

Part II

Agreement Document with schedules

Part I

Preliminary

Engineering, Procurement and Construction Agreement

(To be executed on Rs.300/- non-judicial stamp paper)

THIS AGREEMENT is entered into on this the day of, 2024

Between

The Board of Deendayal Port Authority, an autonomous body of the Ministry of Ports , Shipping and Waterways of the Government of India, incorporated under the Major Port Authority Act,2021 as amended thereafter, under the laws of India and having its principal place of business at A.O Building, PO Box No-50, Gandhidham, Gujarat State- 370201 (here in after 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

< insert name of party >, the selected bidder having its registered office at <insert registered office address of the party>, (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 has decided to construct “Widening and Improvement of existing 2/4 lane carriageway of KK Road connecting to NH-8A in the state of Gujarat (the “**Project**”) through an Engineering, Procurement and Construction on Engineering, Procurement, Construction (“**EPC**”) basis in accordance with the terms and conditions to be set forth in an agreement to be entered into.
- B. The Authority accordingly invited the proposals (the “**Request for Proposals**” or “**RFP**”) from the eligible bidders as per the technical and commercial terms and conditions prescribed in the RFP for undertaking the Project.
- C. After evaluation of the bids received, the Authority accepted the bid of the selected bidder and issued its Letter of Acceptance No. <insert details> dated <insert date> (hereinafter called the “**LOA**”) to the selected bidder for the above Project at the Contract Price specified hereinafter, requiring the selected bidder to inter alia:
 - (i) to give his consent to enter into this Agreement and the enforceability of the provisions thereof, within 10 (ten) days of the date of issue of LOA;
 - (ii) submit Performance Security as per RFP requirements, and
 - (iii) Execute this Agreement within 30 (thirty) days of the date of issue of LOA.

D. The Contractor has fulfilled the requirements specified in Recital (D) above;

NOW, THEREFORE, in consideration of the foregoing and the respective covenants 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:

Article 1

Definitions and Interpretations

1.1 Definitions

(i) The words and expressions beginning with capital letters and defined in this Agreement 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.

(ii) 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, or any supplementary agreement made in accordance with the provisions contained in this Agreement;

“Applicable Laws” means all laws, brought into force and effect by the 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 Highway during the subsistence of this Agreement;

“Appointed Date” means the date declared by the Authority as the project commencement date with the consent of the contractor, as per the process prescribed in Article 3 and 8 of this Agreement;

“Arbitration Act” means the Arbitration and Conciliation Act, 1996, with all its subsequent amendments;

“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 recognized by the Reserve Bank of India

“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 the calendar month, which 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/ Joint venture] in response to the Request for Proposal 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: the enactment of any new Indian law; the repeal, modification or re-enactment of any existing Indian law; the commencement of any Indian law which has not come into effect until the Base Date; or 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.

“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 (i);

“Change of Scope Request” shall have the meaning set forth in Clause 13.2 (ii);

“Change of Scope Order” shall have the meaning set forth in Clause 13.2 (iv);

“Completion Certificate” shall have the meaning set forth in Clause 12.2;

“Construction” shall have the meaning set forth in Clause 1.2 (f);

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

“Construction Zone” shall have the meaning set forth in Clause 8.3 (i);

“Contract Price” means the amount specified in Clause 19.1 (i);

“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 default 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;

“Damages” shall have the meaning set forth in paragraph (w) of Clause 1.2;

“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;

“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 Highway as set forth in Schedule-I, and shall include ‘as built’ drawings of the Project Highway;

“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 Highway, 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 Highway, 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 to payees or beneficiaries or any similar arrangement under any insurance policy pertaining to the Project Highway, 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;

“Final Payment Statement” shall have the meaning set forth in Clause 19.13;

“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 3.1 (iii) (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 Highway or the performance of all or any of the services or obligations of the Contractor under or pursuant to this Agreement;

“Handover Memorandum” shall have the meaning set forth in Clause 8.2;

“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 insurance 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, trademarks, 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, semiconductor, 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;

“Joint Venture” means the group of entities which have come together for implementation of this Project;

“Lead Member” shall, in the case of a joint venture, mean the member of such joint venture who shall have the authority to bind the contractor and each member of the Joint venture; and shall be deemed to be the Contractor for the purposes of this Agreement; the

Lead Member shall itself undertake and perform at least 51% (fifty one per cent) of the total length of the Project Highway;

“LOA” or “Letter of Acceptance” means the letter of acceptance issued by the Authority as referred to in Recital (D);

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

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

“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;

“Manual” shall mean the Manual of Standards and Specifications for Project Highways;

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

“Materials” comprise of all the supplies used by the Contractor used in the Works or for the maintenance of the Project Highway;

“Monthly Maintenance Statement” shall have the meaning set forth in Clause 19.6;

“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” and **“Additional 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 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 (iii);

“Project” means the construction and maintenance of the Project Highway 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, relief centres, maintenance depots and administrative offices; and (b) Project Facilities situated on the Site;

“Project Completion Date” means 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 Highway 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 Highway” means the Site comprising the existing road {, proposed bypasses and tunnels} forming part of **“WIDENING AND IMPROVEMENT OF EXISTING 2/4 LANE CARRIAGEWAY OF KK ROAD CONNECTING TO NH-8A IN THE STATE OF GUJARAT ON EPC MODE”** 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;

“Quality Assurance Plan” or **“QAP”** shall have the meaning set forth in Clause 11.2;

“Re.”, “Rs.” or “Rupees” or “Indian Rupees” or “INR” means the lawful currency of the Republic of India;

“Request for Proposals” or “RFP” shall have the meaning set forth in Recital ‘C’;

“Retention Money” shall have the meaning set forth in Clause 7.5;

“Right of Way” means and refers to the total land required and acquired for the project, both in its width and length, together with all way leaves, easements, unrestricted access and other rights of way, howsoever described, necessary for construction and maintenance of the Project Highway in accordance with this Agreement;

“Safety Consultant” shall have the meaning set forth in Clause 10.1;

“Scheduled Completion Date” shall be the date set forth in Clause 10.3;

“Scheduled Construction Period” means the period commencing from the Appointed Date and ending on Scheduled Completion Date;

“Scope of the Project” shall have the meaning set forth in Clause 2.1;

“Section” means a part of the Project Highway;

“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 Highway, as set forth in Schedule-D, and any modifications thereof, or additions thereto, as included in the design and engineering for the Project Highway 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;

“Taking Over Certificate” shall have the meaning set forth in Clause 14.10;

“Taxes” means any Indian taxes including GST, 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 Highway 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;

“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;

“User” means a person who travels or intends to travel on the Project Highway or any part thereof in/on any vehicle;

“Valuation of Unpaid works” shall have the meaning set forth in Clause 23.5;

“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 Highway 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.

1.2 Interpretation

(i) 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 Highway, 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 Delhi 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 or liquidated damages (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.
- (ii) 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.
- (iii) 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.
- (iv) 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

(i) 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).

(ii) Subject to the provisions of Clause 1.4 (i), 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 Joint and several liability

(i) If the Contractor has formed a Joint Venture of two or more persons for implementing the Project:

- (a) these persons shall, without prejudice to the provisions of this Agreement or any other agreement, be deemed to be jointly and severally liable to the Authority for the performance of the Agreement; and
- (b) the Contractor shall ensure that no change in the composition of the Joint Venture is effected without the prior consent of the Authority.

(ii) Without prejudice to the joint and several liability of all the members of the Joint Venture, the Lead Member shall represent all the members of the Joint Venture and shall always be liable and responsible for discharging the functions and obligations of the Contractor. The Contractor shall ensure that each member of the Joint Venture shall be bound by any decision, communication, notice, action or inaction of the Lead Member on any matter related to this Agreement and the Authority shall be entitled to rely upon any such action, decision or communication of the Lead Member. The Authority shall have the right to release payments solely to the Lead Member and shall not in any manner be responsible or be held liable for the inter se allocation of payments among members of the Joint venture.¹ 1 This Clause 1.5 may be omitted if the Contractor is not a Joint venture. Even if the Contractor is Joint venture, the Authority may, at its discretion, delete this provision.

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 Highway 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 Highway 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 Authority

3.1 Obligations of the Authority

(i) 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.

(ii) 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.

(iii) The Authority shall, upon submission of the Performance Security as per the RFP by the Contractor, shall provide to the Contractor:

(a) No less than 90% (ninety per cent) of the required Right of Way of the Construction Zone of total length of the Project Highway within a period of 30 (thirty) days from the date of this Agreement, which shall be in contiguous stretches of length not less than 5 (five) kilometre.

(b) Deleted

(c) Deleted

(iv) Deleted

(v) Notwithstanding anything to the contrary contained in this Agreement, the Parties expressly agree that the aggregate Damages payable under Clauses 3.1 (iv), 8.3 and 9.5 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 Highway.

Both the parties agree that payment of such 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 that the payment of Damages shall be the final cure for the Contractor against delays of the Authority, without recourse to any other payments.

(vi) 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 Highway 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 violate any 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 4.3, provide reasonable assistance to the Contractor and any expatriate personnel of the Contractor or its Sub-contractors to obtain the applicable visas and the requisite 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.

3.2 Maintenance obligations prior to the Appointed Date

The Authority shall, prior to the Appointed Date, maintain the Project Highway, 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.

3.3 Deleted

3.4 Deemed Termination upon delay

Without prejudice to the provisions of Clause 8.3, and subject to the provisions of Clause 7.3, the Parties expressly agree that in the event the Appointed Date does not occur, for any reason whatsoever, within 90 days of signing of the Agreement and submission of the full Performance Security by the Contractor, the Agreement shall be deemed to have been terminated. The Authority shall pay damages to the Contractor equivalent to 1% of the Contract Price. All other 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. The Contractor shall hand over all information in relation to the Highway, including but not limited to any data, designs, drawings, structures, information, plans, etc. prepared by them for the Highway, to the Authority.

Article 4

Obligations of the Contractor

4.1 Obligations of the Contractor

(i) 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 Highway and observe, fulfil, comply with and perform all its obligations set out in this Agreement or arising hereunder.

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

(iii) Subject to the provisions of Clauses 4.1 (i) and 4.1 (ii), the Contractor shall discharge its obligations in accordance with Good Industry Practice and as a reasonable and prudent person.

(iv) The Contractor shall remedy any and all loss, defects, or damage to the Project Highway 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, defect, or damage shall have arisen from any wilful default or neglect of the Authority.

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

(vi) The Contractor shall remedy any and all loss or damage to the Project Highway during the Contract Period at the Contractor's cost.

(vii) 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 Highway;
- (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 violate any 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 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.
- (viii) The Contractor shall undertake all necessary superintendence to plan, arrange, direct, manage, inspect and test the Works. The Contractor shall provide all necessary superintendence of the Works for the proper fulfilling of the Contractor's obligations under the Agreement. Such superintendence shall be given by competent person having adequate knowledge of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents) for the satisfactory and safe execution of the Works.
- (ix) The Contractor shall obtain and maintain a project related bank account operational at site where all transactions related to the payment of work will be done. The Contractor shall submit a monthly account statement and a detailed report on utilization of funds transferred to this project related bank account to Authority's Engineer. Notwithstanding anything contrary to this agreement, the authority, in the interest and to ensure timely completion of the work, reserves the right to audit such bank accounts to ensure that there is no diversion of funds from this project specific account to any other project being implemented by the Contractor.
- (x) The Contractor shall provide the documents of the Contractor specified in the Agreement, and all Contractors' personnel; Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for the execution, completion of Works and remedying defects.
- (xi) The Contractor shall perform the Works in conformity with the Project requirements and other requirements and standards prescribed under or pursuant to the Agreement.
- (xii) The Contractor shall carry out such work incidental and contingent to the original Scope of the Project to comply with Good Industry Practices.

(xiii) The Contractor shall maintain required staff and necessary Contractor's equipment and materials within the reach of the Site during the Defects Liability Period so that any defects arising are promptly attended.

4.2 Obligations relating to sub-contracts and any other agreements

(i) The Contractor shall not sub-contract any Works and shall carry out complete Works directly under its own supervision and through its own personnel and equipment.

(ii) Deleted

(iii) Deleted

(iv) Deleted

4.3 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 always rest with 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 a Force Majeure Event, and shall not in any manner excuse the Contractor from the performance and discharge it of its obligations and liabilities under this Agreement, and the Contractor's liabilities hereunder shall remain unaffected by such failure, refusal or inability.

4.4 Contractor's personnel

(i) 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 and adequately qualified, skilled and experienced in their respective functions in conformity with Good Industry Practice.

(ii) 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.

(iii) 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 4.4 (ii). 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.

4.5 Advertisement on Project Highway

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

4.6 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 Completion Certificate, save and except to the extent that any such loss or damage shall have arisen from any wilful default or gross neglect of the Authority.

4.7 Electricity, water and other services

The Contractor shall be responsible for procuring of all utilities as may be required, including without limitation, adequate power, water and other services.

4.8 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.

4.9 Co-ordination of the Works

(i) The Contractor acknowledges that in addition to the Agreement, it is also aware of terms of the other Project contracts and other agreements the Authority has negotiated and entered into for performance of its obligations under the Agreement (copies of other contracts and other agreements are made available to the Contractor from time to time) and that the Contractor is fully aware of the consequences to the Authority which would or are likely to result from a breach by the Contractor of its obligations under the Agreement. In the event the actions of the Contractor result in the breach by the Authority of any or all of the other Project contracts and such breach imposes any liability on the Authority, the Contractor shall: (a) undertake all steps as may be possible to mitigate or neutralize the liability that has arisen, and (b) indemnify the Authority against any such liability and compensate the Authority to that extent.

(ii) The Contractor shall be responsible for the co-ordination and proper provision of the Works, including co-ordination of other Contractors or Sub-contractors for the Project. The Contractor shall co-operate with the Authority in the co- ordination of the Works with the works under the

other Project contracts. The Contractor shall provide all reasonable support for carrying out their work to:

- (a) Any other contractors employed by the Authority;
- (b) The workmen of the Authority;
- (c) The workmen of any Governmental Instrumentality who may be employed in the execution of work on or near the Site; and
- (d) Such other persons as is required in the opinion of the Authority for successful completion of the Project.

4.10 Environmental Measures

The Contractor agrees to conduct its activities in connection with the Agreement in such a manner so as to comply with the environmental requirements and applicable law.

4.11 Site Data

(i) The Contractor shall be deemed to have inspected and examined the Site and its surroundings and to have satisfied himself before entering into the Agreement in all material respects including but not limited to:

- (a) The form and nature of the Site (including, inter-alia, the surface and sub- surface conditions and geo-technical factors);
- (b) The hydrological and climatic conditions;
- (c) The extent and nature of the works already completed and Materials necessary for the execution and completion of the Works and the remedying of any defects that includes already executed part also.
- (d) The suitability and the adequacy of the Site for the execution of the Works;
- (e) The means of access to the Site and the accommodation the Contractor may require;
- (f) Arranging permits as required for execution of Project as per the Agreement.
- (g) The requirements of operation and maintenance; and
- (h) All other factors and circumstances affecting the Contractor's rights and obligations under the Agreement, the Contract Price and Time for Completion.

4.12 Sufficiency of Contract Price

The Contractor shall have satisfied itself as to the correctness and sufficiency of the Contract Price. The Contract Price shall cover all its obligations under the Agreement, in addition to all risks the Contractor has agreed to undertake under the Agreement, including those associated with the performance of its obligations under the Agreement and all things necessary for the provision of the Works in a manner satisfactory to the Authority and in accordance with this Agreement.

4.13 Clearance of the Site

During the provision of the Works, and as a pre-condition to the issue of the Taking-Over Certificate, the Contractor shall clear away and remove from the Site, all Contractor's equipment, surplus material, wreckage, rubbish and temporary Works, and shall keep the Site free from all unnecessary obstructions, and shall not store or dispose of any Contractor's equipment or surplus materials on the Site. The Contractor shall promptly clear away and remove from the Site any wreckage, rubbish or temporary Works no longer required and leave the Site and the Works in a clean and safe condition to the sole satisfaction of the Authority.

Article 5

Representations and Warranties

5.1 Representations and warranties of the Contractor

- (i) 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 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 there under including any obligation, liability or responsibility hereunder;
 - (e) The information furnished in the Bid, Request for Qualification and Request for Proposals or otherwise 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, or result in the breach of, or 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) 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;

- (m) it is adequately financed has the requisite knowledge, expertise, technical know-how, experience, resources, infrastructure, licenses, patents, copy rights, for designing, supplying/ procuring the goods and materials, and for providing the installation and construction services required for completing the construction of the Project Facilities; and

- (ii) It represents the Authority that:

- (a) It owns or has the right to use all “**Intellectual Property**” necessary to perform the contractual obligations and to carry on the Works without conflict with the right of others;
- (b) All intellectual property rights necessary to perform the contractual obligations and to carry on the Works are in full force and effect and are vested in, and beneficially owned by the Contractor, and are free from encumbrances.
- (c) None of the intellectual property rights is being used, claimed, or posed or attacked by any other person, nor does the use of such intellectual property rights or any part of them infringe the intellectual property rights owned or enjoyed by any third party.
- (d) None of the intellectual property rights owned or used by the Contractor is the subject of any claim, opposition, attack, assertion or other arrangement of whatsoever nature which does or may impinge upon their use, validity, enforceability or ownership by the Parties, and there are no grounds or other circumstances which may give rise to the same.
- (e) No licenses or registered user or other rights have been granted or agreed to be granted to any third party in respect of such intellectual property rights.
- (f) No act has been done or has been omitted to be done to entitle any authority or person to cancel, forfeit or modify any intellectual property rights.
- (g) The Contractor shall notify the Authority of any adverse use of the intellectual property rights or confusingly or deceptively similar to the intellectual property rights.

- (h) The Contractor shall recognize the Authority's ownership and title to the intellectual property rights and shall not at any time, either directly or indirectly, put to issue the validity or ownership of the intellectual property rights and it will not do any act or thing, either directly or indirectly, which in anyway impairs the validity and ownership of the intellectual property rights.
- (i) The Contractor shall, promptly execute, acknowledge and deliver all documents which are requested by Authority to record with appropriate governmental agencies and authorities the fact that the Authority has the right to the use of the said intellectual property rights.
- (j) The Contractor shall not, for any reason, object to, or interfere in any way with the ownership, registration or use of the intellectual property rights by the Authority (or its licensee or assigns) for any purpose whatsoever.

The Contractor is fully aware that the Agreement is inter linked with the other Project contracts and the non-performance or deficient performance or default by the Contractor and/or any of the Contractor's personnel or Subcontractors under one among the said contracts will have bearing on the other contracts and the evaluation of the Contractor's performance under the Agreement and the Project itself.

If at any time during the Defects Liability Period any item of the Works or Project Facilities or any part thereof, do not conform to the Authority requirements and Specifications and Standards, on being so notified by the Authority, the Contractor shall promptly rectify/remedy such nonconformity to the satisfaction of the Authority solely at the Contractor's expense; failing which the Authority may reject or revoke Taking-Over Certificate, and the Authority may proceed to correct the Contractor's nonconforming Work by the most expeditious means available, the costs of which shall be to the Contractor's account; or the Authority may retain the non-conforming Work and an equitable adjustment reducing the total Contract Price to reflect the diminished value of such non-conforming Work will be made by written amendment.

In addition to the other warranties, the Contractor represents and warrants as follows:

- (a) The Contractor has (or, if the technology does not currently exist, will have granted at the time of passing to The Employer) in and to the technology used in the equipment, materials, goods, Works, Contractor's documents, Drawings and Manuals ("**Technology**")
 - i. all right, title and interest free of any lien, claim or restriction; and
 - ii. right to grant to the Authority the right to use the Technology for the purpose of this contract, free of any lien, claim or restriction and on the terms of license as required.
- (b) The Contractor has granted (or, if the technology does not currently exist, will grant at the time of passing to the Authority the property and title in and to the equipment, materials, goods, Works, spares, Contractor's documents, Drawings and Manuals in which

it is used) to the Authority the right to use the Technology, free of any lien, claim or restriction.

(vi) In addition to the other Warranties, the Contractor represents and warrants as follows:

- (a) No Technology contains any worm (i.e., a program that travels from one computer to another computer but does not attach itself to the operating system of the computer it enters), virus (i.e., a program that travels from one computer to another computer that attaches itself to the operating system it enters) or self-destruct capability.
- (b) The Technology will not abnormally end or provide invalid or incorrect results as a result of date-dependent data.
- (c) The Technology can accurately recognize, manage, accommodate, and manipulate date-dependent data, including single and multi-century formulas and leap years.

(vii) No criminal proceedings instituted against any of the employees or Directors of the Contractor.

(viii) Till date the services of the Contractor has not been terminated by any person for any breach or non-performance or negligence by 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 that the Contractor can commence construction forthwith on 90% (ninety per cent) of the total length of the Project Highway.

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

(i) 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 3.1 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.

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

(iii) 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 (i) 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.

(iv) The Parties agree that any mistake or error in or relating to any of the matters set forth in Clause 6.1 (i) above shall not vitiate this Agreement, or render it voidable.

(v) 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 (i) above, that Party shall immediately notify the other Party, specifying the mistake or error.

(vi) 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 Performance Security

- a) Security Deposit shall consist of two parts; a) Performance Guarantee to be submitted at award of work, and b) Retention money to be recovered from Running Bills.
- b) Security Deposit shall be 10% of Contract price of which 5% of contract price should be submitted as Bank Guarantee/Digital transfer/FDR within 21 days of receipt of Letter of Acceptance and balance 5% recovered as Retention Money from Running Bills. Recovery of 5% of Retention Money to commence from the first bill onwards @ 5% of bill value from each bill. Retention Money be refunded within 14 days from the date of payment of final bill. Balance SD to be refunded immediately not later than 14 days from completion of Maintenance Period & NOC from Geology Department.
- c) The documentary evidence (copy of paid Challan in Govt. Treasury) of Welfare Cess @ 1% of work done or as amended by Statutory Authority from time to time, paid on final bill shall be submitted before releasing the Performance Guarantee.
- d) The Parties agree that in the event of Termination of this Agreement, the Retention Money specified in this Clause 7 (b) above 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 Highway (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 Highway.

8.2 Procurement of the Site

(i) The Authority Representative, the Contractor and Authority’s Engineer shall, within 10 (ten) days of the date of this Agreement, inspect the Site and prepare a detailed 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 (hereinafter referred to as the “**Handover Memorandum**”). Subject to the provisions of Clause 8.2 (iii), the Handover 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 along with details of hindrances in the Construction Zone. For sake of clarity the Handover Memorandum shall clearly specify the parts of Site where work can be executed. Signing of the Handover Memorandum, in three counterparts (each of which shall constitute an original), by the authorized representatives of the Authority, Contractor and Authority’s Engineer 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.

(ii) 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, of the proposed date and time such of hand 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. The signing of the memorandum, in three (3) 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.

If the contractor fails to join for site inspection or disputes the parts of the site available for work, the Authority’s Engineer shall decide the parts of the site where work can be executed and notify to both the parties within 3 days of the proposed date of inspection. The parties agree that such notification of the Authority’s Engineer as mentioned hereinabove shall be final and binding on the parties.

(iii) 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, 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. The Contractor agrees that it shall not be entitled to claim any other damages on account of any such delay by the Authority.

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 (i).

The Authority further acknowledges and agrees that prior to the Appointed Date, it shall have procured issuance of the statutory notification under Applicable Laws for vesting of all the land comprising the Project in the Authority and has taken possession of area for Construction Zone for at least 90% (ninety per cent) of the total length of the Project Highway. The Parties also acknowledge and agree that the conditions specified in this Clause 8.2 (iii) shall not be modified or waived by either Party.

For the avoidance of doubt, the Parties expressly agree that the Appendix shall in no event contain sections of the Project Highway the cumulative length of which exceeds 10% (ten percent) of the total length of the Project Highway.

Pursuant to signing of Handover Memorandum under clause 8.2 (i), Contractor shall submit to the Authority's Engineer, a monthly land possession report till expiry of 180 (one hundred and eighty) days from Appointed Date, in respect of those parts of the site to which vacant access and right of way was not given to the contractor and included in Appendix to the memorandum signed under clause 8.2 (i), duly specifying the part of the site, if any, for which the right of way is yet to be handed over.

8.3 Damages for delay in handing over the Site

(i) 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 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:

$$\text{Amount of Damages in Rs. per day per metre} = 0.05 \times C \times \frac{1}{L} \times \frac{1}{N}$$

Where,

C = the Contract Price;

L = length of the Project Highway 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 (i) 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 (i), 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 "Construction Zone" which shall comprise the following components:

- Main in carriageway
- Median (for 4 lane carriageway or more)
- Paved and earthen shoulders
- Area for Structures including ROBs/RUBs.
- Safety measures including Roadside Drains and Furniture.
- A parallel working space for accommodating slopes/retaining structures etc.

(ii) 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 of Construction Zone is granted on 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 (iii).

(iii) (a) Notwithstanding anything to the contrary contained in this Agreement, unless covered under the deemed de-scoping in terms of sub-clause 8.3 (iii) (b), 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.

(b) 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 or the stretches where vacant access and Right of Way could not be handed over, as the case may be, because the requisite clearances or approvals or affected land parcels for commencing construction of Works therein have not been given within 180 (one hundred and eighty) days of the Appointed date, the affected

Works shall be deemed to be withdrawn under the provisions of this Clause 8.3.3. Such Works shall not be computed for the purposes of the aforesaid ceiling of 10% (ten per cent) hereunder.

(c) Provided further that in case such stretches (as mentioned in Sub-Clause (b) above) can be handed over to the Contractor before the expiry of the original Scheduled Construction

Period of the Project Highway, and the Contractor agrees to take up the work, the same may be allowed to be executed by him with corresponding Extension of Time, subject to the condition that the Contractor shall not be entitled to raise any claims on account of prolongation costs in this behalf.

- iv. In the event of withdrawal of Works under Clause 8.3 (iii) (a), the Contract Price shall be reduced by an amount equal to per cent of the value of the Works withdrawn as mentioned in the Table below and the Contractor shall not be entitled to any other compensation or Damages for the withdrawal of Works.

Value of the works withdrawn	Percentage of value of works to be reduced from Contract Price
Up to Rs. 100 crore	90%
More than Rs. 100 crore	Rs. 90 crore plus 95% of the amount greater than Rs. 100 crores

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' Engineer.

