor. Upon expiry of the permitted period of closure, the Authority's Engineer shall monitor the reopening of such lane(s), and in case of delay, determine the Damages payable by the Contractor to the Authority under Clause 14.5.

6 Determination of costs and time

6.1 The Authority's Engineer shall determine the costs, and/or their reasonableness, that are required to be determined by it under the Agreement.

6.2 The Authority's Engineer shall determine the period of Time Extension that is required to be determined by it under the Agreement.

6.3 The Authority's Engineer shall consult each Party in every case of determination in accordance with the provisions of Clause 18.5.

7. Payments

7.1 The Authority's Engineer shall withhold payments for the affected works for which the Contractor fails to revise and resubmit the Drawings to the Authority's Engineer in accordance with the provisions of Clause 10.2.4 (d).

7.2 Authority's Engineer shall -

(a) within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor pursuant to Clause 19.4, determine the amount due to the Contractor and recommend the release of 90 (ninety) percent of the amount so determined as part payment, pending issue of the Interim Payment Certificate; and

(b) within 15 (fifteen) days of the receipt of the Stage Payment Statement referred to in Clause 19.4, deliver to the Authority and the Contractor an Interim Payment Certificate certifying the amount due and payable to the Contractor, after adjustments in accordance with the provisions of Clause 19.10.

7.3 The Authority's Engineer shall, within 15 (fifteen) days of receipt of the Monthly Maintenance Statement from the Contractor pursuant to Clause 19.6, verify the Contractor's monthly statement and certify the amount to be paid to the Contractor in accordance with the provisions of the Agreement.

7.4 The Authority's Engineer shall certify final payment within 30 (thirty) days of the receipt of the final payment statement of Maintenance in accordance with the provisions of Clause 19.16.

8. Other duties and functions

The Authority's Engineer shall perform all other duties and functions as specified in the Agreement.

9 Miscellaneous

9.1 A copy of all communications, comments, instructions, Drawings or Documents sent by the Authority's Engineer to the Contractor pursuant to this TOR, and a copy of all the test results with comments of the Authority's Engineer thereon, shall be furnished by the Authority's Engineer to the Authority forthwith.

9.2 The Authority's Engineer shall retain at least one copy each of all Drawings and Documents received by it, including 'as-built' Drawings, and keep them in its safe custody.

9.3 Within 90 (ninety) days of the Project Completion Date, the Authority's Engineer shall obtain a complete set of as-built Drawings, in 2 (two) hard copies and in micro film form or in such other medium as may be acceptable to the Authority, reflecting the Project as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Project and setback lines, if any, of the buildings and structures forming part of Project Facilities; and shall hand them over to the Authority against receipt thereof.

9.4 The Authority's Engineer, if called upon by the Authority or the Contractor or both, shall mediate and assist the Parties in arriving at an amicable settlement of any Dispute between the Parties.

9.5 The Authority's Engineer shall inform the Authority and the Contractor of any event of Contractor's Default within one week of its occurrence.

SCHEDULE - O

(See Clauses 19.4.1, 19.6.1, and 19.8.1)

Forms of Payment Statements

1. Stage Payment Statement for Works

The Stage Payment Statement for Works shall state:

(a) the estimated amount for the Works executed in accordance with Clause 19.3.1 subsequent to the last claim;

(b) amounts reflecting adjustments in price for the aforesaid claim;

(c) the estimated amount of each Change of Scope Order executed subsequent to the last claim;

(d) amounts reflecting adjustment in price, if any, for (c) above in accordance with the provisions of Clause 13.2.3 (a);

(e) total of (a), (b), (c) and (d) above;

(f) Deductions:

(i) Any amount to be deducted in accordance with the provisions of the Agreement except taxes;

(ii) Any amount towards deduction of taxes; and

(iii) Total of (i) and (ii) above.

(g) Net claim: (e) – (f) (iii);

(h) The amounts received by the Contractor upto the last claim:

(i) For the Works executed (excluding Change of Scope orders);

(ii) For Change of Scope Orders, and

(iii) Taxes deducted

2. Monthly Maintenance Payment Statement

The monthly Statement for Maintenance Payment shall state:

(a) the monthly payment admissible in accordance with the provisions of the Agreement;

(b) the deductions for maintenance work not done;

(c) net payment for maintenance due, (a) minus (b);

(d) amounts reflecting adjustments in price under Clause 19.12; and

(e) amount towards deduction of taxes

3. Contractor's claim for Damages

Note: The Contractor shall submit its claims in a form acceptable to the Authority.

SCHEDULE - P
(See Clause 20.1)

INSURANCE

1. Insurance during Construction Period

1.1 The Contractor shall effect and maintain at its own cost, from the Appointed Date till the date of issue of the Completion Certificate, the following insurances for any loss or damage occurring on account of Non Political Event of Force Majeure, malicious act, accidental damage, explosion, fire and terrorism:

(a) insurance of Works, Plant and Materials and an additional sum of 15 (fifteen) per cent of such replacement cost to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature; and

(b) insurance for the Contractor's equipment and Documents brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site.

1.2 The insurance under paragraph 1.1 (a) and (b) above shall cover the Authority and the Contractor against all loss or damage from any cause arising under paragraph 1.1 other than risks which are not insurable at commercial terms.

2. Insurance for Contractor's Defects Liability

The Contractor shall effect and maintain insurance cover for the Works from the date of issue of the Completion Certificate until the end of the Defects Liability Period for any loss or damage for which the Contractor is liable and which arises from a cause occurring prior to the issue of the Completion Certificate. The Contractor shall also maintain other insurances for maximum sums as may be required under the Applicable Laws and in accordance with Good Industry Practice.

3. Insurance against injury to persons and damage to property

3.1 The Contractor shall insure against its liability for any loss, damage, death or bodily injury, or damage to any property (except things insured under Paragraphs 1 and 2 of this Schedule or to any person (except persons insured under Clause 20.9), which may arise out of the Contractor's performance of this Agreement. This insurance shall be for a limit per occurrence of not less than the amount stated below with no limit on the number of occurrences.

The insurance cover shall be not less than: Rs. 100 Lakhs

3.2 The insurance shall be extended to cover liability for all loss and damage to the Authority's property arising out of the Contractor's performance of this Agreement excluding:

(a) the Authority's right to have the construction works executed on, over, under, in or through any land, and to occupy this land for the Works; and

(b) damage which is an unavoidable result of the Contractor's obligations to execute the Works.

4. **Insurance to be in joint names**

The insurance under paragraphs 1 to 3 above shall be in the joint names of the Contractor and the Authority.

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