The parties expressly agree that the value of the Works withdrawn shall be determined from the details available in Schedule-H. In the event that it is impossible to determine the value from Schedule-H, then the value shall be determined in accordance with the provisions of Clause 13.2 (iii).

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 because 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, 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 takes place thereon. 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 Highway and the performance of its obligations under this Agreement.

8.7 Access to the Authority and the Authority's Engineer

- (i) 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.

The Contractor shall ensure, subject to all relevant safety procedures, that the Authority has unrestricted 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, it shall be the responsibility of the Contractor to 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.

9.2.1 Shifting of obstructing utilities

Shifting of obstructing existing utilities if any to an appropriate location in accordance with the standards and specifications of concerned Utility Owning agency is part of the scope of work of the Contractor. The bidders may visit the site and assess the quantum of shifting of utilities for the project before submission of their bid. The specifications of concerned Utility Owning agency shall be applicable and followed.

9.2.2 The type/spacing/size/specifications of poles/towers/lines/cables to be used in shifting work shall be as per the guidelines of Utility Owning Agency and it is to be agreed solely between the Contractor and the Utility Owning Agency. No change of scope shall be admissible, and no cost shall be paid for using different type/spacing/size/specifications in shifted work in comparison to those in the existing work or for making any overhead crossings to underground as per requirement of Utility owning Agency and/or construction of project highway. The Contractor shall carry out joint inspection with Utility Owning Department and get the estimates from Utility Owning Department. The assistance of the Authority is limited to giving forwarding letter on the proposal of Contractor. The decision/approval of Utility owning Agency shall be binding on the Contractor.

9.2.3 The supervision charges at the rates/charges applicable of the Utility owning Agency shall be paid directly by the Contractor to the Utility owning Agency.

9.2.4 The utilities shall be handed over after shifting work is completed to Utility Owning Agency to their entire satisfaction. The maintenance liability shall rest with the Utility Owning Agency after handing over process is complete as far as utility shifting works are concerned.

New utilities

- i. The Contractor shall allow, subject to the permission from the Authority and such conditions as the Authority may specify, access to, and use of the Site for laying telephone lines, water pipes, electricity lines/ 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 Highway in accordance with this Agreement and any damage caused by such use shall be restored forthwith at the cost of the Authority.

- ii. The Authority may, by notice, require the Contractor to connect any adjoining road to the Project Highway, 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.

Article 10

Design and Construction of the Project Highway

10.1 Obligations prior to commencement of Works

- (i) Within 10 (ten) 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 Highway under and in accordance with the Applicable Laws and Applicable Permits.
- (ii) The Authority shall, 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.
- (iii) Within 20 (twenty) 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, for review and consent of the Engineer, giving the following details:
 - (a) 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.
 - (b) 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:
 - i. the order in which the Contractor intends to carry out the Works, including the anticipated timing of design and stages of Works;
 - ii. the periods for reviews under Clause 10.2;
 - iii. the sequence and timing of inspections and tests specified in this Agreement; and
 - iv. the particulars for the pre-construction reviews and for any other submissions, approvals and consents specified in the Agreement.

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

(c) Part III : Monthly cash flow forecast.

(iv) The Contractor shall compute, on the basis of the Drawings prepared in accordance with Clause 10.2 (iv), 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.

(v) The Contractor shall appoint a safety consultant (the "**Safety Consultant**") to carry out a safety audit at the design stage of the Project Highway 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 (3) names of qualified and experienced firms from which the Authority may choose one (1) 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 Contractor shall propose to the Authority a revised panel of three (3) 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 highway 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.

(vi) The safety audit pursuant to Clause 10.1 (v) 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 Highway 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

(i) 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 and approval of the Authority's Engineer.

(ii) The Contractor shall appoint a proof check consultant (the "**Proof Consultant**") after proposing to the Authority a panel of three (3) names of qualified and experienced firms from whom the Authority may choose one (1) 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 Contractor shall propose to the Authority a revised panel of three (3) 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 (2) key personnel of the Proof Consultant who shall have adequate experience and qualifications in highways 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.

(iii) 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.

(iv) In respect of the Contractor's obligations with respect to the design and Drawings of the Project Highway 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 (3) copies each of the design and Drawings, duly certified by the Proof Consultant, to the Authority's Engineer for its approval. Provided, however, that in respect of Major Bridges and Structures, the Authority's Engineer may require additional drawings for approval in accordance with Good Industry Practice.
- (b) by submitting the Drawings for review and approval 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 approval/observations to the Contractor with particular reference to their conformity or otherwise with the Scope of the Project and the Specifications and Standards. Provided, however that in case of a major bridge or structure, the aforesaid period of 15 (fifteen) days may be extended up to 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 and approval. 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/approval as aforesaid, the Authority's Engineer may withhold the payment for the affected works in accordance with the provisions of Clause 19.5 (iv). 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/approval and/or observation of the Authority's Engineer and/or its failure to review/approval 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 approval 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.
- (h) the Contractor shall ensure that all the designs and drawings shall be approved from the Authority's Engineer within 90 days (ninety) from the Appointed Date.

(v) Any cost or delay in construction arising from review/approval by the Authority's Engineer shall be borne by the Contractor.

(vi) 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 approval of the Authority's Engineer thereon as communicated pursuant to the provisions of sub-Clause (c) & (d) of Clause 10.2 (iv). 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.

(vii) 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 Highway as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Project Highway and setback lines, if any, of the buildings and structures forming part of Project Facilities.

10.3 Construction of the Project Highway

(i) The Contractor shall construct the Project Highway 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 [545th (five hundred and forty-five days (18 Month))] 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.

(ii) The Contractor shall construct the Project Highway 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 Project Highway is 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 Project Highway is 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 (ii) shall be refunded by the Authority to the Contractor, but without any interest thereon.

The Parties agree that for determining achievement or delays in completion of the Project Milestones or the Project on the due date, the works affected due to delay in providing the site for which time extension has been granted beyond the Scheduled Completion Date will be excluded. For example on the due date to achieve the Project Milestone-I (i.e., Stage Payments of 10% (ten percent) of Contract Price on 180th (one hundred and eighty) day from the Appointed Date), if 5% (five percent) of the project length corresponding to the Project Milestone-I is not handed over or lately handed over resulting in the extension of completion of this 5% (five percent) length beyond Scheduled Completion Date, Stage Payment of $10\% \times 0.95 = 9.5\%$ only is to be achieved by 180th (one hundred and eighty) day.

For the avoidance of doubt, it is agreed that recovery of Damages under this Clause 10.3 (ii) 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 (ii).

(iii) 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 (ii) shall not exceed 10% (ten percent) of the Contract Price. If the damages exceed 10% (ten percent) of the Contract Price, the Contractor shall be deemed to be in default of this agreement having no cure and the Authority shall be entitled to terminate this Agreement by issuing a Termination Notice in accordance with the provisions of Clause 23.1 (ii).

(iv) In the event that the Contractor fails to achieve the Project Completion within a period of 90 (ninety) days from the Schedule Completion Date set forth in Schedule-J, unless such failure has occurred due to Force Majeure or for reasons solely attributable to the Authority, the contractor shall be deemed to be ineligible for bidding any future projects of the Authority, both as the sole party or as one of the parties of Joint Venture/ Consortium during the period from Scheduled Completion Date to issuance of Completion Certificate. This restriction is applicable if the contract value of the delayed project is not less than Rs. 300 Crore.

10.4 Maintenance during Construction Period

(i) During the Construction Period, the Contractor shall maintain, at its cost, the existing lane(s) of the Project Highway so that the traffic worthiness and safety thereof are at no time materially inferior as compared to their condition on Appointed Date, 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 Highway. 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 highway in such sections until the new Works are open to traffic.

(ii) 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 (i) above, the Authority shall get these maintenance works completed in the manner 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

(i) 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 of Construction Zone, environmental clearances or approval of railway authorities, specified in Clause 3.1 (iv);

- (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.

(ii) The Contractor shall 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 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.

(iii) On the failure of the Contractor to issue to the Authority's Engineer a notice in accordance with the provisions of Clause 10.5 (ii), 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 (iii), the Authority shall be discharged from all liability in connection with the claim.

(iv) The Authority's Engineer shall, on receipt of the claim in accordance with the provisions of Clause 10.5 (ii), 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. The Contractor shall, on receipt of the communication of the Authority's Engineer requesting for clarification, furnish the same to the Authority's Engineer. The Authority's Engineer shall 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.

(v) 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 (iv) within a period of 30 (thirty) 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 (ii) 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 Highway 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.

10.8 As-Built Records

The Contractor shall prepare, and keep up-to-date, a complete set of as built records of the execution of the Works, showing the exact as built locations, sizes and details on the Works as executed with cross references to all relevant specifications and data sheets. These records shall be kept on the Site and shall be used exclusively for the purpose of this Sub-Clause 10.8. The Contractor shall provide 2 (two) copies of as built records to the Authority prior to the commencement of the Tests on Completion.

10.9 Contractor's Use of Authority's Documents

Intellectual property in the Authority's requirements and Specifications and Standards and all other documents and materials issued by the Authority or the Authority's Representative to the Contractor shall (as between the parties) remain the property of the Authority. The Contractor may, at its cost, copy, use and communicate any such documents for the purposes of the Contract. They shall not, without the consent of the

Authority, be used, copied or communicated to a third party by the Contractor, except as necessary for the purposes of the Works under the Agreement.

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. Also, the stipulations in Ministry's "Guidelines and SOP for Quality Control/ Assurance in construction of National Highways No. RW/NH-34066/01/2020-QCZ dated 01.10.2020" should be strictly adhered to.

11.2 Quality control system

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

(ii) The Contractor shall, within 20 (twenty) 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/Authority's Engineer shall convey its approval to the Contractor 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.

(iii) 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.

(iv) 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 and consent 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 consent 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 Highway 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

(i) At any time during construction, the Authority may appoint an external technical auditor (Third Party Inspection Agency) to conduct an audit of the quality of the Works. The Auditor in the presence of the representatives of the Contractor and the Authority's Engineer shall carry out the tests and/ or collect samples for testing in the laboratory. The timing, the testing equipment and the sample size of this audit shall be as decided by the Authority. 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.

(ii) After completion of the remedial measures by the Contractor, the Auditor shall undertake a closure audit and this process will continue till the remedial measures have brought the works into compliance with the Specifications and Standards. 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.

The Contractor agrees that reporting under this Clause 11.7 shall continue until the date of the completion of the Works. Each report shall include:

- (a) an executive summary;
- (b) charts showing the status of Contractor's documents, construction and manufacturing and environmental works;
- (c) details of work subcontracted and the performance of Sub-contractors;
- (d) for the construction of each main part of the Works, the extent of progress (both quantity and percentage of the whole), the actual or expected dates of commencement, anticipated completion date of the activity, Contractor's inspections and tests;
- (e) records of manpower and Contractor's equipment on the Site;
- (f) copies for that month of quality assurance documents, test results and certificates;

- (g) safety statistics, accident data collection including details of any hazardous incidents and activities relating to environmental aspects and public relations;
- (h) comparisons of actual and planned progress, with details of any aspects which may jeopardise the completion in accordance with the Agreement, and the measures being (or to be) adopted to overcome such aspects;
- (i) details of any unresolved disputes or claims, in relation to the Project;
- (j) details of any revision to the cash flow estimate, together with a copy of the revised cash flow estimate;
- (k) status of various Applicable Permits and compliance of conditions therein;
 - (l) details of various royalty payment and insurances required to be taken by the Contractor; and
- (m) such other reports as may be required by the Authority for enabling the Authority to comply with its obligations under the other Project contracts.
- (n) details of defects by the Authority;
- (o) change in emission of any sewage or effluent of any nature whatsoever, whether qualitatively or quantitatively;
- (p) any Material Adverse Effect;
- (q) declaration towards compliance with Applicable Laws including but not limited to environmental and labour legislations;
- (r) declaration specifying compliance with all Manuals provided to the Contractor; and
- (s) any change in the flow of traffic in the existing Project Highway.

11.8 Inspection

- (i) The Authority's Engineer and its authorized 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.
- (ii) 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.
- (iii) 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

(i) 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 50% (fifty percent) of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.

(ii) 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.

(iii) In order to document the status/ condition and quality of road, the Contractor shall carry out survey using Network Survey Vehicle (NSV) by engaging Consultant from the MoRTH list of Empanelled NSV Consultants, under the supervision of Authority's Engineer, at the following intervals:

- (a) Before start of the work,
- (b) Before issue of provisional/ final completion certificate,
- (c) Every 6 months after completion of work until completion of Defect Liability Period,
- (d) The output of the NSV test should be reported in the format enclosed with this Agreement.

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

(i) 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 Highway, 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.

(ii) If the Contractor fails to comply with the instructions issued by the Authority's Engineer under Clause 11.13 (i), 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 (ii), 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 Highway 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 a copy of all its quality control records and documents to the Authority's Engineer before the Completion Certificate is issued pursuant to Clause 12.2. The Contractor shall submit Road Signage Plans to the Authority Engineer for approval at least 6 (six) months prior to expected completion of Project Highway.

11.16 Video recording

During the Construction Period, the Contractor shall provide to the Authority for every six months, a video recording (through Drone), which will be compiled into a 3 (three)-hour digital video Pen Drive/Micro SD Card, as the case may be, covering the status and progress of Works. 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. Further, the NOC for using Drone from respective agencies shall be taken by the Contractor.

11.17 Suspension of unsafe Construction Works

(i) 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.

(ii) The Contractor shall, pursuant to the notice under Clause 11.17 (i), 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.

(iii) 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.

(iv) 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.

11.18 Staff and Labour

(i) Engagement of Staff and Labour

(a) The Contractor shall make its own arrangements for the engagement of all personnel and labour, local or otherwise, and for their payment, housing, feeding and transport.

(b) The Contractor has verified/ shall verify the identity and address of all its employees and officials related to the Works by collecting necessary documentary proof.

(c) The Contractor shall seek a self-declaration from its employees that they have not been convicted of any criminal offence by any court and if any criminal proceedings/charge-sheets have been pending

/filed against them. The Contractor shall not employ persons with criminal track record on the project. In cases where it comes to notice later that the employee concerned has concealed any such fact in his self-declaration or commits a criminal offence during the course of his employment, the Contractor shall remove such person from the project

(d) Deleted.

(e) The employees and personnel of the Contractor shall work under the supervision, control and direction of the Contractor and the Contractor shall be solely responsible for all negotiations with its employees and personnel relating to their salaries and benefits, and shall be responsible for assessments and monitoring of performance and for all disciplinary matters. All employees / personnel, executives engaged by the Contractor shall be in sole employment of the Contractor and the Contractor shall be solely responsible for their salaries, wages, statutory payments, etc and under no circumstances the personnel shall be deemed to be the employees of the Authority. Under no circumstances the Authority shall be liable for any payment or claim or compensation of any nature to the employees and personnel of the Contractor.

(ii) Returns of Labour

(a) The Contractor shall deliver to the Authority a detailed return in such form and at such intervals as the Authority may prescribe, showing the details including names, payment details and terms of appointment of the several classes of labour employed by the Contractor from time to time for the Works. The Contractor shall, in its returns certify that all dues of the workers or labour have been fully paid.

(b) The Authority is entitled to witness labour payments made or to be made by the Contractor. If the Contractor defaults in its obligations for making any payments under the labour laws, the Employer may make the relevant payments. Any sum equal to any amount paid by the Employer under clause 19 shall be immediately due as a debt from the Contractor to the Employer and until payment/ set off shall carry interest at 18% per annum. For this purpose it is agreed between the parties that debt due aforesaid shall be set off immediately out the running account bills of the Contractor under this Agreement.

(iii) Persons in the Service of Others

The Contractor shall not recruit, or attempt to recruit from amongst persons in the service of the Authority.

(iv) Labour Laws

(a) The Contractor shall obtain all relevant labour registrations and comply with all relevant labour laws applying to its employees, and shall duly pay them and afford to them all their legal rights.

(b) The Contractor shall make all deductions of tax at source and all contributions to the Payment of Gratuity, Provident Fund (including Employees' contribution) and Employees' State Insurance Scheme as may be required by Applicable Laws and deposit the aforesaid contributed amount with the appropriate authority/(s).

(c) The Contractor shall require all personnel engaged in the Works to obey all Applicable Laws and regulations. The Contractor shall permit Authority to witness labour payments for the Contractors

direct labour, or the Subcontractors labour. The Contractor shall ensure that all its Subcontractors strictly comply with all labour laws.

(d) Documentary evidence confirming compliance with labour laws, as may be required from time to time, shall be provided to the Employer's Representative.

(e) The Employer shall not be liable for any delay/default of the Contractor in compliance of the labour laws.

(v) Facilities for Staff and Labour

The Contractor shall provide and maintain all necessary accommodation and welfare facilities for personnel engaged for the Works. The Contractor shall not permit any personnel engaged for the Works to maintain any temporary or permanent living quarters within the structures forming part of the Works.

(vi) Health and Safety

All necessary precautions shall be taken by the Contractor to ensure the health and safety of staff and labour engaged for the Works. The Contractor shall, in collaboration with and to the requirements of the local health authorities, ensure that para-medical staff, first-aid facilities, ambulance service are available on the Site at all times, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics. The Contractor shall appoint a safety officer to be responsible for the safety of personnel on the Site. This safety officer shall be qualified for his work and shall have the authority to issue instructions concerning safety and take protective measures to prevent accidents. The Contractor shall maintain records and make reports concerning health, safety and welfare of personnel, and damage to property, in such manner as the Authority may reasonably require.

(vii) Contractor's Personnel

The Contractor shall employ only personnel who are appropriately qualified, skilled and experienced in their respective trades or occupations. The Authority may require the Contractor to remove any personnel engaged for the Works, who in the opinion of the Authority:

(a) has engaged in any misconduct;

(b) is incompetent or negligent in the performance of his duties;

(c) fails to conform with any provisions of the Contract;

(d) engages in any conduct which is prejudicial to safety, health, or the protection of the environment; or

(e) makes errors in the discharge of his functions.

If appropriate and required by the Employer, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

(viii) Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst its personnel, and to preserve peace and protection of people and property in the neighbourhood of the Works.

11.19 SPECIAL CONDITIONS OF CONTRACT

1. LABOUR

The contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport. The Contractor shall, if required by the Nodal Officer or his nominee, deliver to the Nodal Officer or his nominee a return in detail, in such form and at such intervals as the Nodal Officer or his nominee may prescribe, showing the staff and numbers of the several classes of labour from time to time employed by the Contractor on the Site and such other information as the Nodal Officer or his nominee may require.

2. COMPLIANCE WITH LABOUR REGULATIONS:

During continuance of the contract, the Contractor and his sub-contractors shall abide at all times by all existing labour enactment and rules made there under, regulations, Notifications and by laws of the State or Central Government or local authority and any other labour law (including rules) regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or Central Government or the local authority. Salient features of some of the major labour laws that are applicable to construction industry are given below. The Contractor shall keep the Employer indemnified in case any action is taken against the employer by competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments. If the Employer is caused to pay or reimburse such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules /regulations including amendments, if any, on the part of the Contractor the Nodal Officer or his nominee/Employer shall have the right to deduct any money due to the Contractor including his amount of performance security. The Employer/Nodal Officer or his nominee shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer. The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

SALIENT FEATURES OF SOME MAJOR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK.

(a) Workmen Compensation Act 1923: - The act provides for compensation in case of injury by accident arising out of and during the course of employment.

(b) Payment of Gratuity Act 1972: - Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years' service or more on death at the rate of 15 days' wages for every completed year of service. Act is applicable to all establishments employing 10 or more employees.

(c) Employees P.F and Miscellaneous Provision Act 1952: - The Act Provides for monthly contribution by the employer plus workers @ 12%/8.33%. the benefits payable under the Act are: Pension to family

pension retirement or death, as the case may be. (ii) Deposit linked insurance on the death in harness of the worker, (iii) payment of P.F accumulation on retirement/death etc.

(d) Maternity Benefit Act 1951: - The Act provides for leave and some other benefits to workmen/employees in case of confinement or miscarriage etc.

(e) Contract Labour (Regulation & Abolition) Act 1970: - The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the 72 Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

(f) Minimum Wages Act 1948: - The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment Construction of Buildings, Roads, Runways are scheduled employment.

(g) Payment of Wages Act 1936: - It lays down as to by what date the wages are to be paid when it will be paid and what deductions can be made from the wages of the workers.

(h) Equal Remuneration Act 1979: - The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

(i) Payment of Bonus Act 1965: - The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/- per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above up to 3500/- per month shall be worked out by taking wages as Rs.2500/- per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

(j) Industrial Disputes Act 1947: - The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lockout becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

(k) Industrial Employment's (Standing Orders) Act 1946: - It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get same certified by the designated Authority.

(l) Trade Unions Act 1926: - The Act lays down the procedure for registration of trade union of workmen and employers. The Trade Union registered under the Act have been certain immunities from civil and criminally abilities.

(m) Child Labour (Prohibition & Regulation) Act 1986: - The Act prohibits employment

of children below 14 years of age in certain occupations and processes and provides for regulation of employment of Children in all other occupations and processes. Employment of Child Labor is prohibited in Building and Construction Industry.

(n) Inter-State Migrant Workmen's (Regulation of Employment & Conditions of Service) Act 1979: - The Act is applicable to an establishment which employs 5 or more inter-state

migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home upon the establishment and back, etc.

(o) The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996: - All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or Construction work and other welfare measures, such as Canteens, First-Aid facilities. Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

(p) Factories Act 1948: - The Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrence to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 more persons without the aid of power engaged in manufacturing process.

11.20 All the royalties of the materials, quarry fees, octroi, charges, sales tax etc. are payable by the contractor directly to the authorities concerned and the rates tendered shall be deemed to be inclusive of all such charges. All royalties of materials, quarry fees, etc., payable by the contractor directly to the authority concerned and rates tendered shall be deemed to be inclusive of all charges. Before claiming security deposit, contractor shall produce "No dues certificate" from the Geologist, Geology and mining department of Bhuj,

Article 12

Completion Certificate

12.1 Tests on Completion

- (i) At least 30 (thirty) days prior to the likely completion of the Project Highway, or a Section thereof, the Contractor shall notify the Authority's Engineer of its intent to subject the Project Highway 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.
- (ii) 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 Highway 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 Highway 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 Highway or Section thereof with the Specifications and Standards.

12.2 Completion Certificate

- (i) Upon completion of all Works forming part of the Project Highway, and the Authority's Engineer determining the Tests to be successful and after the receipt of notarized true copies of the certificate(s) of insurance, copies of insurance policies and premium payment receipts in respect of the insurance defined in Article 20 and Schedule P of this Agreement, it shall, at the request of the Contractor forthwith issue to the Contractor and the Authority certificate substantially in the form set forth in Schedule-L (the "Completion Certificate").
- (ii) 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.

(iii) 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 Highway shall vest in the Authority.

Rescheduling of Tests

If the Authority's Engineer certifies to the Authority and the Contractor that it is unable to issue the Completion 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

(i) 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**") within a period of six months counted from the Appointed Date. Upon the Authority making its intention known to the Contractor for the specific Change of Scope, be it positive or negative, the Contractor shall submit his proposal for the said 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.

(ii) Provided that any such Change of Scope, excluding major structures (e.g. Major Bridge/ ROB/ RUB/ Flyover/ elevated road of more than 50 m length) may be required and agreed to be executed between the parties beyond the period of six months of the Appointed Date but before expiry of 50% of the original Scheduled Construction Period of the Project Highway, subject to the condition that it shall not entail any claims (e.g. Extension of Time/ Prolongation related claims), against the Authority.

(iii) The Change of Scope shall mean the following:

- (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 (iii); 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.

13.2 Procedure for Change of Scope

(i) 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 there under (the "**Change of Scope Notice**"). The Contractor shall submit a detailed proposal as per Clause 13.2 (iii) within 15 days from the receipt of Change of Scope Notice.

(ii) If the Contractor determines, not later than 90 days from the Appointed Date, that a Change of Scope to the Works is required, it shall prepare a proposal with relevant details as per Clause 13.2 (iii) at its own cost and shall submit to the Authority to consider such Change of Scope (the "**Change of Scope Request**").

(iii) 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 detailed proposal 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-up of the quantities, unit rates and cost for different items of work; and
 - ii. proposed design for the Change of Scope;
 - iii. proposed modifications, if any, to the Project Completion Schedule of the Project Highway.

For the avoidance of doubt, the Parties expressly agree that, subject to the provisions of Clause 13.4 (ii), the Contract Price shall be increased or decreased, as the case may be, on account of any such Change of Scope.

(iv) The parties agree that costs and time for implementation of the proposed Change of Scope shall be determined as per the following:

- (a) For works where Schedule of Rates (SOR) of concerned circle or SOR 2022 of DPA & Rate Analysis are applicable at the Base Date are available, the same shall be applicable for determination of costs. In case of non-availability of Schedule of Rates at the Base Date, the available Schedule of Rates shall be applied by updating the same based on WPI. In case the Contract Price is lower/ higher than the Estimated Project Cost as per RFP, then the SOR rates shall be reduced/ increased in the same proportion accordingly.
- (b) For item of Works not included in Schedule of Rates as mentioned in sub-para (a) of Clause 13.2 (iv) above, the cost of same shall be derived on the basis of MORTH Standard Data Book and the Authority's Engineer shall determine the prevailing market rates and discount the same considering WPI to achieve the prevailing rate at the Base Date, 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 Transparency Policy of DPA.
- (c) For the avoidance of doubt, in case the cost as determined by the Contractor and the Authority reveals a difference of more than 10% (ten per cent), the cost as determined by the Authority shall be considered as final and binding on the Contractor.
- (d) The design charges shall be considered only for new works or items (i.e. the Works or items not similar to the works or items in the original scope) @ 1% (one per cent) of cost of such new works or items.
- (e) The costs of existing works or items, which are being changed/ omitted shall also be valued as per above procedure and only net cost shall be considered.
- (f) The reasonable time for completion of works to be taken under Change of Scope shall be determined by the Authority's Engineer on the basis of Good Industry Practice and if such time exceeds the Scheduled Completion Date, the issue of Completion Certificate shall not

be affected or delayed on account of construction of Change of Scope items/ works remaining incomplete on the date of Tests.

(v) Upon consideration of the detailed proposal submitted by the Contractor under the Clause 13.2 (iii), the Authority, within 15(fifteen) days of receipt of such proposal, may in its sole discretion either accept such Change of Scope with modifications, if any, and initiate proceedings thereof in accordance with this Article 13 or reject the proposal and inform the Contractor of its decision and shall issue an order (the **"Change of Scope Order"**) requiring the Contractor to proceed with the performance thereof.

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, that too with verbal approval of Authority which shall be confirmed in writing in next 3 (three) days. 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.

(vi) 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

(i) 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.

(ii) Deleted.

(iii) Notwithstanding anything to the contrary in this Article 13, if any change is necessitated because of any default of the Contractor in the performance of its obligations under this Agreement, the same shall not 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

(i) 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 or agency on the basis of open competitive bidding. It is also agreed that the Contractor shall provide assistance and cooperation to the person or agency who undertakes the works or services hereunder. The Contractor shall not be responsible for rectification of any Defects, but the Contractor shall carry out maintenance of such works after completion of Defect Liability Period of work by other person or agency during the remaining period of this agreement without any extra payment.

(ii) 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 Highway. 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

(i) The Contractor shall maintain the Project Highway for a period of [5 (five)] years, corresponding to the Defects Liability Period, commencing from the date of the Completion Certificate (the "Maintenance Period"). For the performance of its Maintenance obligations, the Contractor shall be paid:

(a) For flexible pavement with 5 years Maintenance Period including structures: no maintenance charges shall be paid for the first year; 0.50% of the Contract Price each for the second, third and fourth year; and 1% of the Contract Price for the fifth year

(b) Deleted

(c) Deleted

(d) Deleted

Above amount for the performance of Contractors' Maintenance obligations 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. It is further agreed that the Contract Price hereunder shall be reckoned with reference to the amount specified in Clause 19.1 (i), which shall be adjusted to the extent of Change of Scope and the works withdrawn under the provisions of Clause 8.3 (iii), but shall not include any price adjustments in pursuance of Clause 19.10.

(ii) 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 Highway;

(b) undertaking routine maintenance including prompt repairs of potholes, cracks, joints, drains, embankments, structures, pavement markings, lighting, road signs and other traffic control devices. For the avoidance of doubt, the electricity charges for operation of electrical infrastructure installed along the project length, except the infrastructure being used by the Contractor for its own use, shall be borne by the Authority;

(c) undertaking repairs to structures;

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

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

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

(iii) 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 wilful default or neglect of the Authority or a Force Majeure Event.

(iv) The Contractor shall remove promptly from the Project Highway any waste materials (including hazardous materials and waste water), rubbish and other debris (including, without limitation, accident debris) and keep the Project Highway 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 Highway conforms to the maintenance requirements set forth in Schedule-E (the "Maintenance Requirements").

14.3 Maintenance Programme

(i) 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

(i) 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.

(ii) The Contractor shall maintain and operate a round-the-clock vehicle rescue post with 1 (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 at Kandla. The Contractor shall promptly

remove any damaged vehicles and debris from the Project Highway to enable safe movement of traffic and shall report all accidents to the police forthwith.

14.5 Lane closure

(i) The Contractor shall not close any lane of the Project Highway 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.

(ii) Upon receiving the permission pursuant to Clause 14.5 (i), the Contractor shall be entitled to close the designated lane for the period specified therein, and for all lane closures extending a continuous period of 48 (forty-eight) hours, the Contractor shall, in the event of any delay in re-opening such lane, 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. In the event of any delay in re-opening such lanes or in the event of emergency decommissioning and closure to traffic of the whole or any part of the Project Highway due to failure of the Contractor, the Contractor shall pay damages to the Authority at double the above rate, without prejudice the rights of the Authority under this Agreement including Termination thereof.

14.6 Reduction of payment for non-performance of Maintenance obligations

(i) 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.

(ii) 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 Highway 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 Highway

Save and except as otherwise expressly provided in this Agreement, in the event that the Project Highway 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 Highway conforms to the provisions of this Agreement.

14.9 Overriding powers of the Authority

(i) 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.

(ii) In the event that the Contractor, upon notice under Clause 14.9 (i), fails to rectify or remove any hardship or danger within a reasonable period, the Authority may exercise overriding powers under this Clause 14.9 (ii) 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.

(iii) 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 Highway 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 (iii), and shall provide assistance and cooperation to the Authority, on a best effort basis, for performance of its obligations hereunder.

14.10 Taking over Certificate

The Maintenance Requirements set forth in Schedule-E having been duly carried out, Maintenance Period as set forth in Clause 14.1 (i) having been expired and Authority's Engineer determining the Tests on Completion of Maintenance to be successful in accordance with Schedule-Q, the Authority will issue Taking Over Certificate to the Contractor substantially in the format set forth in Schedule-R.

Article 15

Supervision and Monitoring during Maintenance

15.1 Inspection by the Contractor

- (i) The Authority's Engineer shall undertake regular inspections to evaluate continuously the compliance with the Maintenance Requirements.
- (ii) 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

- (i) The Authority's Engineer may inspect the Project Highway 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.
- (ii) After the Contractor submits to the Authority's Engineer the Monthly Maintenance Statement for the Project Highway 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.
- (iii) 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.
- (iv) 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 Highway 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' Engineer.

At any time during Maintenance Period, the Authority may appoint an external technical auditor to conduct an audit of the quality of the Works. The Auditor in the presence of the representatives of the Contractor and the Authority's Engineer shall carry out the Tests and/ or collect samples for testing in the laboratory. The timing, the testing equipment and the sample size of this audit shall be as decided by the Authority. 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 measures. After completion of the remedial measures by the Contractor, the auditor shall undertake a closure audit and this process will continue till the remedial measures have brought the maintenance works into compliance with the Specifications and Standards. 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 15.3, the external technical audit shall not affect any obligations of the Contractor or the Authority's Engineer under this Agreement.

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 Highway relating to the safety and security of the Users and Project Highway. 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 Highway shall include:

- (a) accident, death or severe injury to any person;
- (b) damaged or dislodged fixed equipment;
- (c) flooding of Project Highway; and
- (d) any other unusual occurrence.

Article 16

Traffic Regulation

16.1 Traffic regulation by the Contractor

(i) The Contractor shall take all the required measures and make arrangements for the safety of Users during the Construction and Maintenance of the Project Highway 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.

(ii) All works shall be carried out in a manner creating least interference to traffic passing through the Project Highway or a Section thereof. In sections 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. 'ROBOTS' may be used for diversion and control of traffic during Construction. 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

(ii) The Contractor shall be responsible for all the Defects and deficiencies, except usual wear and tear in the Project Highway or any Section thereof, till the expiry of a period of commencing from the date of Completion Certificate (the “**Defects Liability Period**”) as specified below:

- (a) 5 (five) years from the date of completion in case of a road being constructed with flexible pavement;
- (b) 10 (ten) years from the date of completion in case of road being constructed with rigid pavement;
- (c) 10 (ten) years from the date of completion in case of road being constructed with flexible pavement using perpetual design;
- (d) 10 (ten) years from the date of completion in case of all stand-alone structures, e.g. Major Bridges/ and Tunnels;
- (e) 10 (ten) years from the date of completion for the stretches where new technology/ material has been/ is proposed to be used.
- (f) 3 (three) years from the date of completion for stretches requiring renewal of Bituminous Concrete (BC) layer through either using hot-in-place recycling of the entire BC layer or providing a fresh layer of BC with 40mm thickness.
- (g) 3 (three) years from the date of completion for stretches requiring improvement to riding quality, in cases other than those mentioned in para (f) above, through laying a layer of BM/DBM and BC.

The Defects Liability Period shall commence from the date of the Completion Certificate. For the avoidance of any doubt, any repairs or restoration because of usual wear or tear in the Project Highway or any Section thereof shall form a part of the Maintenance obligations of the Contractor as specified in Article 14.

17.2 Remedying Defects

Save and except as provided in Clause 14.1 (iii), the Contractor shall repair or rectify all Defects and deficiencies observed by the Authority or Authority’s Engineer during the Defects Liability Period within a period of 15 (fifteen) days from the date of notice issued by the Authority or Authority’s Engineer in this behalf, or within such reasonable period as may be determined by the Authority or Authority’s Engineer at the request of the Contractor, in accordance with Good Industry Practice.

17.3 Cost of remedying Defects: 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 Highway 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

If 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 to make the Project Highway 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 20% (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 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 or rectified.

Article 18

Authority's Engineer

18.1 Appointment of the Authority's Engineer

- (i) The Authority shall appoint a firm of Consulting Engineers or a Project Monitoring Committee (PMC) substantially in accordance with the selection criteria set forth in Schedule-N, to be the engineer under this Agreement (the "Authority's Engineer"). In unavoidable circumstances, Authority may appoint an officer to act as Authority's Engineer until appointment of a Consulting Engineering firm/ Supervision Consultant/ PMC.
- (ii) The officer in-charge of the Authority is responsible for the overall supervision and monitoring of the execution of project as the representative of the owner of the project. The Authority's Engineer is appointed to assist the Authority for carrying out the functions as detailed under clause 18.2. As such, an officer of the Authority is vested with all such powers and responsibilities as are enjoined upon the Authority's Engineer and is fully competent to issue any instructions for proper monitoring and supervision of the project, either by himself or through the Authority's Engineer. Instructions issued by the concerned officer of the Authority shall have the same effect as that of the Authority's Engineer in terms of this Agreement. Wherever such concerned officer issues any instructions or notice to the Contractor, he shall endorse a copy thereof to the Authority's Engineer.
- (iii) The Authority's Engineer should be appointed within 10 days from the date of this Agreement or before declaration of Appointed Date, whichever is earlier. The Authority shall notify the appointment or replacement of the Authority's Engineer to the Contractor.
- (iv) 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

- (i) 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 Annexure-I 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;
 - (d) issuance of Completion Certificate; or
 - (e) any other matter which is not specified in (a), (b), (c) or (d) above and which creates financial liability on either Party.
- (ii) 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 (i).

- (iii) 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.
- (iv) The Authority's Engineer shall ensure that NSV survey shall be conducted at the following intervals:
 - (a) Before start of the work,
 - (b) Before issue of provisional/ final completion certificate,
 - (c) Every 6 months after completion of work
- (v) The Authority's Engineer in consultation with the Authority shall update Online Portal of the Authority/Ministry (if any) and also ensure uploading Monthly and Quarterly Progress Report along with Strip Chart. Such updations shall be done on the last date of every month/ quarter and if required, on a weekly basis as advised by the Authority. Monthly invoices towards services of the Authority's Engineer shall not be admitted for payment in case of non-compliance of the above.

18.3 Delegation by the Authority's Engineer

- (i) 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.
- (ii) 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.
- (iii) Notwithstanding anything stated in Clause 18.3 (i) 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

- (i) The Authority's Engineer may issue instructions for remedying any Defect(s) to the Contractor. 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.
- (ii) 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 the oral instructions in writing within 2 (two) working days of issuing them.
- (iii) In case the Contractor does not receive the confirmation of the oral instructions within the time specified in Clause 18.4 (ii), 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 instructions.

- (iv) 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

- (i) 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.
- (ii) 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, costs and expenses of the Authority's Engineer shall be paid by the Authority.

18.7 Termination of the Authority's Engineer

- (i) The Authority may, in its discretion, replace the Authority's Engineer at any time. However, the Authority shall ensure that alternative arrangements for appointment of another Authority's Engineer or designation of its own officer as the Authority Engineer for the intervening period are made simultaneously.
- (ii) 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 the 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 and 18.7 (i).

Part IV

Financial Covenants

Article 19

Payment

19.1 Contract Price

(i) 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. (in words) (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. 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.

(ii) The Contract Price includes all duties, taxes, royalty, cess, charges, 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.

(iii) The Contract Price shall not be adjusted for any change in costs stated in Clause 19.1 (ii) above, except as stated in Clauses 19.10 and 19.17.

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

(v) 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 Highway.

(vi) All payments under this Agreement shall be made in Indian Rupees.

19.2 Advance Payment

The Authority shall make an interest-bearing advance payment (the "Advance Payment") @ "SBI PLR + 3%", equal to 10 % (ten percent) of the Contract Price, exclusively 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) mobilization advance would be released after submission of utilization certificate by the Contractor for the first 5% (five per cent) advance already released earlier.

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 per cent) of the Contract Price against Bank Guarantee. This advance shall be further subject to the condition that: such new equipment are considered by the Authority's Engineer to be necessary for the works and 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 the applicable interest rate (@ "SBI PLR + 3%"), to be compounded annually on a reducing balance basis. The interest would be recovered along with the recovery of mobilization Advance Payment as per provision laid down for the mobilization advance recovery.

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.

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.

The Contractor has the option of splitting the Bank Guarantee against Advance Payment for mobilization expenses into parts, each not less than 2.75% (two point seven five per cent) of the Contract Price. Each part of the guarantee shall remain effective till full repayment of such part advance corresponding to this bank guarantee. Such part of Bank Guarantee shall be returned to the Contractor on recovery under the Agreement of the full amount of such part guarantee within 30 (thirty) days of the said recovery.

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.

The Advance Payment shall be repaid through percentage deductions from the stage payments determined by the Authority's Engineer in accordance with Clause 19.5, as follows:

deductions shall commence in the first Stage Payment Statement;

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% (eighty percent) of the Schedule Construction Period is over;

if total certified stage payments (excluding the Advance Payment and deductions and repayments of retention) does not exceed 20% (twenty percent) of the Contract Price within [50% of the Scheduled Construction Period] from the Appointed Date then the Advance Payment including interest shall be recovered by encashment of the Bank Guarantee for the Advance Payment.

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 (vi), in the event of Termination for Contractor Default, the Advance Payment shall be deemed to carry interest @ "SBI PLR+5%" 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 the unrecovered balance.

19.3 Procedure for estimating the payment for the Works

(i) 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.

(ii) 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 (i), supported with necessary particulars and documents in accordance with this Agreement.

(iii) 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 (three) 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.

The payment from 2nd bill to pre-final bill, shall be released, subject to the condition that the documentary evidence (copy of paid Challan in govt. Treasury) of the Welfare Cess @1% of work done or as amended by Statutory Authority from time to time, paid concerned authority is submitted for the previous bill.

19.5 Stage Payment for Works

(i) 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.

(ii) 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.

(iii) 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.

(iv) 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.

(v) 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 Highway:

(i) 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 Highway during the previous month.

(ii) 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 (i).

19.7 Payment for Maintenance of the Project Highway:

(i) 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 (ii).

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.

(ii) Maintenance shall be measured in units of one kilometre 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.

(iii) 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.

(iv) 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

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

(ii) The Authority's Engineer shall issue the IPC within 15 (fifteen) days of the receipt of the claim under Clause 19.8 (i), 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

(i) 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.

(ii) Deleted.

19.10 Price adjustment for the Works

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

Subject to the provisions of Clause 19.10 (iii), 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 (iv).

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.

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:

$$VRW = 0.85RW \times [PL \times \frac{L_I - L_0}{L_0} + PA \times \frac{A_I - A_0}{A_0} + PF \times \frac{F_I - F_0}{F_0} + PB \times \frac{B_I - B_0}{B_0} + PM \times \frac{M_I - M_0}{M_0} + PC \times \frac{C_I - C_0}{C_0} + PS \times \frac{S_I - S_0}{S_0}]$$

$$VBR = 0.85BR \times [PL \times \frac{L_I - L_0}{L_0} + PA \times \frac{A_I - A_0}{A_0} + PF \times \frac{F_I - F_0}{F_0} + PM \times \frac{M_I - M_0}{M_0} + PC \times \frac{C_I - C_0}{C_0} + PS \times \frac{S_I - S_0}{S_0}]$$

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 "Manufacture of machinery for mining, quarrying and construction" for the month of the Base Date. For WPI: Base Year 2011-12 & CPI 2016 for Industrial Workers will be considered.

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 on the Base Date.

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

CO = The WPI for Ordinary Portland Cement for the month of the Base Date.

CI = The WPI for Ordinary Portland 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") on the Base Date.

FI = The official retail price of HSD at the existing consumer pumps of IOC 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 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 Mild Steel –Long Products for the month of the Base Date.

SI = The WPI for Mild Steel –Long Products for the month three months prior to the month to which the IPC relates.

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 & 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%

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 Highway:

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:

$$V = P \times \frac{W_I - W_0}{W_0}$$

Where

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

W0= The wholesale price index (all commodities) for the month of the Base Date.

WI= 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

(i) Within 60 (sixty) days after receiving the Completion Certificate under Clause 12.2, the Contractor shall submit to the Authority's Engineer for consideration 6 (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.

(ii) If the Authority's Engineer does not prescribe the form referred to in Clause 19.13 (i) 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

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.

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:

Within 30 (thirty) days after completion of the Maintenance Period, the Contractor shall submit to the Authority's Engineer 6 (six) copies of the final payment statement for Maintenance of the Project Highway, 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 clause 19.7 (i) and
- (b) any sums which the Contractor considers to be due to it, with supporting documents.

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 (i), 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.

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

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.

(ii) 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.

iii) 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

For early completion of the contract before the stipulated date of completion of work, an incentive amount @ 0.25 % of the contract price may be paid to the contractor for every fortnight of early completion, subject to maximum cap of 5% of the contractor price. The port if satisfied, that the works can be completed by the contractor within a reasonable time after the specified time for completion, may allow extension of time at its discretion, the extension which the contractor make himself eligible for incentive, the extension shall be considered only till the actual date of completion and no incentive shall be payable. For calculation of incentive payment, contract price shall be exclusive of tender price plus taxes and duties.

19.21 GST Clause

- (a). The contractor shall quote the price exclusive of GST. The contractor shall quote prevailing GST rate separately which shall be reimbursed by DPA after ascertaining necessary compliance as per Goods & Service Tax – 2017. The contractor should have valid GST registration number to become eligible for Participating in the bid. However, GST will not be considered for evaluation of bid Price. All other duties, taxes, cesses applicable if any, shall be borne by the contractor.
- (b). GST Registration should be invariably mentioned in the bid / tender, failing which the bid / tender will be treated as non-responsive and liable to be discharged.
- (c). GST & PAN No. may be furnished with documentary evidence along with the Tender Documents.
- (d). It is mandatory to upload scanned copies of all the documents including GST registration certificate as stipulated in the bid document. If such document is not uploaded his bid will become invalid and cost of bid document shall not be refunded.
- (e). The TDS under GST Act is required to be deducted @ 2% (1% CGST and 1% SGST or 2% IGST) from payment / credit given to contractors/professionals and others for work order/contracts exceeding Rs. 2,50,000.00.
- (f). Contractor/service provider/supplier etc. has to ensure timely and proper filling of GSTR 1 so that Deendayal Port Authority can avail input tax credit in timely manner. In case DPA not allowed input tax credit due to failure on part of the contractor/service provider/supplier etc., it will be a financial loss to the DPA and therefore same shall be recovered from the payment/deposit of the contractor/service provider/supplier.

Article 20

Insurance

20.1 Insurance for Works and Maintenance

(i) 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.

(ii) 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.

(iii) Subject to the exceptions specified in Clause 20.1 (iv) 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.

(iv) Notwithstanding anything stated above in Clause 20.1 (iii), 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.

(v) Without prejudice to the obligations of the Parties as specified under Clauses 20.1 (iii) and 20.1 (iv), the Contractor shall maintain or effect such third party insurances as may be required under the Applicable Laws.

(vi) 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

(i) 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.

(ii) 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 wilful 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 wilful 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 Highway 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 Highway 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.

20.12 General Requirements of Insurance Policies

The Contractor must:

- (a) immediately deposit copies of the policies or certificates of any insurance which it is required to effect under the Contract, together with receipts for the premiums;
- (b) effect all insurances for which the Contractor is responsible with an insurer approved by the Authority;
- (c) make no material changes to the terms of any insurance without the Authority's approval;
- (d) in all respects comply with any conditions stipulated in the insurance policies which the Contractor is required to effect under the Agreement or which the Authority has effected in relation to the Facility and notified to the Contractor; and shall provide all assistance to the Authority in the application for, and finalization of, such comprehensive insurance package;
- (e) regardless of the extent of settlement of claims by the underwriters or the time taken for settlement of claims, the Contractor shall make good any loss, or damage at its own cost promptly;
- (f) provide all assistance to the Authority in the application for, and finalization of, such comprehensive insurance package;

- (g) pay the Contractor's share of the insurance premiums for insurance premiums allocated under such comprehensive insurance package policy to the insurances directly to the insurance provider promptly on demand. In case the Contractor fails to make such payment in time, the Authority may elect to pay the Contractor's share and adjust it against amounts payable to the Contractor under this Agreement;
- (h) in the case of occurrence of any event leading to an insurance claim, promptly follow the procedures specified by the insurance provider, and provide full cooperation and access to the insurance provider or its representative, to settle the claim expeditiously;
- (i) require all the Sub-Contractors providing equipment and materials or services to the Contractor or the Authority to obtain, maintain and keep in force during the time in which they are involved in the performance of the Works hereunder insurance coverage consistent with the Contractor's insurance obligations hereunder and the Contractor shall also be responsible for fulfilment of this requirement; and
- (j) the required insurance coverage and the Contractor's obligations-referred to shall in no way affect or limit the Contractor's liability with respect to its performance of the Works. Nothing in this Section shall limit or relieve the Contractor of its liabilities and obligations under 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 Highway 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 Highway 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

(i) 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.

(ii) 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.

(iii) 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 (i), 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

(i) 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.
 - (d) 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.
- (ii) 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.

- (iii) 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

- (i) 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

- (i) 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.
- (ii) 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;
- (iii) 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 (ii) 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 licensed to the Contractor with respect to the Project Highway 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

(i) 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.

(ii) 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

(i) 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.

(ii) 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

(i) 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) after 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 Highway 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) 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;
- (h) 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;
- (i) the Contractor creates any Encumbrance in breach of this Agreement;
- (j) an execution levied on any of the assets of the Contractor has caused a Material Adverse Effect;

- (k) 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;
- (l) 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;
- (m) a resolution for winding up or insolvency of the Contractor is passed, or any petition for winding up or insolvency of the Contractor is admitted by a court of competent jurisdiction and a provisional liquidator or receiver or interim resolution professional, as the case may be, 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;
- (n) Any representation or warranty of the Contractor herein contained which is, as of the date hereof, found to be false or the Contractor is at any time hereafter found to be in breach or non-compliance thereof;
- (o) 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;
- (p) the Contractor has failed to fulfil any obligation, for which failure Termination has been specified in this Agreement; or
- (q) 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.
- (r) gives or offers to give (directly or indirectly) to any person any bribe, gift, gratuity, commission or other thing of value, as an inducement or reward:
 - i. for doing or forbearing to do any action in relation to the Contract, or
 - ii. for showing or forbearing to show favour or disfavour to any person in relation to the Contract, or if any of the Contractor's personnel, agents or subcontractors gives or offers to give (directly or indirectly) to any person any such inducement or reward as is described in this sub-paragraph (s). However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination.

(ii) 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.

(iii) The following shall apply in respect of cure of any of the defaults and/ or breaches of the Agreement:

- (a) The Cure Period shall commence from the date of the notice by the Authority to the Contractor asking the latter to cure the breach or default specified in such notice;
- (b) The Cure Period provided in the Agreement shall not relieve the Contractor from liability for Damages caused by its breach or default;
- (c) The Cure Period shall not in any way be extended by any period of suspension under the Agreement;
- (d) If the cure of any breach by the Contractor requires any reasonable action by the Contractor that must be approved by the Authority hereunder the applicable Cure Period (and any liability of the Contractor for damages incurred) shall be extended by the period taken by the Authority to accord its required approval.

(iv) 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

(i) 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 Highway;

- (d) the Authority becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with its creditors, or carries on business under a receiver, trustee or manager for the benefit of its creditors, or if any act is done or event occurs which (under Applicable Laws) has a similar effect;
 - (e) 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;
 - (f) the Authority's Engineer fails to issue the relevant Interim Payment Certificate within 60 (sixty) days after receiving a statement and supporting documents; or
 - (g) the whole work is suspended by Authority beyond 120 (one hundred twenty) days for any reason which is not attributed to the Contractor.
- (ii) 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 (fifteenth) 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 and he would be deemed to have waived any claim and forfeited any right to any other remedy on that count or in relation to such action or omission.

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 provided to the Contractor.

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 all relevant records, reports, Intellectual Property and other licences pertaining to the Works, Maintenance, other design documents;
- (b) transfer and/or deliver all Applicable Permits to the extent permissible under Applicable Laws; and
- (c) vacate the Site within 15 (fifteen) days.

23.5 Valuation of Unpaid Works

(i) 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.

(ii) 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

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

- (a) encash and appropriate the Performance Security, Additional Performance Security if any and Retention Money, or in the event the Contractor has failed to replenish or extend the Performance Security and Additional Performance Security if any, claim the amount stipulated in Clause 7.1, 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.

(ii) 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, Additional 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 of temporary works, as determined by the Authority's Engineer; and

iii. 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.

(iii) 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 Bank Rate (SBI PLR) + 3% per annum, 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.

(iv) 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 Highway 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, 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.

23.9 Fore closure with mutual consent

(i) Without prejudice to any provision of this Agreement, the Authority and Contractor may foreclose this Agreement by mutual consent in circumstances which does not constitute either party's default without any liability or consequential future liability for either party.

(ii) Should a Party intend to foreclose this Agreement by mutual consent, the intending Party shall issue a notice to the other Party and upon issuance of such notice, the other Party may within 15 days from receipt of such notice either agree to such foreclosure or raise objection(s) to the same by intimating either of the two possible positions to the intending Party in writing.

(iii) In either case of the other Party agreeing to the proposed foreclosure or otherwise, the Parties may negotiate the proposed foreclosure and sign a Supplementary Agreement for foreclosure to the main Contract Agreement within 30 (thirty) days of the date agreeing by both Parties. Foreclosure shall not come into effect unless and otherwise Supplementary Agreement is signed.

(iv) Any attempt or endeavour for foreclosure by mutual agreement shall be without prejudice to the rights and obligations of the Parties herein and the factum of such an attempt or exercise shall not stop either of the Parties from discharging their contractual obligations under this Agreement.

(v) For the avoidance of doubt, it is clarified that such foreclosure will be without prejudice to the Contractor and shall not affect the Contractor in any way if it wishes to bid in future projects of the Authority.

Part VI

Other Provision

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

(i) 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

(i) 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 because 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.

(ii) 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 Highway, 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. If 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

(i) 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.

(ii) 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).

(iii) 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 (iii) 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 Survival on Termination

The provisions of this Article 25 shall survive Termination.

Article 26

Dispute Resolution (Arbitration)

26.1 ARBITRATION

Any dispute in respect of in contracts where party is dissatisfied by the Conciliators decision shall be decided by arbitration as set forth below:

(i) Except where otherwise provided in the contract all questions and disputes relating to the meaning of the specifications, designs, drawings and instructions here in before mentioned and as to the quality of workmanship or materials used on the work or as to any other question, claim right, matter or any other thing what so ever, in any way arising out of or relating to the contract, design, drawings, specifications, estimates, instructions, order or to the condition or otherwise concerning the work or regarding the execution or failure to execute the same whether arising during the progress of work or after the completion thereof as described here in after shall be referred to the Chairman for sole arbitration by himself or by any Office appointed by him.

(ii) It will be no objection to any such appointment that the arbitrator is an employee of the Board or the Government, that he had to deal with the matter to which the contract relates and that in course of his duties as an employee of the Board or the Government, he had expressed views on all or any of the matters in dispute or of different.

(iii) The arbitrator, who has been dealing with the arbitration case, being transferred or vacating his office or in the event of his death or being unable to act for any reason, the Chairman then holding the office shall arbitrate himself or appoint any officer to act as arbitrator.

(iv) It is also a term of the contract that no person other than the Chairman himself or any officer appointed by him shall act as arbitrator.

(v) It is a term of the contract that only such question and disputes as were raised during progress of work till its completion and not there after shall be referred to arbitration. However, this would not apply to the questions and disputes relating to liabilities of parties during the guarantee period after completion of the work.

(vi) It is a term of the contract that the party invoking arbitration shall give a list of disputes with amounts of claim in respect of each said disputes along with the notice seeking appointment of arbitrator.

(vii) It is also a term of the contract that if the contractor does not make any demand for appointment of arbitrator in respect of any claims/disputes in writing, as aforesaid, within 120 days of receiving the intimation from the Nodal officer or his nominee that the final bill is ready for payment, the claim of the contractor shall be deemed to have been waived and absolutely barred and the Port Authority shall be discharged and released of all liabilities under the contract in respect of these claims.

(viii) It is also a term of the contract that the arbitrator shall adjudicate only suchdisputes/claims as referred to him by the appointing authority and give separate award against each dispute/claim referred to him. The arbitrator will be bound to give claim wise detail and speaking award and it should be supported by reasoning.

(ix) The award of the arbitrator shall be final, conclusive and binding on all the parties to the contract.

- (x) The arbitrator from time to time, with the consent of both the parties, enlarges the time for making and publishing the award.
- (xi) Arbitration shall be conducted in accordance with the provision of Indian Arbitration Act, 1996 or any statutory modifications or re-enactment thereof and rules made there under and for the time being in force shall apply to the arbitration proceedings under this clause.
- (xii) It is also a term of the contract that if any fees are payable to the arbitrator, this shall be paid equally by both the parties.
- (xiii) It is also a term of the contract that the arbitration shall be deemed to have been entered on the reference on the date he issued the first notice to both the parties calling them to submit their statement of claims and counter statement of claims.
- (xiv) Venue of the arbitration shall be such place as may be fixed by the arbitrator at his sole discretion”.

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 India, and the courts at [Delhi] 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 under Article 19.

27.4 Waiver

(i) 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.

(ii) 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 Highway 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

(i) 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.

(ii) 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 [Delhi] 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

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

- (i) 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.
- (ii) 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.

27.19 Care and Supply of Documents

- (i) Each of the Contractor's documents shall be in the custody and care of the Contractor, unless and until taken over by the Authority. Unless otherwise stated in the Agreement, the Contractor shall supply to the Authority 2 (two) copies of each of the Contractor's documents.

- (ii) The Contractor shall keep, on the Site, a copy of the Agreement, publication named in the Authority's requirements, the Contractor's documents, and variations and other communications given under the Agreement. The Authority's personnel shall have the right of access to all these documents at all reasonable times.
- (iii) If a Party becomes aware of an error or defect of a technical nature in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other party of such error or defect.

27.20 Authority's Use of Contractor's Documents.

- (i) 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.
- (ii) The Contractor hereby gives to the Authority a non-terminable transferable nonexclusive royalty-free license to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This license shall:
 - (a) apply through out 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 the Contractor, including replacements of any computers supplied by the Contractor.
- (iii) 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 Sub-Clause.

27.21 Contractor's Use of Authority's Documents

As between the Parties, the Authority shall retain the copyright and other intellectual property rights in the Authority's requirements 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 purpose of the Agreement. They shall not without the Authority's consent, be copied, used or communicating to a third party by the Contractor, except as necessary for the purposes of the Agreement.

27.22 Access to the Site by Others

The Contractor shall, at all times, afford access to the Site to the authorized representatives of the Authority, the Authority's Engineer and anyone else authorized by the Authority to access the site and to the persons duly authorized by any Governmental Agency having jurisdiction over the Project, including those concerned with safety, security or environmental protection to inspect the Project Highway and to investigate any matter within their authority and upon reasonable notice, the Contractor shall provide to such persons reasonable assistance necessary to carry out their respective duties and functions with minimum disruption to the construction, operation and maintenance of the Project Highway consistent with the purpose for which such persons have gained such access to the Site.

27.23 Term

This Agreement shall come into force and effect from the date first hereinabove written and shall remain in force and effect till the Termination Date i.e. the Parties perform all their respective obligations or is terminated by any of the Parties for the reasons and in the manner provided for in the Agreement.

27.24 Amendments

The Agreement may not be supplemented, amended, modified or changed except by an instrument in writing signed by the Contractor and the Authority and expressed to be a supplement, modification or change to the Agreement.

27.25 Representation and Bribes

The Contractor represents and warrants to the Authority that:

- (a) No representation or warranty by the Contractor contained herein or in any other document furnished by it to the Authority, or to any Governmental Instrumentality in relation to Applicable Permits contains or will contain any untrue statement of material fact or omits or will omit to state a material fact necessary to make such representation or warranty not misleading; and
- (b) It warrants that no sums, in cash or kind, have been paid or will be paid by or on behalf of the Contractor, to any person by way of fees, commission or otherwise for securing or entering into the Contractor for influencing or attempting to influence any officer or employee of the Authority or GOI in connection therewith.

27.26 No Agency

The Agreement does not constitute either Party as the agent, partner or legal representative of the other for any purposes whatsoever, and neither Party shall have any express or

implied right or authority to assume or to create any obligation or responsibility on behalf of or in the name of the other Party.

27.27 Contractor shall provide one no. of four wheeler tourist vehicle (Innova or equivalent) with driver during construction period for the use of Authority. This vehicle will be used only for duties related to the works of this contract. Vehicle must be in very good condition and to the satisfaction of Authority. Necessary fuel/ oil / driver / maintenance etc., will have to be borne by the Contractor.

27.28 Contractor shall provide office with all furniture, Two computers and stationery with two office assistant personal minimum graduate knowing basic computer for helping to Authority during construction period.

Part II

Schedules

Schedule-A

(See Clauses 2.1 & 8.1)

SITE OF THE PROJECT

1. THE SITE

- i. Site of the Project Widening and Improvement of existing 2/4 lane carriageway of Kandla Kharirohar (KK) Road connecting to NH-8A, project highway comprises the road network of Deendayal Port Authority, Kandla, Kutch district in the State of Gujarat shall include the land, buildings, structures and road works as described in Annex-I of this Schedule-A.
- ii. The dates of handing over the Right of Way to the Contractor are specified in Annex-II of this Schedule-A.
- iii. 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.
- iv. The alignment plans of the Project Highway are specified in Annex-III. The proposed profile of the project highway as indicated in the Annex-III shall be followed by the contractor with minimum FRL as indicated in the alignment plan. Based on site/design requirement, the Contractor may, however, improve/upgrade upon the alignment plans and profiles as indicated in Annexure –III and raise the finished roadway level (FRL) with approval from the Authority's Engineer within the available Right of Way.
- v. The status of the environment clearances obtained or awaited is given in Annex-IV.

Annex – I

(Schedule-A)

2. Site

The Site of the Widening and Improvement of existing 2/4 lane carriageway of KK Road connecting to NH-8A, project highway comprises the road network of Kandla Port, Kutchh district in the State of Gujarat. The project road starts at Km 0.0 and ends at Km 9.0. The land, carriageway and structures comprising the Site are described below.

3. Land

The Site of the Project Highway comprises the land as described below:

Sr. No.	Design Chainage		Length (Km)	Width (m)
	From	To		Existing Row
1	0	100	100	6 to 7
2	100	560	460	25 to 30
3	560	9000	8440	25 to 38

4. Carriageway

The existing road is two/four lane without paved shoulder. The type of the existing pavement is flexible.

5. Major Bridge: Deleted

6. Road over-bridge (ROB)/ Road under-bridge (RUB): Deleted

7. Grade separators: Deleted

8. Minor Bridges– 01 No.

The site includes the following Minor Bridges:

S. No	Existing Chainage	Type of Structure		No. of Spans with Span Length (m)	Width (m)	
		Foundation	Super Structure		Clear Width	Overall Width
1	5+995	Shallow	RCC Solid Slab	3 x 6.6	14.56	16.65

8. Railway level crossings: - 01 Nos

Sr. No	Existing Chainage	Road	Railway Chainage	Level Crossing No.	Remarks
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1	1+090	-	-	IFFCO
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9. Underpass: Deleted

10. Culverts

The Site includes the following culverts:

Slab / Box Culverts: 17 Nos.

Sr. No	Chainage	Type of Culvert/Pipe Utility	No. x Span / Opening with Span Length (m)
1	0+15	Box	1
2	0+470	Box	2
3	0+480	Box	1
4	0+965	Box	1
5	0+985	Box	1
6	0+995	Box	1
7	1+000	Pipe	1
8	1+490	Box	4
9	1+540	Box	1
10	1+590	Box	1
11	3+480	Box	1
12	3+750	Box	1
13	4+00	Box	1
14	5+900	Box	1
15	7+340	Box	1
16	7+350	Box	2
17	7+930	Box	1

Note: The Number / Span / Length of Culverts mentioned in above Tables are indicative and any change is deemed to be within the scope of work and no Change of Scope will be considered.

The Structures / Culverts / Bridges which are falling on service road locations shall be widened / Re Constructed upto service road formation width as per IRC codal provisions.

11. Bus bays: Deleted

12. Truck Lay byes: Deleted

13. Road side drains: Deleted

14. Major junctions

The details of the Junctions are as follows:

Major Junction– 1 Nos.

Sl	Ch	Type	Legs	To	Remarks
1	03+600	+	4-leg	Port	Roundabout

15. Minor Junctions– 10 Nos.

Sl	Ch	Type	Side	To	Remarks
1	00+310	T	LHS	Port	
2	00+360	T	RHS	IFFCO Gate	
3	00+700	T	LHS	Port	
4	01+390	T	LHS		
5	01+950	T	LHS	Port	
6	03+050	T	LHS	Port	
7	07+620	+	4-leg	Port	
8	08+900	T	LHS		
9	09+215	T	LHS		
10	09+360	T	RHS		

16. Bypasses: Deleted

17. Other structures: Deleted

18. Electrical Utilities: Electrical lines (HT/LT)

19. Cross Drainage structures

The Project Highway site includes 01 no of Minor Bridge, 17 nos. of pipeline utility–cum culvert along the existing alignment of the project road. There is no Major Bridge in the project corridor. The details of existing structures are as in following tables.

Table A – 1

Type	Major Bridges	Minor Bridges	Pipeline utility Culvert	HP Culvert	ROB	Level Crossing	Total
Existing Structure	-	01	17	-	-	01	19

Note: Refer Final Feasibility Report

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 project site. Land acquisition not requires

Annex-III
(Schedule-A)

Alignment Plans

The existing alignment of the Project Highway shall be modified in the following sections as per the alignment plan indicated below:

The proposed alignment of the Project Highway shall be as per enclosed plan.

(Schedule-A)

Environmental Clearances

(Not Applicable)

Schedule-B

(See Clause 2.1)

DEVELOPMENT OF THE PROJECT HIGHWAY

Development of the Project Highway

Development of the Project Highway shall include design and construction of the design length 9.0 km to 4/6 Lane configuration with Paved Shoulders in the State of Gujarat on EPC mode, as described in this Schedule-B and in Schedule-C.

Rehabilitation and Augmentation

Rehabilitation and Improvement shall include combination of Single lane, four lanes and six lanes configuration of the Project Highway as described in Annex-I of this Schedule-B and in Schedule-C.

Specifications and Standards

The Project Highway 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 FOUR/SIX LANING****1. WIDENING OF THE EXISTING HIGHWAY**

Total Length of Project Road is 9.0 km. The project highway of 4/6 Lane configuration and shall be constructed as per Schedule D.

The Project Highway shall follow the existing alignment unless otherwise specified by the Authority and shown in the alignment plans specified in Annex III of Schedule-A. Geometric deficiencies, if any, in the existing horizontal and vertical profiles shall be corrected as per the prescribed standards for plain/rolling terrain to the extent of land is available.

WIDTH OF THE CARRIAGEWAY

Single lane: - The paved carriageway shall be 3.75 m wide with the typical cross-section drawings in the Manual.

Sr. No.	Design Chainage		Length (m)	Typical cross section
	From (Km)	To (Km)		
1	0+000	0+100	100	Type -I
	TOTAL LENGTH		100	

Four lane at built up area: -Four Lane shall be constructed in built-up area as mentioned in table below

Sr. No	Design Chainage		Length (m)	Typical Cross Section
	From (Km)	To (Km)		
1	0+100	0+560	460	Type-II
	TOTAL LENGTH		460	

Six lane at built up area: Six Lane shall be constructed in built-up area as mentioned in table below.

Sr. No	Design Chainage		Length (m)	Typical Cross Section
	From (Km)	To(km)		
1	0+560	2+500	1940	Type-III
	TOTAL LENGTH		1940	

Six lane at Open area: Six Lane shall be constructed in open area as mentioned in table below.

Sr. No	Design Chainage		Length (m)	Typical Cross Section
	From (Km)	To(km)		
1	2+500	9+000	6500	Type-IV
	TOTAL LENGTH		6500	

Note:

- 1) Cross-section at Major/Minor Bridge approaches are to be followed matching to adjoining cross-section with suitable transition.
- 2) Earthen shoulders width of 1.0 m on either side as per Ministry's circular
RW/NH-33044/22/2020-S&R (P&B) Dt: 17.07.2020

2. GEOMETRIC DESIGN AND GENERAL FEATURES:

2.1 General

Geometric design and general features of the Project Highway shall be in accordance with section 2 of the manual. (IRC: SP 84/87) and relevant IRC codes.

2.2 Design Speed

The design speed shall confirm to the provisions of Clause 2.2 of Manual and as per design alignment report.

2.3. Improvement of the existing road geometry

Capacity augmentation / Widening are proposed. No major geometric improvement / re-alignment are proposed for the project corridor.

Horizontal Alignment

At following sections, the intermediate sight distance is not available and Safe stopping sight distance is provided at these locations:

b) Vertical Alignment

Sr. No	Stretch/Design Chainage (from km to km)	Type of deficiency		Remarks.
		Curve Length	Design Speed	
--NIL--				

2.4. New Construction of Bypasses and Realignments: -

Flexible pavement shall be entirely constructed from sub-grade for bypasses, realignment and geometric improvements.

Realignment

Sr. No	Design Chainage		Design Length (km)	Type of Deficiency/Improvement
	From (km)	To (km)		
--NIL--				

Bypasses: -NIL

Geometry of the existing road shall be improved as per alignment plan included in Annex-III of Schedule-A.

2.5. Right of Way

Details of the Right of Way are given in Annex II of Schedule A

2.6. Type of Shoulders

In built-up sections, shoulders shall be provided as per applicable TCS in the following stretches:

Sr. No	Built up Stretch (Town ship)	Design Chainage		Pavement Width (m)	TCS	Width of Footpath cum Drain as mentioned in TCS
		From Km	To Km			
--NIL--						

Design and specification of earthen shoulder 1.0 m.

2.7. Lateral and vertical clearances at underpasses

2.7.1 Lateral and vertical clearances at underpasses and provision of guardrails/crash barriers shall be as per paragraph 2.11 of the Manual. (IRC: SP 84/87)

2.7.2 Lateral clearance: The width of the opening at the underpasses shall be as follows:-

Sr. No	Location (Chainage) (from km to km)		Proposed Span/opening (in m)	Total Width of the Structure (in m)	Remarks
	Design Chainage	Location			
-- NIL --					

Note: Approach Gradient: Approach and exit gradient of road crossing through underpass shall be maintained.

2.8. Lateral and vertical clearance at overpasses

2.8.1 Lateral and vertical clearances at Overpasses and provision of guardrails/crash barriers

Shall be as per paragraph 2.11 of manual (IRC: SP 84/87)

2.8.2 Lateral clearance: The width of the opening at the Overpasses shall be as follows:

Sr. No	Design Chainage	Name of Intersecting Roads	Proposed Span arrangement (in m)	Total Width of the Structure (in m)	Remarks
-- NIL --					

2.9. a) Service Roads

Service Roads shall be constructed at the locations and for the lengths indicated below:

Service roads shall be constructed at the following locations and as per cross sections shown at Schedule D

Sr. No	Location of Service Road (Design Chainage)		Right hand side (RHS)/Left hand side (LHS)/or Both side	Length (Km) of Service Road	Remarks
	From (km)	To (km)			
--NIL--					

b) Slip roads: -

Slip roads shall be constructed at the following locations and as per cross sections shown at Schedule D.

Sr. No	Location of Service Road (Design Chainage)		Right hand side (RHS)/Left hand side (LHS)/or Both side	Length (Km) of Service Road	Remarks
	From (km)	To (km)			
-- NIL --					

Above length of the Service/Slip Road is indicative and specified as minimum. The actual length of the service/slip road shall be determined by the contractor in accordance with the Manual requirements with approval from the Authority's Engineer. Any Increase in the Length specified in the clause of 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 provision of Article 13.

*The length specified is tentative; however, the exact length shall be finalized as per provisions of Clause 2.9 of Manual and in consultation with the Authority Engineer. Increase/Decrease in length on account of above compliance will not attract Change of Scope.

2.10. Grade separated structures

Grade separated structures shall be constructed as per paragraph 2.13 of the Manual IRC manuals. The requisite particulars are given below:

Sr. No.	Location of structure		Length (m)	Number & length of span (m)	Approach Gradient & RE Walls	Remarks, if any
	Location	(Design Ch.)				
-- NIL --						

In the case of grade separated structures, the type of structure and the level of the Project Highway and the cross roads shall be as follows: [Refer to paragraphs 2.13 of the Manual and specify the type of vehicular under pass/ overpass structure and whether the cross road is to be carried at the existing level, raised or lowered]

Sr. No	Location (Chainage)	Type of Structure	Clear Span/ Opening	Width of Structure
--NIL--				

Approaches to the Grade Separated structures shall be built with Reinforced Earth retaining structures on either side of the structure duly providing a longitudinal gradient of 2.0%. The applicable TCS for Construction of Approaches and Slip Roads is TCS.

2.11. Cattle and Pedestrian Underpass / Overpass

Cattle and pedestrian underpass/ overpass shall be constructed as follows:

Cattle/pedestrian underpasses and provision of guardrails/crash barriers shall be as per paragraph 2.10 & 2.13 of the Manual (IRC: SP: 84/87-2018). Under pass shall be constructed at following locations.

Sr. No	Location (Design Chainage)	Type of Structure	Clear Span/ Opening	Width of Structure
--NIL--				

2.11.2 Animal Underpass

Animal underpass shall be constructed as follows:

Animal underpasses and provision of crash barriers shall be as per paragraph 2.10 & 2.13 of the Manual (IRC: SP:84/87). Under pass shall be constructed at following locations.

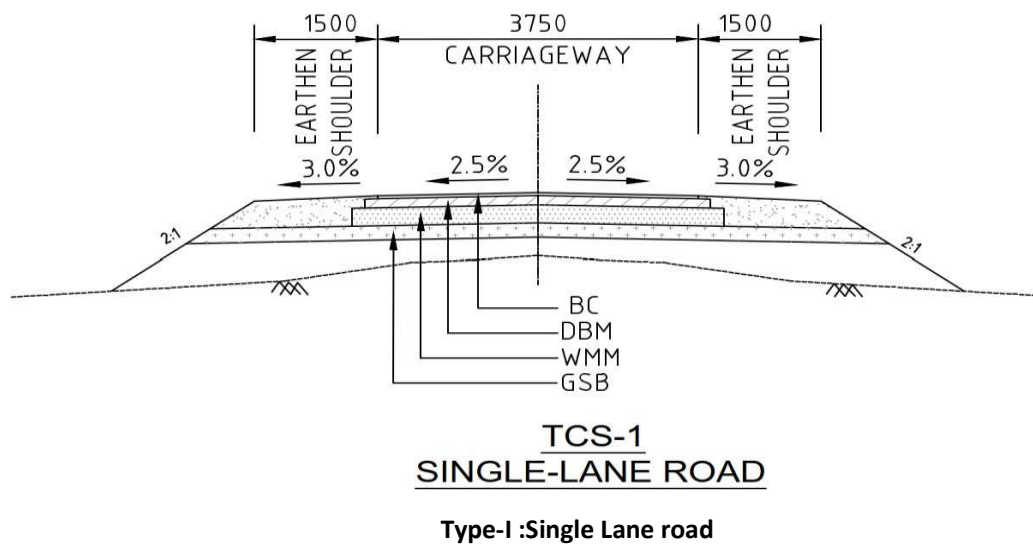
Sl No.	Chainage	Remarks
--NIL--		

2.12. Typical cross-sections of the Project Highway

Indicative Typical cross sections to be developed in different segments of the project highway are as follows:

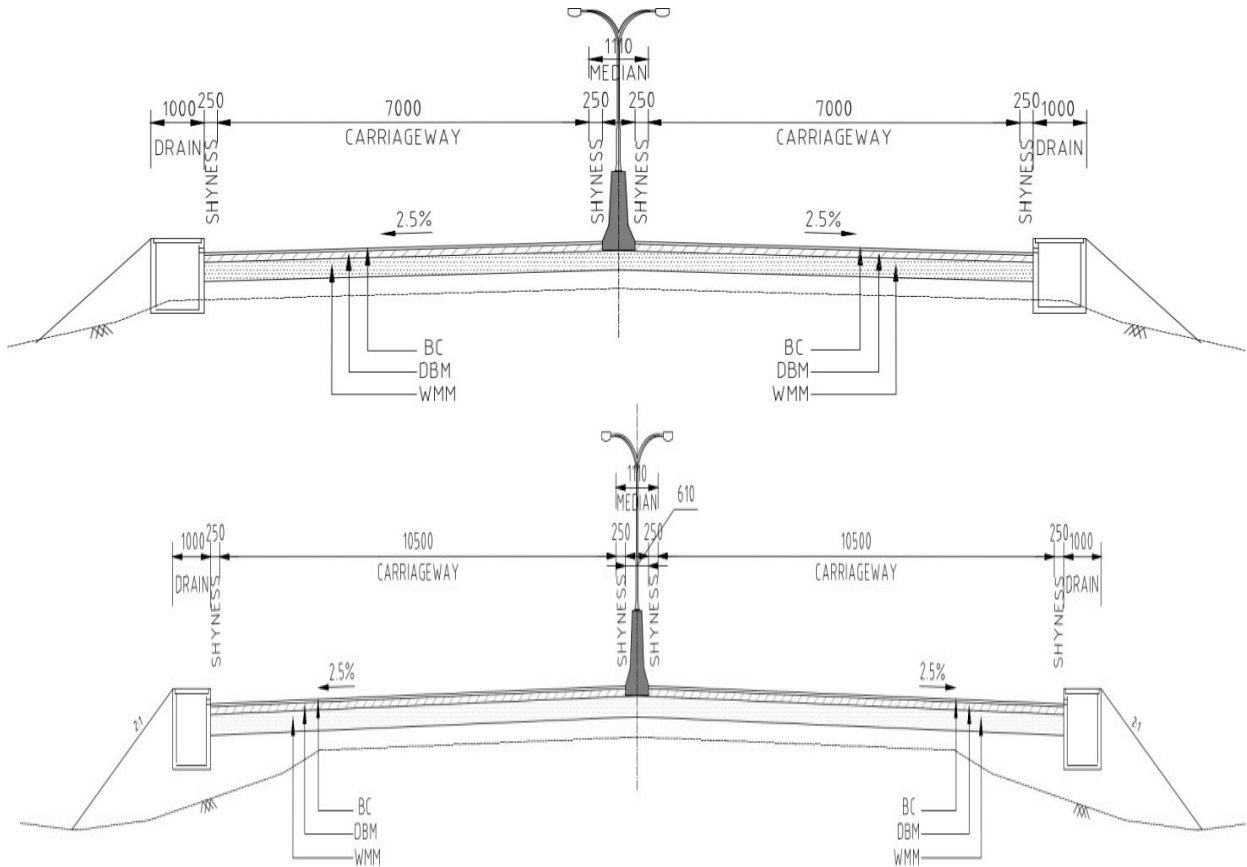
Design Chainage (Km.)		Length (m)	TCS Type	Widening Schedules
From	To			
00+000	00+100	100	Type-I	Single lane road (3.75m)
00+100	00+560	460	Type-II	4 lane divided at Built-up Area
00+560	02+500	1940	Type-III	6 lane divided at Built-up Area
02+500	09+000	6500	Type-IV	6 lane divided at Open Area
Total Length:		09+000		

Note: The above table is presenting the type of cross section with respect to the carriageway features. Based on the vertical profile, the pavement rehabilitation work may include overlay for BT layer with bituminous profile correction or partial reconstruction or full reconstruction or cut. The works details provided are indicative.

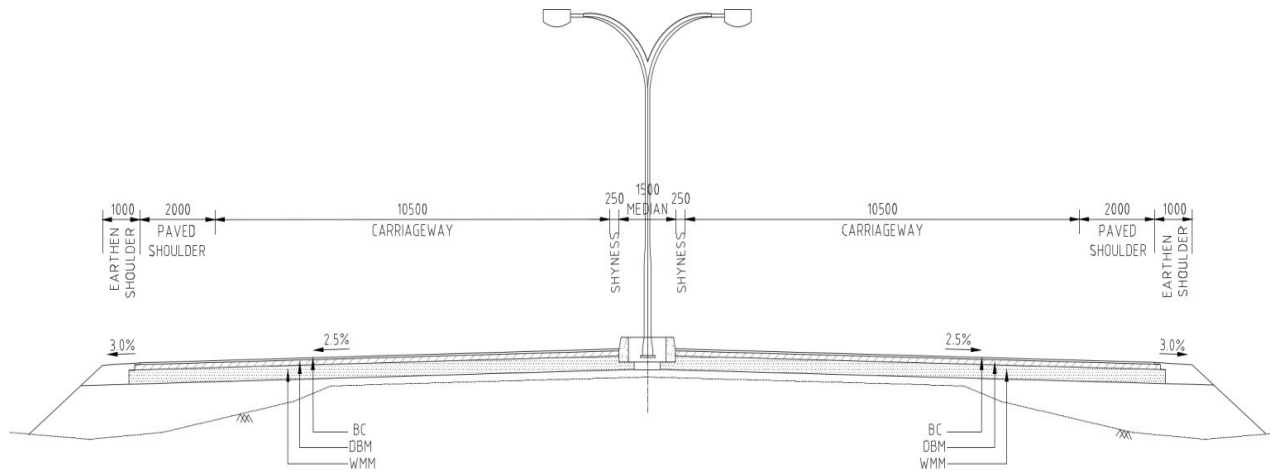


Note : In overlay portion, to meet the specified vertical profile, profile correction shall be provided with DBM/WMM/GSB or combination thereof subject to the provision of minimum layers of 70mm DBM + 40mm BC and minimum 250mm WMM if the profile correction is done with GSB and minimum of 200mm GSB if profile correction done with earthwork. If profile correction is done with granular material / earth existing BT is to be scarified.

Type-II: 4 lane divided at Built-up Area



Type-III: 6 lane divided at Built-up Area



Type-IV: 6 lane divided at Open Area

3. INTERSECTIONS AND GRADE SEPARATORS

All intersections and grade separators shall be as per Section 3 of the Manual. Existing intersections which are deficient shall be improved to the prescribed standards. For improvement of intersections and at grade junction standards and type plan MoRTH and IRC: SP: 41-1994 shall be followed.

Properly designed intersections shall be provided at the locations and of the types and features given in the table below:

3.1 At-grade intersections

3.1.1 Major Junction – 01 Nos

Sr. No	Design Chainage (Km)	Category of Road	Type of Junction	Remarks
1	3+600	-	Roundabout	

3.1.2 Minor Junction – 09 Nos.

Sl	Ch	Type	Side	To	Remarks
1	00+310	T	LHS	Port	
2	00+360	T	RHS	IFFCO Gate	
3	00+700	T	LHS	Port	

Sl	Ch	Type	Side	To	Remarks
4	01+390	T	LHS		
5	01+950	T	LHS	Port	
6	03+050	T	LHS	Port	
7	6+400	T	RHS	Jetty	
8	07+620	+	4-leg	Port	
9	08+900	T	LHS		

3.1.3 Rumble Strips: - The crossroad junctions as mentioned above shall be provided with Rumble strips at the approach of junctions as per IRC: 99

Note: All junctions shall be developed as per Section-3 of IRC: SP: 84/87. The indicative junction improvement shown in alignment plan are the minimum requirements, which are to be further improved as per the Manual and relevant IRC Codes within the available ROW.

4. ROAD EMBANKMENT AND CUT SECTION

4.1. 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 section 4 of the Manual and the specified cross section details. Deficiencies in the plan and profile of the existing road shall be corrected. The profile indicated in the enclosed plan and profile drawing shall be the minimum.

4.2 Raising of the existing road: -NIL

5. PAVEMENT DESIGN

5.1 Pavement design shall be carried out in accordance with Section 5 of the Manual.

5.2 Type of Pavement

Flexible Pavement will be designed in accordance with the IRC: 37-2018

5.3 Design Requirements

Pavement design shall be as per paragraph 5.4, 5.9 and 5.10 of the Manual, subjected to minimum following Crust as per the design as follows.

For widening portion, new construction portions, realignment portions and raising portions:

Design Layer No.	Crust Layers (with individual thickness)				Thickness (mm)
1	BC =	40	DBM =	110	150

Design Layer No.	Crust Layers (with individual thickness)		Thickness (mm)
2	Base (B) =	300	300
3	Sub-Base (SB) =	200	200
4	Sub-grade =	-	500 (at Widening and wherever applicable)

Note: Profile Corrective course (PCC) over the existing carriageway shall be provided as per provisions of Section 501.8.3.4 of MoRTH Specifications. A tentative depth for scarifying of existing top layers is up to 200 mm.

For the stretches identified for rehabilitation with overlay, PCC layer shall be provided based on clearance between FRL & Existing Road levels. In case of requirement for provision of non-bituminous layer as PCC layer, existing bituminous layer shall be scarified over which granular layer shall be provided.

5.3.1 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 15 years. Stage construction shall not be permitted.

5.3.2 Design Traffic

Notwithstanding anything to the contrary contained in this Agreement or the Manual, the Contractor shall design the pavement for design traffic as per details given below. The crust composition shown in Sub-Clause 5.3 of Annex-I of Schedule-B above, shall be the minimum to be provided.

Sr. No	Design Chainage(km)		Design MSA
	From	To	
1	0+000	9+000	40 msa

Reconstruction of stretches:

Scarifying of exiting BT layers, if any (A tentative depth for scarifying of existing top layers is up to 200 mm.)

Sr. No	Design Chainage(km)	
	From	To

1	560	9+000
---	-----	-------

Strengthening of existing pavement: NIL

5.6 New Construction of Realignment: -

Flexible pavement shall be constructed for Bypasses, realignments and Curve improvements.

Realignments: -NIL

Bypasses: - NIL

6. ROADSIDE DRAINAGE

Drainage system including surface and subsurface drains for the Project Highway shall be provided as per Section 6 of the Manual.

RCC Drain:

Sr. No	Location		Length (m)	Side	Width of RCC Drain
	From Km	To Km			
1	00+100	00+560	460	Both Side	1.0 m on either side
2	00+560	01+000	440	Both Side	1.0 m on either side
	Total Length:		1000		

The drain shall be provided up to nearest outfall point

7. DESIGN OF STRUCTURES

7.1 General

7.1.1 All bridges, culverts and structures shall be designed and constructed in accordance with Section 7 of IRC: SP:84/87 and the cross-sectional features shall conform to the cross-sectional features of the Manual specified in Schedule-D or as stated in Schedule-B / the GADs provided in the Agreement.

7.1.2 Width of the carriageway of new /widening structures of more than 60m length shall be as follows:

Sr. No	Design Chainage (Km)	Span Arrangement No. of vents X Span length in (m)	Overall Width (m)	Remarks
--NIL--				

7.1.3 The following structures shall be provided with footpaths: -

Sr. No	Design Chainage (Km)	Span Arrangement No. of vents X Span length in (m)	Overall Width (m)	Remarks
--NIL--				

All bridges shall be high level bridges.

7.1.5. The following structures shall be designed to carry utility services specified in table below

Sr. No	Location	Spans Arrangement	Proposed Overall Deck Width (m)	Remarks
	(Km)	No. of vents X Span length in (m)		
1	6+462	1x20	15.0	New bridge on LHS with 3 lane configuration

7.1.6. Cross-sectional features of the new culverts shall be as per Manual and bridges at deck level shall conform to the GADs provided.

7.2 Culverts

7.2.1 The Culverts overall width shall be equal to the roadway width as per Manual.

7.2.2 Reconstruction of existing culverts: -NIL

Note: - It is clarified that as per site requirement new box culverts if required for drainage arrangement shall be identified & constructed (if any) during development shall be constructed as per Manual & as per instruction of Authority's Engineer shall be included in the scope of work of EPC.

Note: The vent height of the culvert shall be as per profile and the bed level at the location of the culvert.

Reconstruction of Existing Slab/Box to New RCC Slab Culverts: -NIL

Note: - It is clarified that as per site requirement new HP culverts if required for drainage arrangement shall be identified & constructed (if any) during development shall be constructed as per Manual & as per instruction of Authority's Engineer shall be included in the scope of work of EPC.

Reconstruction of Existing RCC Slab to New Hume Pipe Culverts: -NIL

Reconstruction of Existing Hume Pipe to New Hume Pipe Culverts: -NIL

7.2.3 Widening/Retained of Existing Culverts

Culvert/Pipe Utility: -17 nos

All existing Culverts, which are not to be reconstructed, shall be widened to the roadway width of the Project Highway and as per the typical cross section. Repairs and rehabilitation of existing structures as required shall be carried out in consultation with Authority Engineer. The following culverts are to be widened /retained.

Sr. No	Chainage	Type of Culvert/Pipe Utility	No. x Span / Opening with Span Length (m)
1	0+15	Box	1
2	0+470	Box	2
3	0+480	Box	1
4	0+965	Box	1
5	0+985	Box	1
6	0+995	Box	1
7	1+00	Pipe	1
8	1+490	Box	4
9	1+540	Box	1
10	1+590	Box	1
11	3+480	Box	1
12	3+750	Box	1
13	4+00	Box	1
14	5+900	Box	1
15	7+340	Box	1
16	7+350	Box	2
17	7+930	Box	1

7.2.4 Additional New Construction of Culverts

Additional culverts (given in the Table) shall be constructed for width equal to the Roadway Width of the Project Highway and as per Typical Cross Section. The following are the list of new culverts to be constructed.

New Construction of RCC Box: 18 Nos.

SI No.	Design Chainage (km)	Type	Span Details	Proposal
1	0+728	BOX	1x2x2	New
2	1+060	BOX	1x2x2	New
3	1+280	BOX	1x2x2	New
4	1+420	BOX	1x2x2	New

Sl No.	Design Chainage (km)	Type	Span Details	Proposal
5	1+535	BOX	1x2x2	New
6	1+570	BOX	1x2x2	New
7	1+750	BOX	1x2x2	New
8	2+180	BOX	1x2x2	New
9	2+595	BOX	1x2x2	New
10	3+600	BOX	1x2x2	New
11	3+980	BOX	1x2x2	New
12	4+350	BOX	1x2x2	New
13	5+420	BOX	1x2x2	New
14	6+320	BOX	1x2x2	New
15	7+730	BOX	1x2x2	New
16	7+960	BOX	1x2x2	New
17	8+620	BOX	1x2x2	New
18	8+960	BOX	1x2x2	New

New Construction of Hume Pipe Culverts: -NIL

7.2.6 Repairs / Replacements of railing / parapets, flooring and protection works of the existing retained culverts shall be undertaken as follows

a) SLAB / BO/X CULVERTS: – NIL

PIPE CULVERTS: – NIL

Note: - It is clarified that above repairing & strengthening measures are indicative and minimum specified. The condition survey of the existing structure shall be carried out by the contractor as per IRC 35, & Strengthening / repairing shall be carried out as per the requirement of site and as per instruction of Authority Engineer. If any Increase in the above specified, shall not constitute Change of Scope.

7.2.7 Floor protection works shall be as specified in the relevant IRC codes and specifications: –NIL

7.3 Bridges

7.3.1 Existing bridges to be re-constructed as per relevant MoRTH specification.

Major Bridges:

Existing Bridges to be reconstructed at the following locations:

Sr. No	Design Chainage (Km)	Type of Structure			Proposed Span Arrangement	Proposed Width of Structures (m)
		Foundation	Sub-Structure	Super Structure		
--NIL--						

Minor Bridges: -NIL

Existing Bridges to be reconstructed at the following locations:

Sr. No	Existing Chainage (Km)	Design Chainage (Km)	Details of Existing Structure	Existing	Details of Proposed structure
			Type of Structure	Span Details	Span Details
--NIL--					

Animal Underpasses

Sr. No	Design Chainage (Km)	Type of Structure			Proposed Spans Arrangement	Proposed Overall Deck Width (m)
		Foundation	Sub Structure	Super Structure	No. of vents X Span length in (m)	
--NIL--						

The Following Narrow Bridges shall be widened:

MAJOR BRIDGES:

Sr. No.	Existing Chainage (Km)	Design Chainage (Km)	Existing Width (m)	Span Arrangement (m)	Cross-section at deck level for widening
--NIL--					

MINOR BRIDGES:

Sr. No.	Existing Chainage (Km)	Design Chainage (Km)	Existing Width (m)	Span Arrangement (m)	Cross-section at deck level for widening
--NIL--					

* CB – Crash Barrier & C/W – Carriage Way.

Note: Span arrangement and Overall length of Minor Bridges shall be designed by contractor on the basis of detailed surveys & investigations subject to minimum specified in GAD as well as Table above. Founding Type / levels shall be decided after detailed Geo-Technical investigation, Scour depth estimation. Waterway, road top level, soffit etc. shall be decided on the basis of land survey conforming to various codal provisions applicable.

Additional New Bridges:

Additional Bridges at the following locations on the Project Highway shall be constructed.

MAJOR BRIDGES: - 1 nos

Sr. No	Location	Spans Arrangement	Proposed Overall Deck Width (m)	Remarks
	(Km)	No. of vents X Span length in (m)		
1	6+462	1x20	15.0	New bridge on LHS with 3 lane configuration

MINOR BRIDGES: - NIL

The Railings of existing Bridges shall be replaced with Crash Barriers/ parapets at the following locations: -NIL

Drainage System for Bridge Deck

An effective drainage system for bridge decks shall be provided as specified in paragraph 7.20 of the Manual (IRC: SP 84/87). The arrangement at shall take away the runoff water away from the super structure and sub-structure to avoid corrosion.

Structures in Marine Environment: -NIL**Railroad Bridges: -NIL**

Design, Construction and Detailing of ROB/RUB shall be as specified in the Manual. The Width of proposed ROB shall be as specified in the Schedule D.

Sl. No.	Existing Chainage (Km)	Design Chainage (Km)	Proposed span arrangement (m)	Width (m)	Track	Lane
--NIL--						

Road Over Bridges: -

Road over-bridge (road over rail) shall be provided at the following level crossings, as per GAD drawings attached.

Sl. No.	Existing Chainage (Km)	Design Chainage (Km)	Proposed span arrangement (m)	Width (m)	Track	Lane
--NIL--						

Road under Bridges: -NIL

Sl. No.	Existing Chainage (Km)	Design Chainage (Km)	Proposed span arrangement (m)	Width (m)	Track	Lane
--NIL--						

Grade Separated Structures

The Grade Separated structures shall be provided at the locations and the type and length specified in Paragraphs 2.9 and 3 of this Annexure – I – Not Applicable.

Repairs and Rehabilitation of bridges and structures

[Refer to paragraph 7.23 of the Manual IRC SP 84/87 and provide details]

The existing bridges and structures to be repaired/rehabilitated, and the nature and extent of repairs /rehabilitation required are given below:

BRIDGES

MAJOR BRIDGES: -NIL

Sr. No.	Location of bridge (km)	Nature and extent of repairs /strengthening to be carried out
-NIL-		

MINOR BRIDGES: -1 Nos.

Sr. No.	Design Chainage (km)	Nature and extent of repairs /strengthening to be carried out
---------	----------------------	---

1	6+462	Overlay and Milling of Deck, Parapet wall, Median, Crash Barrier, Road marking and Signages
---	-------	---

ROB/RUB :

ROB: - NIL

RUB: - NIL

Overpass / Underpass and Other structures – NIL

Sr. No.	Location of Structures (Km)	Nature and extend of repairs / strengthening to be carried out
--- NIL ---		

Note: The location and vent size of all the culverts proposed for drainage Purpose shall be decided in consultation with Road authority / Authority's Engineer.

Width of culverts shall be reconciled as per cross section at that location.

Cross road culvert to be provided at the location of Major and Minor Intersections or Utility purposes etc. shall be finalized by Authority's Engineer and Authority shall not be treated as Change of Scope.

8. TRAFFIC CONTROL DEVICES AND ROAD SAFETY WORKS

Traffic control devices and road safety works shall be provided in accordance with Section 9 of the IRC SP-84/87:

Traffic Signs: Traffic signs include roadside signs, overhead signs and curb Mounted signs along the entire Project Highway.

Pavement Marking: Pavement markings shall cover road marking for the entire Project Highway.

Safety Barrier: Provide W-beam crash barrier along the project highway at all Locations as specified in IRC SP-84/87:

Specifications of the reflective sheeting shall be as provided in the IRC SP-84/87:

9. ROADSIDE FURNITURE

Roadside furniture shall be provided in accordance with the provisions of section 9 & 11 of IRC SP-84/87:

- a. Road Boundary Stones: Shall be provided along the entire Project Highway.
- b. Pedestrian Guard Railing: At each bus stop location & four lane stretches at the edge of lined drain for channelizing movement of pedestrians.
- c. Delineators: For the entire Project Highway at the locations as suggested in the IRC SP-84/87:

Overhead traffic signs: location and size

S. No	Location (Design Chainage)	Type	Remark
1	9+000	Overhead 6 Lane Gantry Sign	--

Provide Overhead traffic Signs (locations & sizes) shall conform to the Manual of Specifications (IRC SP-84/87).

1. AVENUE PLANTATION / COMPULSORY AFFORESTATION

The number of trees which are required to be planted by the Contractor, in accordance to IRC: SP-21-2009, should be a minimum of nos. of 4000

2. HAZARDOUS LOCATIONS

Safety Barriers (Metal Beam Crash Barrier):

The safety barriers shall be provided at the following locations, as per IRC: SP: 84/87

- i) All embankments with height more than 3m;
- ii) All curves having radii up to 450m for complete length of curves including length of transition and 20m further before and after the curve;
- iii) All hazardous locations where there are roadside obstacles; and
- iv) Approaches to Bridges.

Any change in length of crash barrier will not subject to change of scope.

3. TOE WALL

The provision of toe wall as required in high embankment portions shall be provided to restrict the Project Highway within ROW, as per Manual, in a minimum length of 1.4 Km.

Slope protection works shall be provided in high embankment locations as per provisions of Section 4 of Manual.

4. SPECIAL TREATMENT FOR PAVEMENT:

Potholes identified at various places in Existing pavement, in this regard special treatment/Improvement may kindly design like Geo Grit etc.

i. Change of Scope

The Span arrangement and length of Structures specified herein above shall be treated as an approximate assessment. The actual span arrangement and length 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 span arrangement and length 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.

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:

- a. Roadside furniture;
- b. Parking Area
- c. Installation of ROW pillar
- d. Highway Lighting

2. Description of Project Facilities

Each of the Project Facilities is described below and as included in the drawing volume

a. Roadside furniture

The roadside furniture shall include the provisions of:

I. Traffic Signs:

Traffic signs include roadside signs, overhead signs and kerb mounted signs along the entire Project Highway as per IRC: SP: 84/87.

II. Pavement Markings:

Pavement markings shall cover road marking for the entire Project Highway as per IRC: SP: 84/87.

III. LED Traffic Blinkers:

LED Traffic Blinkers shall be provided along the Project Highway at the locations finalised in consultation with Authority's Engineer and Authority.

IV. Studs

Studs shall be provided along the Project Road at the locations as per IRC: SP: 84/87.

V. Hectometer / Kilometer stones

Hectometer/ Kilometer Stones shall be provided for the entire Project Highway at the locations as per IRC: SP: 84/87.

VI. Road Boundary stones

Road Boundary Stones shall be provided for the entire Project Highway at the locations as per IRC: SP: 84/87.

VII. Pedestrian Facilities

The pedestrian facilities shall be provided as per IRC: SP: 84/87.

b. Parking Area

Parking area has been proposed at following locations:

Sr. No	Design Chainage (Km)	Remark
1	0+300	--

c. Installation of ROW pillar, KM stone:

Boundary stone and Kilometre stone shall be installed by contractor as per standard given in **IRC-25**

d. Highway Lighting

Lighting with LED bulbs shall be provided at the following locations in conformity with the provisions of IRC: SP: 84/87:

High Mast Lighting shall be provided at all Major Intersections. Total no of High Mast Lighting is **1 no (at the roundabout)**.

Street Lighting shall be provided at entire sections as indicated in the TCS, at a spacing of 30m staggered. Total no of Street Lighting is **330 nos**

The lighting work shall be got done from the qualified specialised agency.

The scope include providing entire lighting systems, trenching, underground / building in cabling, transformers etc and obtaining electric supply / approval from concern Govt department.

Schedule-D

(See Clause 2.1)

SPECIFICATIONS AND STANDARDS

1. Construction

The Contractor shall comply with the Specifications and Standards set forth in Annex- I of this Schedule-D for construction of the Project Highway.

2. Design Standards

The Project Highway including Project Facilities shall conform to design requirements set out in the following documents:

3. Manual of Specifications and Standards for Four/Six Lane of Highways.

Earthen Shoulders width of 1.0/2.0 m is proposed as per Ministry's Circular RW/NH-33044/22/2020-S&R(P&B) Dt:17.07.2020

Width of Cross Drainage Structures including Minor and Major Bridges:

The widths of all Cross Drainage Structures including Minor Bridges are proposed as line with Plan & Profile and GAD Drawing.

(Schedule-D)

SPECIFICATIONS AND STANDARDS FOR CONSTRUCTION**1. Specifications and Standards**

All materials, works and construction operations shall conform to the Manual of Specifications and Standards for Four/Six Lane of Highways, (IRC: SP: 84/87) referred to as manual and MORTH Specifications for Road and Bridge Works. Where the specification for a work is not given, Good Industry Practice shall be adopted to the satisfaction of the Authority's Engineer.

2. Deviations from the Specifications and Standards

- I. The terms “Concessionaire”, “Independent Engineer” and “Concession Agreement” used in the Manual shall be deemed to be substituted by the terms “Contractor”, “Authority's Engineer” and “Agreement” respectively.
- II. Notwithstanding anything to the contrary contained in Paragraph 1 above, the following Specifications and Standards shall apply to the Project Highway, and for purposes of this Agreement, the aforesaid Specifications and Standards shall be deemed to be amended to the extent set forth below:

Sr. No	Item	Manual Clause Reference	Provision as per Manual	Modified Provision
1	Cross-Sectional Features	Section-2 of Manual	Cross-sectional features	Applicable TCS given in Schedule-B
2	Utility Corridor	Section 2.15 of Manual	2m wide strip of land at extreme edge of ROW	Varies based on the available ROW.

Schedule-E

(See Clauses 2.1 and 4.2)

MAINTENANCE REQUIREMENTS

1. Maintenance Requirements

- I. The Contractor shall, at all times maintain the Project Highway in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.
- II. 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-fulfilment of the Maintenance obligations by the Contractor.
- III. 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.

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 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.

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 Highway 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 Highway and maintain a record thereof in a register to be kept in such form and manner as the Authority may specify. Such record shall be kept in safe custody of the Contractor and shall be open to inspection by the Authority 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 Highway on account of a Force Majeure Event or wilful 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.

(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

ROADS		Time limit
(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 (twenty-four) 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 (six) 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 carriage way)	7 (seven) days
(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 (twenty-four) 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 (forty-eight) hours
(ii)	Painting of km stone, railing, parapets, crash barriers	As and when required/ Once every year
(iii)	Damaged/missing signs road 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 (twenty-four) hours
(ii)	Faults and minor failures	8 (eight) hours
(e)	Trees and plantation	
(i)	Obstruction in a minimum head- room of 5 m above carriage way or obstruction in visibility of road signs	24 (twenty-four) hours
(ii)	Removal of fallen trees from carriageway	4 (four) hours
(iii)	Deterioration in health of trees and bushes	Timely watering and treatment
(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 (four) hours
(ii)	Defects in electrical, water and sanitary installations	24 (twenty-four) hours
(g)	[Toll Plaza]: Deleted	
(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 (forty-eight) 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
(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 4.1 (vii) (a))

APPLICABLE PERMITS

I. Applicable Permits

The Contractor shall obtain, as required under the Applicable Laws, the following Applicable Permits:

Permission of the State Government for extraction of boulders from quarry;

Permission of Village Panchayats and Pollution Control Board for installation of crushers;

Licence for use of explosives;

Permission of the State Government for drawing water from river/reservoir;

Licence from inspector of factories or other competent Authority for setting up batching plant;

Clearance of Pollution Control Board for setting up batching plant;

Clearance of Village Panchayats and Pollution Control Board for setting up asphalt plant;

Permission of Village Panchayats and State Government for borrow earth; and

Any other permits or clearances required under Applicable Laws.

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 and 19.2)

Annex-I

SPECIMEN BANK GUARANTEE PERFORMANCE

GUARANTEE / SECURITY DEPOSIT

(To be executed on Rs.300/- non-judicial Stamp Paper)

[The bank, as requested by the successful Tenderer, shall fill in this form in accordance with the instruction indicated]

In consideration of the Board of Deendayal Port Authority incorporated by the Major Port Authorities Act, 2021 (hereinafter called "The Board" which expression shall unless excluded by or repugnant to the context or meaning thereof be deemed to include the Board of Deendayal Port Authority of the port its successors and assigns) having agreed to release Performance Guarantee / Security Deposit to (hereinafter called the "contractor")

(Name of the contractor/s)

from the demand under the terms and condition of the contract, vide from the demand under the condition of the contract, vide 's letter

No

(Name of the Department)

Date _____ made between the contractors and the Board for execution of Covered under Tender No. _____ dated (hereinafter called "the said contract") for the payment of Security Deposit in cash or Lodgment of Government Promissory Loan Notes for the due fulfillment by the said contractors of the terms and condition of the said contract, on production of a bank Guarantee for Rs. _____ (Rupees) only we, the (Name of the Bank and Address)

_____ (here in after Referred to as "the Bank") at the request of the contractors do here by undertake to pay to the Board an amount not exceeding Rs. _____ (Rupees) only against any loss or damage caused to or suffered by the Board by reason of any breach by the contractors of any of the terms and conditions of the said contract.

1. We, _____, do here by

(Name of Bank)

(Name of Branch)

Undertake to pay the amount due and payable under this guarantee without any demur merely on a demand from the Board stating that the amount claimed is due by way of loss or damage caused to or which would be caused to or suffered by the Board by reason of the contractor's failure to perform the said contract. Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this Guarantee. However, our liability under this guarantee shall be restricted to any amount not exceeding Rs.

_____(Rupees _____) only.

2. We, _____, undertake to pay to the (Name of Bank and Branch)

Board any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the Contractor(s) shall have no claim against us for making such payment.

3. We, _____ further agree with the Board that the (Name of Bank and Branch)

guarantee herein contained shall remain in full force and effect during the period that would be taken for performance of the said contract and that it shall continue to be enforceable till all the dues of the Board under or by virtue of the said contract have been fully paid and its claims satisfied or discharged or till the

(Name of the user department)

of the said certifies that the terms and conditions of the said contract have been fully and properly carried out by the said Contractors and accordingly discharge this guarantee. Provided however that the Bank shall be the request of the Board but at the cost of the Contractors, renew or extend this guarantee for such further period or periods as the Board may require from time to time.

4. We, _____ further agree with the Board that the (Name of Bank and Branch)

Board shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said contract or to extend the time of performance by the said contract or to extend the time of performance by the said Contractors from time to time or to postpone for any time or

from time to time any of the powers exercisable by the board against the said Contractors and to forebear or enforce any of the terms and conditions relating to the said contract and we shall not be relieved from our liability by reason of any such variation or extensions being granted to the contractors or for any forbearance, act or omission on the part of the Board or any indulgence shown by the board to the Contractors or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

5. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

6. It is also hereby agreed that the Courts in Gandhidham would have exclusive jurisdiction in respect of claims, if any, under this Guarantee.

7. We, Bank lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Board in writing.

8. Notwithstanding anything contained herein:

(a) Our liability under this Bank Guarantee shall not exceed Rs.

_____ (Rupees_____ only);

(b) This Bank Guarantee shall be valid up to ; and

(c) We are liable to pay the guarantee amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or

before _____ (date of expiry of Guarantee).”

Date _____ day of _____ 20

For (Name of Bank)

(Name)

Signature

Annex – II

(Schedule-G)

(See Clause 19.2)

Annex-II FORM FOR GUARANTEE FOR ADVANCE PAYMENT

[Deendayal Port Authority, Kandla, Gujarat]

SPECIMEN BANK GUARANTEE FOR ADVANCE PAYMENT

{To be executed on non-judicial stamp paper of appropriate value}

{As per CVC guideline BGs for advance shall be taken in equal numbers that of accepted number of instalments and BG shall be valid for period of successive date of recoveries}

[The bank as requested by the successful Tenderer, shall fill in this form in accordance with the instruction indicated]

Date: [insert date (as day, month, and year) of Tender submission] Tender No. and title: [insert number and title of Tendering process]

[bank's letterhead]

Beneficiary: [insert legal name and address of port]

ADVANCE PAYMENT GUARANTEE No. [insert advance payment guarantee no.]

We, [insert legal name and address of bank], have been informed that [insert complete name and address of contract] (hereinafter called "the contract")

Furthermore, we understand that, according to the contract, an advance is to be made against an advance payment guarantee.

At the request of the contractor, we hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [insert amount(s) ¹ in figures and words] upon receipt by us of your first demand in writing declaring that the contractor is in breach of its obligation

under the contract because the contractor used the advance payment for the purpose intended.

It is a condition for any claim and payment under this Guarantee to be made that the advance payment referred to above must have been received by the contractor

on its account [insert number and domicile of the account]

This guarantee shall remain valid and in full effect from the data of the advance payment received by the contractor under the contract until [insert data]

[Signature (s) of authorized representative(s) of the bank]

[Authorisation letter from the issuing bank that the signatory of this BG is authorised to do so should also be enclosed]

The bank shall insert the amount(s) specified in the SCC and denominated, as specified in the SCC, either in the currency (ies) of the contract or a freely convertible currency acceptable to the Employer.

Insert the completion scheduled data stipulated in the contract Delivery Schedule. The Employer should note that in the event of an extension of the time to perform the Contract, the Employer would need to request an extension of this Guarantee from the bank such request must be in writing and must be made prior to the expiration data established in the Guarantee. In preparing this Guarantee the Employer might consider adding the following text to the Form at the end of the penultimate paragraph: "We agree to extend this Guarantee for a period not exceeding [six months]\[one year] at a time, in the Employer written request for such extension, such request to be presented to us before the expiry of the Guarantee."

Schedule-H
(See Clauses 10.1 (iv) and 19.3)

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 Project Highway shall be as specified below:

Item	Weightage in percentage to the Contract Price	Stage for Payment	Percentage weightage to Particular item (col.2)
1	2	3	4
Road works including culverts and Minor Bridges	91.79%	A- Widening and reconstruction of existing road (flexible payment)	
		(1) Earthwork up to top of the sub-grade	2.91%
		(2) Granular work (sub-base, base, shoulders)	16.36%
		(3) Dense Bituminous Macadam (DBM)	45.26%
		(4) Bituminous Concrete	16.37%
		B- Culverts, minor bridges,	
		(1) New Culverts & Widening of Existing Culverts	13.43%
		(2) New 4 Lane/ Multi Lane Minor bridges & Additional 2 Lane Bridges	-
		(a) Foundation	1.89%
		(b) Sub-structure	1.89%
		(c) Super-structure	1.89%
Total			100 %
Other works	8.21%	(i) Service/slip roads/junctions	57.52%
		(ii) Road side drains	18.59%
		(iii) Road signs, markings, km stones, boundary stones, safety devices etc.	3.47%
		(iv) Project facilities	-
		(v) Site clearance & Dismantling (Dismantling of Flexible pavement & Drain and Scarifying Existing BT surface)	5.71%
		(vi) Street Lighting/Highway Lighting/Other Road Furniture Items /Parking Area	14.71%
Total	100 %		100 %

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 Road works including approaches to minor bridges, Major Bridges and Structures
Procedure for estimating the value of road work done shall be as follows:

Table 1.3.1

Stage of Payment	Percentage-weightage	Payment Procedure
A-Widening and Reconstruction of Existing Road (flexible Pavement)		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.
(1) Earthwork up to top of the sub-grade	2.91%	
(2) Granular work (sub-base, base, shoulders)	16.36%	
(3) Dense Bituminous Macadam (DBM)	45.26%	
(4) Bituminous Concrete	16.37%	
B-New culverts, minor bridges (1) New Culverts	13.43%	Cost of each culvert shall be determined on pro rata basis with respect to the total number of culverts. Payment shall be made on the completion of five culverts.
(2) New 6-lane Minor Bridges Foundation: On completion of the foundation work including foundations for wing and return walls	1.89%	Cost of each minor bridge shall be determined on pro rata basis with respect to the total linear length of the minor bridges. Payment shall be made on the completion of a minor bridge
Sub-structure: On completion of abutments, piers up to the abutment/pier cap	1.89%	
Super-structure: On completion of the girders and deck slab	1.89%	

@. 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:

$$\text{Cost per km} = P \times \text{weightage for road work} \times \text{weightage for bituminous work} \times (1/L)$$

Where P= Contract Price

L = Total length in km

Similarly, the rates per km for stages (1), (2) and (4) above shall be worked out.

Procedure for estimating the value of other works done shall be as stated in table 1.3.4.

Table 1.3.4

Stage of Payment	Percentage -weightage	Payment Procedure
(i) Service/slip roads	57.52%	Unit of measurement is linear length in km. Cost per km shall be determined on pro rata basis with respect to the total length of the service roads. Payment shall be made for completed service road in a length of not less than 10 (ten) percent of the total length of service roads.
(iii) Road Drain	18.59%	Unit of measurement is linear length in km. Payment shall be made on pro rata basis on completion of a stage in a length of not less than 10% (ten per cent) of the total length.
(iii) Road signs, markings, km stones, boundary stones, safety devices etc.	3.47%	
(iv) Project Facilities	-	-
(v) Site clearance & Dismantling (Dismantling of Flexible pavement & Drain and Scarifying Existing BT surface)	5.71%	Payment shall be made for completed items.
(vi) Street Lighting/Highway Lighting/Other Road Furniture Items /Parking Area	14.71%	Payment shall be made on pro-rata basis as completed item.

2. Procedure for payment for Maintenance

2.1 The cost for maintenance shall be as stated in Clause 14.1.1.

2.2 Payment for Maintenance shall be made in quarterly instalments in accordance with the provisions of Clause 19.7.

3. Contractor shall be carried out on his own cost and no extra cost will be paid by the Authority/Client for the following works.

- i. Cost of shifting of any types of utilities.
- ii. Cost of widening of all existing culverts, utility-ducts upto extend of proposed road configuration.
- iii. Cost of filling of pot hole and any types of surface distress/damages during profile correction
- iv. Cost of construction of additional road and tapering portion (at proposed roundabout legs) to connect to the existing Six lane ROB approach road near SIPC.

- v. Cost of repairing and strengthening of existing Bridges as per standard Specification in the MoRTH.

Schedule-I

(See Clause 10.2 (iv))

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.

(Schedule-I)

Annex-I LIST OF DRAWINGS

[Note: The Authority shall describe in this Annex-I, all the Drawings that the Contractor is required to furnish under Clause 10.2.]

Schedule-J

(See Clause 10.3 (ii))

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

- I. Project Milestone-I shall occur on the date falling on the **150th** day from the **Appointed Date (the “Project Milestone- I”)**.
- II. Prior to the occurrence of Project Milestone-I, the Contractor shall have commenced construction of the Project Highway 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

- I. Project Milestone-II shall occur on the date falling on the **280th day** from the **Appointed Date (the “Project Milestone- II”)**.
- II. Prior to the occurrence of Project Milestone-II, the Contractor shall have continued with construction of the Project Highway and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than **30% (thirty percent) of the Contract Price**.

4. Project Milestone-III

- I. Project Milestone-III shall occur on the date falling on the **410th** day from the Appointed Date (the **“Project Milestone- III”**).
- II. Prior to the occurrence of Project Milestone-III, the Contractor shall have continued with construction of the Project Highway and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 60% (sixty percent) of the Contract Price and should have started construction of all project facilities.

5. Scheduled Completion Date

The Scheduled Completion Date shall occur on the Scheduled Construction Period i.e. **545th Day** (18 Month) from the Appointed Date.

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 maybe, 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 (ii))

TESTS ON COMPLETION

1. Schedule for Tests

- I. 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 Project Highway 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.
- II. The Contractor shall notify the Authority's Engineer of its readiness to subject the Project Highway 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

- I. 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.
- II. Riding quality test: Riding quality of each lane of the carriageway shall be checked with the help of a Network Survey Vehicle (NSV) fitted with latest equipment's and the maximum permissible roughness for purposes of this Test shall be [2,000 (two thousand)] mm for each kilometer.
- III. 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 Non-destructive 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) meters or more shall also be subjected to load testing.
- IV. Pavement strength:- The pavement strength is to be measured using falling weight deflectometer (FWD), at least once a year upon Completion of the Project.

- V. 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 Project Highway with Specifications and Standards, except tests as specified in clause 5, but shall include measuring the reflectivity of road markings and road signs; and measuring the illumination level (lux) of lighting using requisite testing equipment.
- VI. Safety Audit: The Authority's Engineer shall carry out, or cause to be carried out, a safety audit to determine conformity of the Project Highway 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. The necessary charges for tests will be borne by Contractor.

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.

5. The Authority's Engineer (if required by Authority) will carry out tests with following equipment at his own cost in the presence of contractor's representative.

1	Surface defects of pavement	Network Survey Vehicle (NSV)	At least twice a year (As per survey months defined for the state basis rainy season)
2	Roughness of pavement	Network Survey Vehicle (NSV)	At least twice a year (As per survey months defined for the state basis rainy season)
3	Strength of pavement	Falling Weight Deflectometer (FWD)	At least once a year
4	Bridges	Mobile Bridge Inspection Unit (MBU)	At least twice a year (As per survey months defined for the state basis rainy season)
5	Road signs	Retro-reflectometer	At least twice a year (As per survey months defined for the state basis rainy season)

The first testing with the help of NSV shall be conducted at the time of issue of completion Certificate.

Schedule-L

(See Clause 12.2)

COMPLETION CERTIFICATE

I, (Name of the Authority's Engineer), acting as the Authority's Engineer, under and in accordance with the Agreement dated (the "**Agreement**"), for [Widening and Improvement of existing 2/4 lane carriageway of KK Road connecting to NH-8A on EPC Mode in the state of Gujarat] (the "Project Highway") 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 Highway with the provisions of the Agreement, and I am satisfied that the Project Highway can be safely and reliably placed in service of the Users thereof.

It is certified that, in terms of the aforesaid Agreement, all works forming part of Project Highway have been completed, and the Project Highway is hereby declared fit for entry into operation on this the day of 20....., Scheduled Completed Date for which was 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

- I. Monthly lump sum payments for maintenance shall be reduced in the case of non-compliance with the Maintenance Requirements set forth in Schedule-E.
- II. 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.
- III. 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 on monthly basis

- I. 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 cross fall, 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%
(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/accident 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%

- II. The amount to be deducted from monthly lump-sum payment for non-compliance of particular item shall be calculated as under:

$$R = \frac{P}{100} \times (M1 \text{ or } M2) \times \frac{L1}{L}$$

Where,

P= Percentage of particular item/Defect/deficiency for deduction

M1= Monthly lump-sum payment in accordance para 1.2 above of this Schedule

M2= Monthly lump-sum payment in accordance para 1.2 above of this Schedule

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 kilometre, the non-conforming length shall be taken as one kilometre.

Schedule-N

(See Clause 18.1 (i))

SELECTION OF AUTHORITY’S ENGINEER

1. Selection of Authority’s Engineer

- I. The provisions of the Model Request for Proposal for Selection of Technical Consultants, issued by the Ministry of Finance in May 2009, or any substitute thereof shall apply for selection of an experienced firm to discharge the functions and duties of an Authority’s Engineer.
- II. 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 as the Authority’s Engineer; provided that such entity shall be a body corporate having as one of its primary functions the provision of consulting, advisory and supervisory services for engineering projects; provided further that a government-own identity which is owned or controlled by the Authority shall not be eligible for appointment as Authority’s Engineer.

(Schedule-N)

Annex-I Terms of Reference for Authority's Engineer

1. Scope

- I. 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 [name and address of the Authority] (the “Authority”) and..... (the “Contractor”)# for [Widening and Improvement of existing 2/4 lane carriageway of KK Road connecting to NH-8A on EPC Mode in the state of Gujarat], and a copy of which is annexed hereto and marked as Annex-A to form part of this TOR.

- In case the bid of Authority’s Engineer is invited simultaneously with the bid of EPC project, then the status of bidding of EPC project only to be indicated

- II. The TOR shall apply to construction and maintenance of the Project Highway.

2. Definitions and interpretation

- I. 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.
- II. 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.
- III. The rules of interpretation stated in Article 1 of the Agreement shall apply, mutatis mutandis, to this TOR.

3. General

- I. 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.
- II. 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. issuance of Completion Certificate or
 - e. Any other matter which is not specified in (a), (b), (c) or (d) above and which creates a financial liability on either Party.
- III. 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.
- IV. 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.
- V. The Authority's Engineer shall aid and advise the Authority on any proposal for Change of Scope under Article 13.
- VI. 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

- I. During the Construction Period, the Authority's Engineer shall review and approve 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 (vi). The Authority's Engineer shall complete such review and approval 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 up to 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.

- II. The Authority's Engineer shall review and approve any revised Drawings sent to it by the Contractor and furnish its comments within 10 (ten) days of receiving such Drawings.
- III. The Authority's Engineer shall review and approve 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.
- IV. The Authority's Engineer shall complete the review and approve of the methodology proposed to be adopted by the Contractor for or 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.
- V. 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 Highway for purposes of maintenance during the Construction Period in accordance with the provisions of Clause 10.4.
- VI. 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.
- VII. The Authority's Engineer shall inspect the Construction Works and the Project Highway 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.
- VIII. 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.
- IX. 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 (ix), 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.

- X. The Authority's Engineer shall test check at least 50 (fifty) percent of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.
- XI. The timing of tests referred to in Paragraph 4 (ix), 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.
- XII. 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.
- XIII. The Authority's Engineer may instruct the Contractor to execute any work which is urgently required for the safety of the Project Highway, whether because of an accident, unforeseeable even to otherwise; provided that in case of any work required on account of a Force Majeure Event, the provisions of Clause 21.6 shall apply.
- XIV. 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 Highway 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.
- XV. 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 12.2.
- XVI. 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.
- XVII. 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.

- XVIII. 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, as the case may be. For carrying out its functions under this Paragraph 4 (xviii) 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. Determination of costs and time

- I. The Authority's Engineer shall determine the costs, and/or their reasonableness, that are required to be determined by it under the Agreement.
- II. The Authority's Engineer shall determine the period of Time Extension that is required to be determined by it under the Agreement.
- III. The Authority's Engineer shall consult each Party in every case of determination in accordance with the provisions of Clause 18.5.

6. Payments

- I. 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 (iv) (d).
- II. 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.
- III. 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.
- IV. 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.

7. Other duties and functions

The Authority's Engineer shall perform all other duties and functions as specified in the Agreement.

8. Miscellaneous

- I. 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.
- II. 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.
- III. 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 Highway as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Project Highway and set backlines, if any, of the buildings and structures forming part of Project Facilities; and shall hand them over to the Authority against receipt thereof.
- IV. 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.
- V. 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 (i), 19.6 (i), and 19.8 (i))

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 (i) 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 (iii) (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 up to the last claim:
- i. For the Works executed (excluding Change of Scope orders);
 - ii. For Change of Scope Orders, and
 - iii. Taxes deducted

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

- I. 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.
- II. The insurance under sub para (a) and (b) of paragraph 1 (i) 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 affect and maintain insurance cover of not less than 15% of the Contract Price 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

- I. 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. [*****]

- II. 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.

Schedule-Q

TESTS ON COMPLETION

1. Riding Quality test:

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 [2,200 (two thousand and two hundred only)] mm for each kilometre.

2. 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 include measurement of cracking, rutting, stripping and potholes and shall be as per the requirement of maintenance mentioned in Schedule-E.

Schedule-R

(See Clause 14.10)

TAKING OVER CERTIFICATE

I, (Name and designation of the Authority's Representative) under and in accordance with the Agreement dated..... (the "Agreement"), for [***Widening and Improvement of existing 2/4 lane carriageway of KK Road connecting to NH-8A on EPC Mode in the state of Gujarat***] (the "Project Highway") on Engineering, Procurement and Construction (EPC) basis through (Name of Contractor), hereby certify that the Tests on completion of the Agreement have been successfully undertaken to determine compliance of the Project Highway with the provisions of the Agreement and I hereby certify that the Authority has taken over the Project highway from the Contractor on this day.....

SIGNED, SEALED AND DELIVERED

(Signature)

(Name and designation of Authority's Representative)

(Address)

-----END-----



DEENDAYAL PORT AUTHORITY ENGINEERING DEPARTMENT



ISO 9001:2008 ISO 14001
ISPS compliant port

Request for Proposal (RFP)

FOR

**Widening and Improvement of Existing 2/4 lane carriageway of
KK-Road Connecting to NH-8A in the state of Gujarat on EPC
Mode**

“Invited by”

**Executive Engineer (TD),
TD Division,
Administrative Office Building,
Room No – 105, Annexe, Post Box-50
Gandhidham-370201
Kutch District -Gujarat, India
Email: tddivisionkpt@gmail.com**

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Notice Inviting Tender (NIT)

Tender Id: 03-TD/2024

Dated 08/03/2024

The Deendayal Port Authority is engaged in the development of Highways as part of this endeavor and it has been decided to undertake **Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat** through an Engineering, Procurement and Construction (EPC) Contract.

The Deendayal Port Authority now invites bids from eligible contractors for the following project:

State	Work Description	Tender Fee (In Rs.)	Estimated cost (In Rs.)	Bid Security / EMD (In Rs.)	Last Date and time of online Submission of bid documents	Date and time of online opening
Gujarat	Widening and improvement of existing 2/4 lane carriageway of KK Road connecting to NH-8A in the state of Gujarat on EPC Mode	₹5000.00 (+) 18% GST = ₹5900.00 (In Digital mode of Payment at Bank of Baroda Gandhidham Branch Account No.- 1008010002242 7 IFSC code – BARB0GANK UT)	₹73,84,51,847 (Excluding GST)	₹50.00 Lakhs (in the form of Bank Guarantee Drawn in favour of Board of Deendayal Port Authority, issued by any Nationalized /scheduled bank (Except Co-op bank) having branch at Gandhidham as per enclosed format) APPENDIX-II)	Up to 16:00 Hrs. on 09/04/ 2024	09/04/2024 at 16:00 hrs.

Detailed tender notice along with complete tender documents can be downloaded from DPA's E-tender Website <https://tender.nprocure.com/> from 08/03/2024 to 09/04/2024@ 16:00 hrs. Tender Notice is also available on <http://deendayalport.gov.in>. Technical Bid will be opened on 09/04/2024@ 16:30 Hrs. Date of opening of price bid shall be notified after scrutiny & evaluation of Technical Bid. For further details and general enquiries prospective bidders may contact **Executive Engineer(TD), Ground Floor A.O. Building, Annexe, Gandhidham-370201, Kutch District, Gujarat State, INDIA**, during working hours before the last date and time of downloading of tender documents.

**EXECUTIVE ENGINEER (TD)
DEENDAYAL PORT AUTHORITY**

DISCLAIMER

The information contained in this Request for Proposal document (the “RFP”) or subsequently provided to Bidder(s), whether verbally or in documentary or any other form by or on behalf of the Authority or any of its employees or advisors, is provided to Bidder(s) on the terms and conditions set out in this RFP and such other terms and conditions subject to which such information is provided.

This RFP is not an Agreement and is neither an offer nor invitation by the Authority to the prospective Bidders or any other person. The purpose of this RFP is to provide interested parties with information that may be useful to them in making their financial offers (BIDs) pursuant to this RFP. This RFP includes statements, which reflect various assumptions and assessments arrived at by the Authority in relation to the Project. Such assumptions, assessments and statements do not purport to contain all the information that each Bidder may require. This RFP may not be appropriate for all persons, and it is not possible for the Authority, its employees or advisors to consider the investment objectives, financial situation and particular needs of each party who reads or uses this RFP. The assumptions, assessments, statements and information contained in the Bidding Documents, especially the [Feasibility Report], may not be complete, accurate, adequate or correct. Each Bidder should, therefore, conduct its own investigations and analysis and should check the accuracy, adequacy, correctness, reliability and completeness of the assumptions, assessments, statements and information contained in this RFP and obtain independent advice from appropriate sources.

Information provided in this RFP to the Bidder(s) is on a wide range of matters, some of which may depend upon interpretation of law. The information given is not intended to be an exhaustive account of statutory requirements and should not be regarded as a complete or authoritative statement of law. The Authority accepts no responsibility for the accuracy or otherwise for any interpretation or opinion on law expressed herein.

The Authority, its employees and advisors make no representation or warranty and shall have no liability to any person, including any Applicant or Bidder under any law, statute, rules or regulations or tort, principles of restitution or unjust enrichment or otherwise for any loss, damages, cost or expense which may arise from or be incurred or suffered on account of anything contained in this RFP or otherwise, including the accuracy, adequacy, correctness, completeness or reliability of the RFP and any assessment, assumption, statement or information contained therein or deemed to form part of this RFP or arising in any way for participation in this BID Stage. The Authority also accepts no liability of any nature whether resulting from negligence or otherwise howsoever caused arising from reliance of any Bidder upon the statements contained in this RFP. The Authority may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement the information, assessment or assumptions contained in this RFP. The issue of this RFP does not imply that the Authority is bound to select a Bidder or to appoint the Selected Bidder JV or Contractor, as the case may be, for the Project and the Authority reserves the right to reject all or any of the Bidders or BIDs without assigning any reason whatsoever. The Bidder shall bear all its costs associated with or relating to the preparation and submission of its BID including but not limited to preparation, copying, postage, delivery fees, expenses associated with any demonstrations or presentations which may be required by the Authority or any other costs incurred in connection with or relating to its BID. All such costs and expenses will remain with

the Bidder and the Authority shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder in preparation or submission of the BID, regardless of the conduct or outcome of the Bidding Process.

GLOSSARY

Agreement	As defined in Clause 1.1.4
Authority	As defined in Clause 1.1.1
Bank Guarantee	As defined in Clause 2.20.1
BID(s)	As defined in Clause 1.2.2
Bidders	As defined in Clause 1.2.1
Bidding Documents	As defined in Clause 1.1.5
BID Due Date	As defined in Clause 1.1.5
Bidding Process	As defined in Clause 1.2.1
BID Security	As defined in Clause 1.2.4
BID Price or BID	As defined in Clause 1.2.6
Contractor	As defined in Clause 1.1.2
Construction Period	As defined in Clause 1.2.6
Conflict of Interest	As defined in Clause 2.2.1(c)
Defect Liability Period	As defined in Clause 1.2.6
Eligible Experience	As defined in Clause 2.2.2.5 (i)
Eligible Projects	As defined in Clause 2.2.2.5 (i)
EPC	As defined in Clause 1.1.1
EPC Contract	As defined in Clause 1.1.2
Estimated Project Cost	As defined in Clause 1.1.3
Feasibility Report	As defined in Clause 1.2.3
Financial Capacity	As defined in Clause 2.2.2.3 (i)
Government	Government of India
Joint Venture	As defined in Clause 2.2.1
Jt. Bidding Agreement	As defined in Clause 2.1.11(f)
Lead Member	As defined in Clause 2.1.11 (c)
Lowest Bidder	As defined in Clause 1.2.6
LOA	As defined in Clause 3.3.4
Net Worth	As defined in Clause 2.2.2.9 (ii)
Performance Security	As defined in Clause 2.21.1
Additional Performance Security	As defined in Clause 2.21.1
Project	As defined in Clause 1.1.1
Re. or Rs. or INR	Indian Rupee
RFP or Request for Proposals	As defined in the Disclaimer
Selected Bidder	As defined in Clause 3.3.1
Technical Capacity	As defined in Clause 2.2.2.2 (i)
Tie BIDs	As defined in Clause 3.3.2
Threshold Technical Capacity	As defined in Clause 2.2.2.2 (i)

The words and expressions beginning with capital letters and defined in this document shall, unless repugnant to the context, have the meaning ascribed thereto herein.

DEENDAYAL PORT AUTHORITY

SECTION 1

INTRODUCTION

1.1 Background

1.1.1 The Deendayal Port Authority (the “**Authority**”) is engaged in the development of Highways and as part of this endeavor, it has been decided to undertake Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat (the “**Project**”) through an Engineering, Procurement and Construction (the “**EPC**”) Contract, and has decided to carry out the bidding process for selection of a Bidder to whom the Project may be awarded.

A brief description of the project may be seen in the Detailed tender notice along with complete tender documents can be downloaded from PA’s E-tender Website <https://tender.nprocure.com/> from 08/03 /2024 to 09/04/ 2024@ 16:00 hrs. Tender Notice is also available on <http://deendayalport.gov.in>. Brief particulars of the Project are as follows:

Name	Length in Km (approx.)	Estimated Project Cost (In Rs.)	No of Years for completion of work
Widening and improvement of existing 2/4 lane carriageway of KK Road connecting to NH-8A in the state of Gujarat on EPC Mode	9 Km	₹73,84,51,847.00 (Excluding GST)	18 Months (545 Days)

1.1.2 The selected Bidder (the “**Contractor**”) shall be responsible for designing, engineering, procurement and construction of the Project under and in accordance with the provisions of an engineering, procurement and construction contract (the “**EPC Contract**”) to be entered into between the Contractor and the Authority in the form provided by the

³ Serially numbered footnotes are for guidance of the Authority and should be omitted prior to issue of RFP. Foot notes marked in non-numerical characters shall be retained in the RFP.

⁴Estimated Project Cost is the cost of civil work for which Bid is invited.

⁵No. of years for completion of work shall be selected as per following criteria:

Project category	Project Length	Condition	If length of an individual Major Bridge/RUB/ROB/Elevated Structure	Construction Period*
Widening to 2 lane with paved shoulders carriageway	<= 50 km	And	<=200 mtrs	18 months
	> 50 km	Or	> 200 mtrs	24 months
Widening to carriageway 4 lane	<= 50 km	And	<=200 mtrs	24 months
	> 50 km	Or	> 200 mtrs	30 months
Widening to carriageway 6 lane	For projects with a continuous elevated highway (excluding Major Bridges/ ROBs/ RUBs/ VUPs) section upto 200 mtrs length (excluding approaches)			30 months

	For projects with a continuous elevated highway (excluding Major Bridges/ ROBs/ RUBs/ VUPs) sections more than 200 mtrs length (excluding approaches)	Shall be decided on case to case basis
Standalone projects (Major Bridges/ ROBs/ RUBs/ Flyovers/ Elevated Highway)	Length of project upto 200 mtrs (excluding approaches)	18 months
	Length of project >200 mtrs (excluding approaches) but < = 500 mtrs (excluding approaches)	24 months
	Length of project >500 mtrs (excluding approaches)	30 months
	For specialized type of structure like extradozed/ cable stayed/ segmental etc.	Shall be decided on case to case basis

* For projects in hilly terrain the Construction Period may be increased by 6 month

Authority as part of the Bidding Documents pursuant hereto. The Contractor shall also be responsible for the maintenance of the project during the Defect Liability Period. The scope of work will broadly include rehabilitation, upgradation and augmentation of the existing carriageway as per standards with construction of new pavement, rehabilitation of existing pavement, construction and/or rehabilitation of major and minor bridges, culverts, road intersections, interchanges, drains, etc. and maintenance of the Project during the Defect Liability Period, which shall be 5 (five) years.

- 1.1.3 The estimated cost of the Project (the “**Estimated Project Cost**”) has been specified in the clause 1.1.1 above. The assessment of actual costs, however, will have to be made by the Bidders.
- 1.1.4 The Agreement sets forth the detailed terms and conditions for award of the project to the Contractor, including the scope of the Contractor’s services and obligations.
- 1.1.5 The Authority shall receive BIDs pursuant to this RFP in accordance with the terms set forth in this RFP and other documents to be provided by the Authority pursuant to this RFP (collectively the “**Bidding Documents**”), and all BIDs shall be prepared and submitted in accordance with such terms on or before the BID due date specified in Clause 1.3 for submission of BIDs (the “**BID Due Date**”).
- 1.2 **Brief description of Bidding Process**
- 1.2.1 The “**Bidding Process**” for selection of the Bidder for award of the Project. Under this process, the bid shall be evaluated under three parts as under:

1st Part (Preliminary Bid): In this part, the qualification of the Bidder will be first examined based on Tender Fees, Bid Security (EMD) and Integrity Pact.

Tender Fees, Bid Security (EMD) or Bid Security Declaration and Integrity Pact document need to be submitted ONLINE in Preliminary bid stage failing which the bid will be considered **non-responsive**. The pre-contract Integrity Pact (as per appendix) document should be duly scanned, stamped, signed and dated. The bid/tender shall also be accompanied by Integrity Pact Agreement duly signed by DPA authority along with witness which needs to be signed by the bidder along with witness as per format available in the RFP document.

In case of **Micro** and **Small Enterprise (MSEs)** holding valid certificate issued by any agencies/organization under The Ministry of Micro, Small and Medium Enterprises, GoI indicating the list of activity related to the subject tender shall become eligible for exemption

from payment of Tender Fee & EMD. Such bidder shall upload a scanned copy of valid certificate in preliminary bid.

2nd Part (Technical Bid): The Technical Bid shall be opened of only those Bidders whose Bids are responsive in Preliminary Bid. In 2nd part, Eligibility and qualification of the Bidder will be first examined based on the details submitted under second part (Technical Bid) with respect to eligibility and qualifications criteria prescribed in this RFP. (The “Bidder”, which expression shall, unless repugnant to the context, include the members of the Joint Venture, if applicable).

3rd Part (Financial Bid): The Financial Bid shall be opened of only those Bidders whose Technical Bids are responsive to eligibility and qualifications requirements as per this RFP.

- 1.2.2 The Bid shall be valid for a period of 120 days from the date specified in Clause 1.3 for submission of BIDs.

¹The Defect Liability Period/Maintenance Period for the development of National Highway shall be as under:

- (a) 5 (five) years from the date of completion in case of a road being constructed with flexible pavement.
- (b) 10 (ten) years from the date of completion in case of road being constructed with rigid pavement.
- (c) 10 (ten) years from the date of completion in case of road being constructed with flexible pavement using perpetual design
- (d) 10 (ten) years from the date of completion in case of all stand-alone structures, e.g. Major Bridges/ and Tunnels
- (e) 10 (ten) years from the date of completion for the stretches where new technology/ material has been/ is proposed to be used.

⁵ The categorization whether the project highway is constructed with flexible pavement or rigid pavement shall depend on the basis of major length of the project highway to be covered with that type of pavement.

- 1.2.3 The complete Bidding Documents including the draft Agreement for the Project is enclosed for the Bidders. The Feasibility Report / Detailed Project Report prepared by the Authority/ consultants of the Authority (the "**Feasibility Report/Detailed Project Report**") is also enclosed. The Feasibility Report / Detailed Project Report of the Project is being provided only as a preliminary reference document by way of assistance to the Bidders who are expected to carry out their own surveys, investigations and other detailed examination of the Project before submitting their Bids. Nothing contained in the Feasibility Report/Detailed Project Report shall be binding on the Authority nor confer any right on the Bidders, and the Authority shall have no liability whatsoever in relation to or arising out of any or all contents of the Feasibility Report/Detailed Project Report. The aforesaid documents and any addenda issued subsequent to this RFP Document, will be deemed to form part of the Bidding Documents.

- 1.2.4 A Bidder is required to submit, along with its BID, a BID Security of ₹50.00 Lakhs (the "**BID Security**"), refundable not later than 150 (One hundred & fifty) days from the BID Due Date, except in the case of the Selected Bidder whose BID Security shall be retained till it has provided a Performance Security and Additional Performance Security (if any) as per the provision of this RFP and LOA. (By Bank Guarantee in format given at APPENDIX-II). The Bidders shall also submit Tender Fee ₹5000.00 (+) 18% GST = ₹5900.00 (In Digital mode of Payment at Bank of Baroda Gandhidham Branch Account No.- 10080100022427 IFSC code – BARB0GANKUT).

- 1.2.5 Bidders are advised to examine the Project in greater detail, and to carry out, at their cost, such studies as may be required for submitting their respective BIDs for award of the contract including implementation of the Project.

- 1.2.6 BIDs will be evaluated for the Project on the basis of the lowest cost required by a Bidder for implementing the Project (the "**BID Price**"). The total time allowed for completion of construction under the Agreement (the "**Construction Period**") and the period during which the Contractor shall be liable for maintenance and rectification of any defect or deficiency in the Project after completion of the Construction Period (the "**Defect Liability Period**") shall be pre-determined, and are specified in the draft Agreement forming part of the Bidding Documents.

In this RFP, the term "**Lowest Bidder**" shall mean the Bidder who is quoting the lowest BID price.

- 1.2.7 Generally, the Lowest Bidder shall be the selected Bidder. In case such Lowest Bidder withdraws or is not selected for whatsoever reason except the reason mentioned in Clause 2.1.12 (b) (4), the Authority shall annul the Bidding Process and invite fresh BIDs.
- 1.2.8 Other details of the process to be followed under this bidding process and the terms thereof are spelt out in this RFP.

The Bid Security shall be an amount equivalent to 1% of the Estimated Project Cost. However, the Authority may, in its discretion, a higher Bid Security not exceeding 2% of the Estimated Project Cost. In case of a project having an Estimated Project Cost of Rs. 2,000 cr. or above, the Authority may, in its discretion, reduce the Bid Security, but not less than 0.5% of the Indicative Project Cost in any case.

⁶The cost of RFP document may be determined at the rate of Rs. 10,000 for every Rs. 100 crore or part thereof comprising the Estimated Project Cost. Thus the cost of an RFP document for a project of Rs. 200 crore shall be Rs. 20,000.

- 1.2.9 Any queries or request for additional information concerning this RFP shall be submitted by e-mail to the officer designated in clause no. 2.11.4.

1.3 Schedule of Bidding Process

The Authority shall endeavor to adhere to the following schedule:

Sr. No.	Event Description	Date
1.	Invitation of RFP (NIT)	08.03.2024
2.	Last date for receiving queries	15.03.2024 (1700 hrs)
3.	Pre-BID meeting as per clause 5.1, Pre-BID conference of the Bidders shall be held on-line only	18.03.2024 (1600 hrs)
4.	Authority response to queries latest by	Shall be uploaded online.
5.	Last date of Request for BID Document	09.04.2024 (16:00 Hrs)
6.	BID Due Date	09.04.2024 (16:00 Hrs)
7.	Opening of Preliminary BID	09.04.2024 (16.05 Hrs)
8.	Declaration of eligible / qualified bidders	To be intimated later
09.	Opening of Financial BID	To be intimated later
10.	Letter of Award (LOA)	To be intimated later
11.	Validity of BID	120 days from BID Due Date

SECTION-2

INSTRUCTIONS TO BIDDERS

A. GENERAL

2.1. General terms of Bidding

- 2.1.1 No Bidder shall submit more than one BID for the Project. A Bidder bidding individually or as a member of a Joint Venture shall not be entitled to submit another BID either individually or as a member of any Joint Venture, as the case may be.
- 2.1.2 An International Bidder bidding individually or as a member of a Joint Venture shall ensure that Power of Attorney is apostille by appropriate authority and requirement of Indian Stamp Act is duly fulfilled.
- 2.1.3 Notwithstanding anything to the contrary contained in this RFP, the detailed terms specified in the draft Agreement shall have overriding effect; provided, however, that any conditions or obligations imposed on the Bidder hereunder shall continue to have effect in addition to its obligations under the Agreement. Further, the statements and explanations contained in this RFP are intended to provide a better understanding to the Bidders about the subject matter of this RFP and should not be construed or interpreted as limiting in any way or manner the scope of services and obligations of the Contractor set forth in the Agreement or the Authority's rights to amend, alter, change, supplement or clarify the scope of work, the work to be awarded pursuant to this RFP or the terms thereof or herein contained. Consequently, any omissions, conflicts or contradictions in the Bidding Documents including this RFP are to be noted, interpreted and applied appropriately to give effect to this intent, and no claims on that account shall be entertained by the Authority
- 2.1.4 The BID shall be furnished in the format exactly as per Appendix-I i.e. Technical Bid as per Appendix IA and Financial Bid as per Appendix IB. BID amount shall be indicated clearly in both figures and words, in Indian Rupees in prescribed format of Financial Bid. In the event of any difference between figures and words, the amount indicated in words shall be taken into account.
- 2.1.5 The Bidder should submit a Power of Attorney as per the format at Appendix-III, authorizing the signatory of the BID to commit the Bidder.
- 2.1.6 In case the Bidder is a Joint Venture, the Members thereof should furnish a Power of Attorney in favour of the Lead Member in the format at Appendix-IV. And joint bidding agreement in the format at Appendix-V
- 2.1.7 Any condition or qualification or any other stipulation contained in the BID shall render the BID liable to rejection as a non-responsive BID.

- 2.1.8 The BID and all communications in relation to or concerning the Bidding Documents and the BID shall be in English language.
- 2.1.9 This RFP is not transferable.
- 2.1.10 Any award of Project pursuant to this RFP shall be subject to the terms of Bidding Documents and also fulfilling the criterion as mentioned in clause 2.2.
- 2.1.11 In case the Bidder is a Joint Venture, it shall comply with the following additional requirements **(Not applicable)**:
- (a) Number of members in a Joint Venture shall not exceed 3 (Three);
 - (b) subject to the provisions of clause (a) above, the Bid should contain the information required for each Member of the Joint Venture;
 - (c) Members of the Joint Venture shall nominate one member as the lead member (the “**Lead Member**”). Lead Member shall meet at least 60% requirement of Bid Capacity, Technical and Financial Capacity, required as per Clause 2.2.2.1, 2.2.2.2(i) & 2.2.2.3. The nomination(s) shall be supported by a Power of Attorney, as per the format at Appendix-III, signed by all the other Members of the Joint Venture. Other Member(s) shall meet at least 20% requirement of Bid Capacity, Technical and Financial Capacity required as per Clause 2.2.2.1, 2.2.2.2(i) & 2.2.2.3 and the JV as a whole shall cumulatively/collectively fulfil the 100% requirement;
 - (d) the Bid should include a brief description of the roles and responsibilities of individual members, particularly with reference to financial, technical and defect liability obligations;
 - (e) the Lead Member shall itself undertake and perform at least 51(fifty one) per cent of the total length of the Project Highway,
 - (f) members of the Joint Venture shall have entered into a binding Joint Bidding Agreement, substantially in the form specified at Appendix V (the “**Jt. Bidding Agreement**”), for the purpose of making the Application and submitting a Bid in the event of being pre-qualified. The Jt. Bidding Agreement, to be submitted along with the Application, shall, *inter alia*:
 - (i) convey the commitment(s) of the Lead Member in accordance with this RFP, in case the contract to undertake the Project is awarded to the Joint Venture; and clearly outline the proposed roles & responsibilities, if any, of each member;
 - (ii) commit the approximate share of work to be undertaken by each member conforming to sub-clause 2.1.11 (e) mentioned above;

- (iii) include a statement to the effect that all members of the Joint Venture shall be liable jointly and severally for all obligations of the Contractor in relation to the Project until the Defect Liability Period is achieved in accordance with the EPC Contract; and
- (g) except as provided under this RFP, there shall not be any amendment to the Jt. Bidding Agreement.
- (h) **No Joint Venture up to Estimate Project Cost of Rs. 100 crores (One Hundred Crores).**

2.1.12 While bidding is open to persons from any country, the following provisions shall apply:

- (a) Where, on the date of the Application, not less than 50% (fifty percent) of the aggregate issued, subscribed and paid up equity share capital in the L-1 Bidder or its Member is held by persons resident outside India or where a Bidder or its Member is controlled by persons resident outside India, then the eligibility and award of the project to such L-1 Bidder shall be subject to approval of the competent authority from national security and public interest perspective as per the instructions of the Government of India applicable at such time. The decision of the authority in this behalf shall be final and conclusive and binding on the Bidder.
 - (b) Further, where the LoA of a project has been issued to an agency, not covered under the category mentioned above, and it subsequently wishes to transfer its share capital in favour of another entity who is a resident outside India or where a Bidder or its Member is controlled by persons resident outside India and thereby the equity capital of the transferee entity exceeds 50% or above, any such transfer of equity capital shall be with the prior approval of the competent authority from national security and public interest perspective as per the instructions of the Government of India applicable at such point in time.
- (1) The holding or acquisition of equity control, as above shall include direct or indirect holding, acquisition, including by transfer of the direct or indirect legal or beneficial ownership or control, by persons acting for themselves or in concert and in determining such holding or acquisition, the Authority shall be guided by the principles, precedents and definitions contained in the Securities and Exchange Board of India (Substantial Acquisition of Shares and Takeovers) Regulations, 2011, or any substitute thereof, as in force on the date of such acquisition.
 - (2) The Bidder shall promptly inform the authority of any change in the shareholding, as above, and failure to do so shall render the Bidder liable for disqualification from the Bidding process.
 - (3) In case the L-1 Applicant under (a) above is denied the security clearance, for

whatsoever reasons, then the applicants emerging as L-2, L-3 eligible Bidders (in that order) may be given a counter-offer (one by one sequentially) to match the bid of L-1 applicant/preferred Bidder. In the event of acceptance of the counter-offer by another eligible Bidder, the project may be awarded to such Bidder. In case no applicant matches the bid of the L-1 applicant, the bid process shall be annulled and fresh bids invited.

- 2.1.13 Notwithstanding anything to the contrary contained herein, in the event that the Bid Due Date falls within three months of the closing of the latest financial year of a Bidder, it shall ignore such financial year for the purposes of its Bid and furnish all its information and certification with reference to the 5 (five) years or 1 (one) year, as the case may be, preceding its latest financial year. For the avoidance of doubt, financial year shall, for the purposes of a Bid hereunder, mean the accounting year followed by the Bidder in the course of its normal business.
- 2.1.14 The Bidder, including an individual or any of its Joint Venture member, should not be a non-performing party on the bid submission date. The Bidder, including any Joint Venture Member, shall be deemed to be a non-performing party (not applicable to the project whose contract is terminated by the Authority) if it attracts any or more of the following parameters:
- (i) Fails to complete or has missed more than two milestones in already awarded two or more projects, even after lapse of 6 months from the scheduled completion date, unless Extension of Time has been allowed on the recommendations of the Independent Engineer due to Authority's default;
 - (ii) Fails to complete a project, as per revised schedule, for which One Time Fund Infusion (OTFI) has been sanctioned by the Authority;
 - (iii) Physical progress on any project is not commensurate with the funds released (equity+debt+grant) from the escrow account and such variation is more than 25% in last one year as observed by the Independent Engineer in one or more projects;
 - (iv) Punch List Items in respect of any project are pending due to Bidder's default in two or more Projects even after lapse of the prescribed time for completion of such items;
 - (v) Fails to fulfil its obligations to maintain a highway in a satisfactory condition inspite of two rectification notices issued in this behalf;
 - (vi) Fails to attend to Non Conformity Reports (NCRs) issued by the Independent/ Authority's Engineer on the designs/ works constructed by the Bidder pending for more than one year in two or more projects.

- (vii) Fails to make premium payments excluding the current instalment in one or more projects.
- (viii) Damages/ Penalties recommended by the Independent/ Authority's Engineer on the Bidder during O&M period and the remedial works are not taken up in two or more projects.
- (ix) Fails to achieve financial closure in two or more projects within the given or extended period (which shall not be more than six months in any case).
- (x) Fails to submit the Performance Security within the permissible period in more than one project(s).
- (xi) Rated as an unsatisfactory performing entity/ non-performing entity by an independent third party agency and so notified on the website of the Authority.
- (xii) Has Failed to perform for the works of Expressways, National Highways, ISC & EI works in the last 2(two) years, as evidenced by imposition of a penalty by an arbitral or judicial authority or a judicial pronouncement or arbitral award against the Bidder, including individual or any of its Joint Venture Member, as the case may be.
- (xiii) Has been expelled or the contract terminated by the DEENDAYAL PORT AUTHORITY or its implementing agencies for breach by such Bidder, including individual or any of its Joint Venture Member; Provided that any such decision of expulsion or termination of contract leading to debarment of the Bidder from further participation in bids for the prescribed period should have been ordered after affording an opportunity of hearing to such party.

The Bidder, including individual or each member of Joint Venture, shall give the list of the projects of Expressways, National Highways, ISC and EI works of DEENDAYAL PORT AUTHORITY or its implementing agencies and the status of above issues in each project as on the bid submission date and undertake that they do not attract any of the above categories (Ref. Sr. No.6, Annex-I of Appendix – IA).

The Bidder including individual or any of its Joint Venture Member may provide

- (i) details of all their on-going projects along with updated stage of litigation, if so, against the Authority / Governments;
- (ii) details of updated on-going process of blacklisting if so, under any contract with Authority / Government; and
- (iii) details of all their on-going projects in the format at Annexure-VII of Appendix IA.

The Authority reserves the right to reject an otherwise eligible Bidder on the basis of the

information provided under this clause 2.1.14. The decision of the Authority in this case shall be final

2.2. Eligibility and qualification requirements of Bidder

2.2.1 For determining the eligibility of Bidder the following shall apply:

- (a) **The Bidder may be a single entity or a group of entities (the “Joint Venture”), coming together to implement the Project. The term Bidder used herein would apply to both a single entity and a Joint Venture. However, in case the estimated cost of the project for which bid is invited is upto Rs. 100 Crore, then Joint Venture shall not be allowed.**
- (b) Bidder may be a natural person, private entity, or any combination of them with a formal intent to enter into a Joint Venture agreement or under an existing agreement to form a Joint Venture. A Joint Venture shall be eligible for consideration subject to the conditions set out in Clause 2.1.11 above.
- (c) A Bidder shall not have a conflict of interest (**“Conflict of Interest”**) that affects the Bidding Process. Any Bidder found to have a Conflict of Interest shall be disqualified and liable for forfeiture of the BID Security or Performance Security as the case may be. A Bidder shall be deemed to have a Conflict of Interest affecting the Bidding Process, if:
 - (i) the Bidder, its Joint Venture Member (or any constituent thereof) and any other Bidder, its Member or any Member of its Joint Venture thereof (or any constituent thereof) have common controlling shareholders or other ownership interest; provided that this disqualification shall not apply in cases where the direct or indirect shareholding of a Bidder, or its Joint Venture Member thereof (or any shareholder thereof having a shareholding of more than 5% (five percent) of the paid up and subscribed share capital of such Bidder, or its Joint Venture Member, as the case may be), in the other Bidder, its Joint Venture Member is less than 5% (five percent) of the subscribed and paid up equity share capital thereof; provided further that this disqualification shall not apply to any ownership by a bank, insurance company, pension fund or a public financial institution referred to in section 4A of the Companies Act 1956. For the purposes of this Clause 2.2.1(c), indirect shareholding held through one or more intermediate persons shall be computed as follows: (aa) where any intermediary is controlled by a person through management control or otherwise, the entire shareholding held by such controlled intermediary in any other person (the **“Subject Person”**) shall be taken into account for computing the shareholding of such controlling person in the Subject Person; and (bb) subject always to sub- clause (aa) above, where a person does not exercise control over an intermediary, which has shareholding in the Subject Person, the computation of indirect shareholding of such person in the Subject Person shall be undertaken on a proportionate basis; provided, however, that no such shareholding shall be reckoned under this sub-clause (bb) if the shareholding of such person in the intermediary is less than 26% of the subscribed and paid up equity shareholding of such intermediary; or

- (ii) a constituent of such Bidder is also a constituent of another Bidder; or
- (iii) such Bidder, or any of its Joint Venture Member thereof receives or has received any direct or indirect subsidy, grant, concessional loan or subordinated debt from any other Bidder, or any of its Joint Venture Member thereof or has provided any such subsidy, grant, concessional loan or subordinated debt to any other Bidder, its Member or any of its Joint Venture Member thereof; or
- (iv) such Bidder has the same legal representative for purposes of this Application as any other Bidder; or
- (v) such Bidder, or any of its Joint Venture Member thereof has a relationship with another Bidder, or any of its Joint Venture Member thereof, directly or through common third party/ parties, that puts either or both of them in a position to have access to each other's' information about, or to influence the Application of either or each other; or
- (vi) such Bidder, or any of its Joint Venture Member thereof has participated as a consultant to the Authority in the preparation of any documents, design or technical specifications of the Project.

2.2.2 Qualification requirements of Bidders:

2.2.2.1 BID Capacity

Bidders who *inter alia* meet the minimum qualification criteria will be qualified only if their available BID capacity is more than the total BID value (Estimated Project Cost as per Clause 1.1.1). The available BID capacity will be calculated as per following, based on information mentioned at Annexure-VI of Appendix-IA:

Assessed Available BID capacity = $(A * N * 2.5 - B + C)$, Where

N= Number of years prescribed for completion of work for which Bid is invited.

A = Maximum value of civil engineering works excluding the amount of bonus received, if any, in respect of EPC Projects executed in any one year during the last five years (updated to the price level of the year indicated in table at Note-3 below) taking into account the completed as well as works in progress. The **EPC projects** include turnkey project/ Item rate contract/ Construction works.

B = Value (updated to the price level of the year indicated in table at Note-3 below) of existing commitments, works for which Appointed Date/ Commencement Date has been declared or on-going works to be completed during the period of completion of the works for which BID is invited. For

the sake of clarification, it is mentioned that works for which LOA has been issued but Appointed Date/ Commencement Date not declared as on Bid Due Date shall not be considered while calculating value of B.

C = The amount of bonus received, if any, in EPC Projects during the last 5 years (updated to the price level of the year indicated in table at Note-3 below).

Note:

1. The Statement showing the value of all existing commitments, works for which Appointed Date/ Commencement Date has been declared and ongoing works as well as the stipulated period of completion remaining for each of the works listed should be countersigned by the Client or its Engineer-in-charge not below the rank of Executive Engineer or equivalent in respect of EPC Projects **or** Concessionaire / Authorized Signatory of SPV in respect of BOT Projects and verified by Statutory Auditor.
2. The amount of bonus received, if any, in EPC Projects should be countersigned by the Client or its Engineer-in-charge not below the rank of Executive Engineer or equivalent in respect of EPC Projects.
3. The factor for the year for updating to the price level is indicated as under:

Financial Year	2022-23*	2021-22	2020-21	2019-20	2018-19
Index	152.5	139.4	123.4	121.8	119.8
Up-dation factor	1	1.09	1.24	1.25	1.27

*In case of work is completed in FY 2023-24, then the up-dation factor shall be considered as 1 (one).

2.2.2.2 Technical Capacity

- (i) For demonstrating technical capacity and experience (the “**Technical Capacity**”), the Bidder shall, over the past 5 (five) financial years preceding the Bid Due Date, have received payments for construction of Eligible Project(s), or has undertaken construction works by itself in a PPP project, such that the sum total thereof, as further adjusted in accordance with clause 2.2.2.5 (i) & (ii), is more than [₹73.85 crore (Rupees Seventy Three Crore Eighty Five Lakh Only) (Excluding GST)]. (the “**Threshold Technical Capacity**”)⁷.

⁷This amount should be as follows:

Sl. No	Estimated Project Cost (EPC) of the Project being invited	Threshold Technical Capacity
1	Estimated Project Cost ≤ 100 Crore	1.0 time of EPC
2	Estimated Project Cost > 100 Crore & ≤ 500 Crore	1.5 times of EPC

3	Estimated Project Cost > 500 Crore	2 times of EPC
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- (ii) For normal Highway projects (including Major Bridges/ROB/Flyovers/Tunnels):

Provided that at least one similar work of 25% of Estimated Project Cost [₹18.46 crore (Rupees Eighteen Crore Forty Six Lakhs Only) (Excluding GST)] shall have been completed from the Eligible Projects in Category 1 and/or Category 3 specified in Clause 2.2.2.5. For this purpose, a project shall be considered to be completed, if more than 90% of the value of work has been completed and such completed value of work is equal to or more than 25% of the estimated project cost. If any Major Bridge/ROB/Flyover/Tunnel is (are) part of the project, then the sole Bidder or in case the Bidder being a Joint Venture, any member of Joint Venture shall necessarily demonstrate additional experience in construction of Major Bridge/ROBs/Flyovers/Tunnel in the last 5 (Five) financial years preceding the Bid Due Date i.e. shall have completed at least one similar Major Bridge/ROB/Flyover having span equal to or greater than 50% of the longest span of the structure proposed in this project and in case of tunnel, if any, shall have completed construction of at least one tunnel consisting of single or twin tubes (including tunnel(s) for roads/Railway/Metro rail/irrigation/hydro-electric projects etc.) having at least 50% of the cross-sectional area and 25% length of the tunnel to be constructed in this project.

- (iii) For Stand-alone specialized projects:

- (a) **Major Bridges/ROB/Flyovers projects:** The sole Bidder or in case the Bidder being a Joint Venture, any member of Joint Venture shall have completed at least one similar Major Bridge/ROB/Flyover project in the last 5 (Five) financial years preceding the Bid Due Date, having span equal to or greater than 50% of the longest span of the structure proposed in this project and also the cost of such similar project shall be at least 25% of the Estimated Project Cost. For this purpose, a project shall be considered to be completed, if more than 90% of the value of work has been completed and such completed value of work is equal to or more than 25% of the Estimated Project Cost.
- (b) **Tunnel project:** The sole Bidder or in case the Bidder being a Joint Venture, any member of Joint Venture shall have completed at least one tunnel project in the last 5 (Five) financial years preceding the Bid Due Date, consisting of single or twin tubes (including tunnel(s) for roads/Railway/Metro rail/irrigation/hydro-electric projects etc.) having at least 50% of the cross-sectional area and 25% length of the tunnel to be constructed in this project and the cost of such project shall be at least 25% of the Estimated Project Cost. For this purpose, a project shall be considered to be completed, if more than 90% of the value of work has been completed and such completed value

of work is equal to or more than 25% of the Estimated Project Cost.

- (iv) The updation factor to update the price of the eligible projects for the year indicated in table below:

Financial Year	2022-23*	2021-22	2020-21	2019-20	2018-19
Index	152.5	139.4	123.4	121.8	119.8
Up-dation factor	1	1.09	1.24	1.25	1.27

*In case of work is completed in FY 2023-24, then the up-dation factor shall be considered as 1 (one).

2.2.2.3 Financial Capacity:

- (i) The Bidder shall have a minimum Net Worth⁸ (the “**Financial Capacity**”) of [₹3.69 crore (Rupees Three Crore Sixty-Nine Lakhs Only) (Excluding GST)]⁹ at the close of the preceding financial year.
- (ii) The Bidder shall have a minimum Average Annual Turnover (updated to the price level of the year based on factors indicated in table below) of [₹14.77 crore (Rupees Fourteen Crore Seventy-Seven Lakhs Only) (Excluding GST)]¹⁰ for the last 5 (five) financial years.

Financial Year	2022-23*	2021-22	2020-21	2019-20	2018-19
Index	152.5	139.4	123.4	121.8	119.8
Up-dation factor	1	1.09	1.24	1.25	1.27

*In case of work is completed in FY 2023-24, then the up-dation factor shall be considered as 1 (one).

2.2.2.4 In case of a Joint Venture (**Not applicable**):

- (i) The Bid Capacity, Technical Capacity and Financial Capacity of all the Members of Joint Venture would be taken into account for satisfying the above conditions of eligibility. Further, Lead Member shall meet at least 60% requirement of Bid Capacity, Technical and Financial Capacity as per Clause 2.2.2.1, 2.2.2.2(i) and 2.2.2.3 and each of other JV members shall meet at least 20% requirement of Bid Capacity, Technical and Financial Capacity individually as per Clause 2.2.2.1, 2.2.2.2(i) and 2.2.2.3. For avoidance of doubt it is further clarified that the Joint Venture must collectively and individually satisfy the above qualification criteria i.e. JV shall cumulatively/collectively fulfill the 100% requirement.
- (ii) For requirement of 2.2.2.2 (ii), one similar work of 25% of Estimated Project Cost should have been completed from the Eligible Projects in Category 1 and/or Category 3 specified in Clause 2.2.2.5 individually by any of the JV members as a single work.

- 2.2.2.5 Categories and factors for evaluation of Technical Capacity:
- (i) Subject to the provisions of Clause 2.2.2 the following categories of experience would qualify as Technical Capacity and eligible experience (the "**Eligible Experience**") in relation to eligible projects as stipulated in Clauses 2.2.2.6 (i) & (ii) (the "**Eligible Projects**"). In case the Bidder has experience across different categories, the experience for each category would be computed as per weight of following factors to arrive at its aggregated Eligible Experience:

Category	Project / Construction experience on Eligible Projects	Factors
1	Project in highways sector that qualify under Clause 2.2.2.6 (i)	1
2	Project in core sector that qualify under Clause 2.2.2.6 (i)	0.70
3	Construction in highways sector that qualify under Clause 2.2.2.6 (ii)	1
4	Construction in core sector that qualify under Clause 2.2.2.6 (ii)	0.70

⁸ Net worth has been adopted as the criterion for assessing financial capacity since it is a comprehensive indication of the financial strength of the Applicant.

⁹ This amount should be 5% (five percent) of the Estimated Project Cost of the Project for which bids are being invited.

¹⁰ This amount should be 20% (twenty percent) of the Estimated Project Cost of the Project for which bids are being invited.

- (ii) The Technical capacity in respect of an Eligible Project situated in a developed country which is a member of OECD shall be further multiplied by a factor of 0.5 (zero point five) and the product thereof shall be the Experience Score for such Eligible Project.
- (iii) For the purpose of this RFP:
- (a) highways sector would be deemed to include highways, expressways, bridges, tunnels, runways, railways (construction/re-construction of railway tracks, yards for keeping containers etc.) metro rail and ports (including construction/re-construction cost of Jetties, any other linear infrastructure including bridges etc.); and
 - (b) core sector would be deemed to include civil construction cost of power sector, commercial setups (SEZs etc.), airports, industrial parks/ estates, logistic parks, pipelines, irrigation, water supply, sewerage and real estate development.
- (I) In case of projects executed by applicant under category 3 and 4 as a member of Joint Venture, the project cost should be restricted to the share of the applicant in the joint venture for determining eligibility as per provision under clause 2.2.2.2 (ii). In case Statutory Auditor certifies that, the work of other member(s) is also executed by the applicant, then the total share executed by applicant can be considered

for determining eligibility as per provision under clause 2.2.2.2 (ii).

- (II) Maintenance works are not considered as eligible project for evaluation as per Instruction No.6 to Annex-IV. As such works with nomenclature like PR, OR, FDR,SR, site/micro grading, surface renewal, resurfacing work, Tarring, B.T. surface work, temporary restoration, urgent works, periodic maintenance, repair & rehabilitation, one time maintenance, permanent protection work of bank, external pre stressing, repair of central hinge, short term OMT contract of NHAI, any type of work related to border fencing, work of earthwork alone, construction of buildings/ hostels/hospitals, etc, or not specified, shall not be considered.
- (III) The works such as Improvement in Riding Quality work (IRQP/IRQ), shall be considered for Technical Capacity [2.2.2.2 (i)] but not for single completed works [2.2.2.2 (ii)]
- (IV) Project in Highway sector shall constitute the following for the purpose of consideration under category 1 or 3 as applicable, if:
 - (i) Widening / reconstruction / up-gradation works on NH / SH or on any category of road taken up under CRF, ISC/ EI, SARDP, LWE
 - (ii) Widening/ re-construction/up-gradation works on MDRs with loan assistance from multilateral agencies or on BOT basis,
 - (iii) Widening/ reconstruction / up-gradation work of roads in Municipal corporation limits, construction of Bypasses,
 - (iv) Construction of stand- alone bridges, ROB, tunnels w.r.t roads.
 - (v) Long term OMT works of NHAI/MoRT&H.
- (V) The projects with the title of RIDF, PMGSY road, link road, city roads, rural road, sector/ municipality road, Bridges for railway line, work of metro rails (bridges/ tunnel), real estate projects which demonstrate road development/construction bridges or culverts may be considered under category — 4.
- (VI) In case both the estimated cost of project and revised cost of project are provided, the revised cost of project shall be considered for evaluation.

2.2.2.6 Eligible Experience on Eligible Projects in respect of each category:

- (i) For a project to qualify as an Eligible Project under Categories 1 and 2:

- (a) It should have been undertaken as a PPP project on BOT, BOLT, BOO, BOOT or other similar basis for providing its output or services to a public sector entity or for providing non-discriminatory access to users in pursuance of its charter, concession or contract, as the case may be. For the avoidance of doubt, a project which constitutes a natural monopoly such as an airport or port should normally be included in this category even if it is not based on a long-term agreement with a public entity;
 - (b) the entity claiming experience should have held, in the company owning the Eligible Project, a minimum of 26% (twenty-six per cent) equity during the entire year for which Eligible Experience is being claimed;
 - (c) the capital cost of the project should be more than 10% of the amount specified as the Estimated Project Cost; and
 - (d) the entity claiming experience shall, during the last 5 (five) financial years preceding the Bid Due Date, have itself undertaken the construction of the project for an amount equal to at least one half of the Project Cost of eligible projects, excluding any part of the project for which any contractor, sub-contractor or other agent was appointed for the purposes of construction.
- (ii) For a project to qualify as an Eligible Project under Categories 3 and 4, the Bidder should have received payments from its client(s) for construction works executed, fully or partially, or work executed and certified by the Engineer-in-charge/Independent Engineer/Authority's Engineer during the 5 (five) financial years immediately preceding the Bid Due Date, and only the amounts (gross) actually received/ work executed, during such 5 (five) financial years shall qualify for purposes of computing the Experience Score. However, receipts of or work executed amount less than [₹7.39 crore (Rupees Seven Crore Thirty-Nine Lakhs Only) (Excluding GST)]¹¹ shall not be reckoned as receipts for Eligible Projects. For the avoidance of doubt, construction works shall not include supply of goods or equipment except when such goods or equipment form part of a turn-key construction contract / EPC contract for the project. Further, the cost of land and also cost towards pre- construction activities (like shifting of utilities etc.) shall not be included hereunder.

¹¹ This amount should not be less than 10% of the Estimated Project Cost

- (iii) The Bidder shall quote experience in respect of a particular Eligible Project under any one category only, even though the Bidder (either individually or along with a member of the Joint Venture) may have played multiple roles in the cited project. Double counting for a particular Eligible Project shall not be permitted in any form.
- (iv) Experience for any activity relating to an Eligible Project shall not be claimed by two or more Members of the Joint Venture. In other words, no double counting by a Joint Venture in respect of the same experience shall be permitted in any manner whatsoever.

- 2.2.2.7 Submission in support of Technical Capacity
- (i) The Bidder should furnish the details of Eligible Experience for the last 5 (five) financial years immediately preceding the Bid Due Date.
 - (ii) The Bidder must provide the necessary information relating to Technical Capacity as per format at Annex-II of Appendix-IA.
 - (iii) The Bidder should furnish the required Project-specific information and evidence in support of its claim of Technical Capacity, as per format at Annex - IV of Appendix-IA.
- 2.2.2.8 Submission in support of Financial capacity
- (i) The Technical Bid must be accompanied by the Audited Annual Reports of the Bidder (of each Member in case of a Joint Venture) for the last 5 (five) financial years, preceding the year in which the bid is submitted.
 - (ii) In case the annual accounts for the latest financial year are not audited and therefore the Bidder cannot make it available, the Bidder shall give an undertaking to this effect and the statutory auditor shall certify the same. In such a case, the Bidder shall provide the Audited Annual Reports for 5 (five) years preceding the year for which the Audited Annual Report is not being provided.
 - (iii) The Bidder must establish the minimum Net Worth specified in Clause 2.2.2.3, and provide details as per format at Annex-III of Appendix-IA.
- 2.2.2.9 The Bidder shall enclose with its Technical Bid, to be submitted as per the format at Appendix-IA, complete with its Annexes, the following:
- (i) Certificate(s) from its statutory auditors^s or the concerned client(s) stating the payments received or in case of a PPP project, the construction carried out by itself, during the past 5 years, in respect of the Eligible Projects. In case a particular job/ contract has been jointly executed by the Bidder (as part of a Joint Venture), it should further support its claim for the payments received or construction carried out by itself in PPP Projects as applicable the share in work done for that particular job/ contract by producing a certificate from its statutory auditor or the client; and

^s In case duly certified audited annual financial statements containing explicitly the requisite details are provided, a separate certification by statutory auditors would not be necessary in respect of Clause 2.2.2.9 (i). In jurisdictions that do not have statutory auditors, the firm of auditors which audits the annual accounts of the Applicant may provide the certificates required under this RFP.

- (ii) Certificate(s) from its statutory auditors specifying the net worth of the Bidder, as at the close of the preceding financial year, and also specifying that the methodology adopted for calculating such net worth conforms to the provisions of this Clause 2.2.2.9 (ii). For the purposes of this RFP, net worth

(the “**Net Worth**”) shall mean the aggregate value of the paid-up share capital and all reserves created out of the profits and securities premium account, after deducting the aggregate value of the accumulated losses, deferred expenditure and miscellaneous expenditure not written off, as per the audited balance sheet, but does not include reserves created out of revaluation of assets, write-back of depreciation and amalgamation.

2.2.2.10 Deleted

2.3 Proprietary data

All documents and other information supplied by the Authority or submitted by a Bidder to the Authority shall remain or become the property of the Authority and are transmitted to the Bidders solely for the purpose of preparation and the submission of a BID in accordance herewith. Bidders are to treat all information as strictly confidential and shall not use it for any purpose other than for preparation and submission of their Bid. The provisions of this Clause 2.3 shall also apply *mutatis mutandis* to BIDs and all other documents submitted by the Bidders, and the Authority will not return to the Bidders any BID, document or any information provided along therewith.

2.4 Cost of Bidding

The Bidders shall be responsible for all of the costs associated with the preparation of their BIDs and their participation in the Bidding Process. The Authority will not be responsible or in any way liable for such costs, regardless of the conduct or outcome of the Bidding Process.

2.5 Site visit and verification of information

2.5.1 Bidders are encouraged to submit their respective BIDs after visiting the Project site and ascertaining for themselves the site conditions, traffic, location, surroundings, climate, availability of power, water & other utilities for construction, access to site, handling and storage of materials, weather data, applicable laws and regulations, and any other matter considered relevant by them. Bidders are advised to visit the site and familiarise themselves with the Project with in the stipulated time of submission of the Bid. No extension of time is likely to be considered for submission of Bids.

2.5.2 It shall be deemed that by submitting a BID, the Bidder has:

- (a) made a complete and careful examination of the Bidding Documents, Schedules annexed to EPC agreement Document;
- (b) received all relevant information requested from the Authority;
- (c) accepted the risk of inadequacy, error or mistake in the information provided in the Bidding Documents or furnished by or on behalf of the Authority relating to any of the matters referred to in Clause 2.5.1 above. No claim shall be admissible at any stage on this account.
- (d) satisfied itself about all matters, things and information including matters referred to in Clause 2.5.1 hereinabove necessary and required for submitting

an informed BID, execution of the Project in accordance with the Bidding Documents and performance of all of its obligations thereunder;

- (e) acknowledged and agreed that inadequacy, lack of completeness or incorrectness of information provided in the Bidding Documents or ignorance of any of the matters referred to in Clause 2.5.1 hereinabove shall not be a basis for any claim for compensation, damages, extension of time for performance of its obligations, loss of profits etc. from the Authority, or a ground for termination of the Agreement by the Contractor;
- (f) acknowledged that it does not have a Conflict of Interest; and
- (g) agreed to be bound by the undertakings provided by it under and in terms hereof.

2.5.3 The Authority shall not be liable for any omission, mistake or error in respect of any of the above or on account of any matter or thing arising out of or concerning or relating to RFP, including any error or mistake therein or in any information or data given by the Authority.

2.6 Verification and Disqualification

2.6.1 The Authority reserves the right to verify all statements, information and documents submitted by the Bidder in response to the RFP and the Bidder shall, when so required by the Authority, make available all such information, evidence and documents as may be necessary for such verification. Any such verification, or lack of such verification, by the Authority shall not relieve the Bidder of its obligations or liabilities hereunder nor will it affect any rights of the Authority thereunder.

2.6.2 The Authority reserves the right to reject any BID and appropriate the BID Security if:

- (a) at any time, a material misrepresentation is made or uncovered, or
- (b) the Bidder does not provide, within the time specified by the Authority, the supplemental information sought by the Authority for evaluation of the BID.

Such misrepresentation/ improper response shall lead to the disqualification of the Bidder. If the Bidder is a Joint Venture, then the entire Joint Venture and each Member of the Joint Venture may be disqualified/ rejected. If such disqualification/rejection occurs after the BIDs have been opened and the lowest Bidder gets disqualified / rejected, then the Authority reserves the right to annul the Bidding Process and invites fresh BIDs.

2.6.3 In case it is found during the evaluation or at any time before signing of the Agreement or after its execution and during the period of defect liability subsistence thereof, that one or more of the eligibility and /or qualification requirements have not been met by the Bidder, or the Bidder has made material misrepresentation or has given any materially incorrect or false information, the Bidder shall be disqualified forthwith if not yet appointed as the contractor either by issue of the LOA or entering into of the Agreement, and if the Selected Bidder has already been issued the LOA or has entered into the Agreement, as the case may be, the same shall, notwithstanding anything to the contrary contained therein or in this RFP, be liable to be terminated, by a communication in writing by the Authority to the Selected Bidder

or the Contractor, as the case may be, without the Authority being liable in any manner whatsoever to the Selected Bidder or the Contractor. In such an event, the Authority shall be entitled to forfeit and appropriate the BID Security or Performance Security, as the case may be, as Damages, without prejudice to any other right or remedy that may be available to the Authority under the Bidding Documents and / or the Agreement, or otherwise.

- 2.6.4 A Bidder shall be liable for disqualification and forfeiture of BID Security, if any legal, financial or technical adviser of the Authority in relation to the Project is engaged by the Bidder, its Member or any Associate thereof, as the case may be, in any manner for matters related to or incidental to such Project during the Bidding Process or subsequent to the (i) issue of the LOA or (ii) execution of the Agreement. In the event any such adviser is engaged by the selected Bidder or Contractor, as the case may be, after issue of the LOA or execution of the Agreement for matters related or incidental to the project, then notwithstanding anything to the contrary contained herein or in the LOA or the Agreement and without Prejudice to any other right or remedy of the Authority, including the forfeiture and appropriation of the BID Security or Performance Security, as the case may be, which the Authority may have there under or otherwise, the LOA or the Agreement, as the case may be, shall be liable to be terminated without the Authority being liable in any manner whatsoever to the Selected Bidder or Contractor for the same. For the avoidance or doubt, this disqualification shall not apply where such adviser was engaged by the Bidder, its Member or Associate in the past but its assignment expired or was terminated 6 (six) months prior to the date of issue of this RFP. Nor will this disqualification apply where such adviser is engaged after a period of 3 (three) years from the date of commercial operation of the Project.

B. DOCUMENTS

2.7 Contents of the RFP

- 2.7.1 This RFP comprises the Disclaimer set forth hereinabove, the contents as listed below, and will additionally include any Addenda issued in accordance with Clause 2.9.

Part –I

Appendix

- IA Letter comprising the Technical BID
- IB Letter comprising the Financial BID
- II Bank Guarantee for BID Security
- III Format for Power of Attorney for signing of BID
- IV Format for Power of Attorney for Lead Member of Joint Venture
- V Format for Joint Bidding Agreement for Joint Venture
- VI Integrity Pact Format
- VII Format of LOA
- VIII Format of Bid Security Declaration form Bidders

Annexure of Appendix 1A

- I Details of Bidder

- II Technical Capacity of the Bidder
- III Financial Capacity of the Bidder
- IV Details of Eligible Project
- V Statement of legal capacity
- VI Information required to Evaluate the Bid capacity
- VII Details of ongoing Works

Part –II

Agreement Document with schedules

Part – III

[Feasibility Report / Detailed Project Report provided by the Authority]

- 2.7.2 The draft Agreement and the Feasibility / Detailed Project Report provided by the Authority as part of the BID Documents shall be deemed to be part of this RFP.
- 2.8 Clarifications
 - 2.8.1 Bidders requiring any clarification on the RFP may notify the Authority in writing by e-mail in accordance with Clause 1.2.9. They should send in their queries on or before the date mentioned in the Schedule of Bidding Process specified in Clause 1.3. The Authority shall endeavor to respond to the queries within the period specified therein, but no later than 10 (ten) days prior to the BID Due Date. The responses will be sent by fax or e-mail. The Authority will forward all the queries and its responses thereto, to all Bidders without identifying the source of queries.
 - 2.8.2 The Authority shall endeavor to respond to the questions raised or clarifications sought by the Bidders. However, the Authority reserves the right not to respond to any question or provide any clarification, in its sole discretion, and nothing in this Clause shall be taken or read as compelling or requiring the Authority to respond to any question or to provide any clarification.
 - 2.8.3 The Authority may also on its own motion, if deemed necessary, issue interpretations & clarifications to all Bidders. All clarifications & interpretations issued by the Authority shall be deemed to be part of the Bidding Documents. Verbal clarifications and information given by Authority or its employees or representatives shall not in any way or manner be binding on the Authority.
- 2.9 Amendment of RFP
 - 2.9.1 At any time prior to the BID Due Date, the Authority may, for any reason, whether at its own initiative or in response to clarifications requested by a Bidder, modify the RFP by the issuance of Addenda.

2.9.2 Any Addendum issued hereunder will be hosted on the <https://tender.nprocure.com/> and www.deendayalport.gov.in

2.9.3 In order to afford the Bidders a reasonable time for taking an Addendum into account, or for any other reason, the Authority may, in its sole discretion, extend the BID Due Date¹².

¹²While extending the BID Due Date on account of an addendum, the Authority shall have due regard for the time required by Bidders to address the amendments specified therein. In the case of significant amendments, at least 15 (fifteen) days shall be provided between the date of amendment and the BID Due Date, and in the case of minor amendments, at least 7 (seven) days shall be provided.

C. PREPARATION AND SUBMISSION OF BIDS

2.10 Format and Signing of BID

2.10.1 The Bidder shall provide all the information sought under this RFP. The Authority will evaluate only those BIDs that are received online in the required formats and complete in all respects and Bid Security, Copy of online receipt/ Digital mode of payment towards payment of cost of Bid document, POA and Joint Bidding Agreement etc. are received in hard copies.

2.10.2 The BID shall be typed and signed in indelible blue ink by the authorized signatory of the Bidder. All the alterations, omissions, additions or any other amendments made to the BID shall be initialed by the person(s) signing the BID.

2.11 Documents comprising Technical and Financial BID

2.11.1 The Bidder shall first upload all the project details, net worth details, turnover details, bridge and tunnel details and all other details required in this RFP for technical qualification. The Bidder shall ensure that all the details are updated as on the due date of submission of this bid.

The Bidder shall then apply for the RFP on the website <https://tender.nprocure.com/> submitting the documents mentioned below along with the supporting documents which shall comprise of the Technical BID on the portal:

Technical Bid

- (a) Appendix-IA (Letter comprising the Technical Bid) including Annexure I-VI and supporting certificates / documents.
- (b) Power of Attorney for signing the BID as per the format at Appendix-III;
- (c) if applicable, Power of Attorney for Lead Member of Joint Venture as per the format at Appendix-IV;
- (d) if applicable, Joint Bidding Agreement for Joint Venture as per the format at Appendix-V;
- (e) Earnest money Deposit (EMD) shall be ₹50.00 Lakhs to be submitted in form

of Bank guarantee in favour of Deendayal Port Authority. EMD in any other form shall not be accepted. Micro and Small Enterprises shall be exempted from submission of EMD as indicated in the NIT conditions.

- (f) The EMD upto Rs. 5 Lakhs be payable by Digital transfer. EMD beyond Rs. 5 Lakhs be payable in the form of Bank Guarantee for the entire amount from any Nationalized / Scheduled Bank (Except Co-Operative Banks) from any branch in India preferably from the local branch where the port is situated. Bank Guarantee submitted as Earnest Money shall be valid for 28 days beyond the validity of the bid. Bank Guarantee shall be verified independently by the Port with the bank before finalization of technical offer. In the event of lack of confirmation of issue of the Bank Guarantee by the Bank, the bid shall stand disqualified.
- (g) In case of Micro and Small Enterprise (MSMEs) holding valid certificate issued by any agencies/ organization under the Ministry of Micro, Small and Medium Enterprise indicating the list of activity related to the subject tender ONLY shall become eligible for exemption from payment of tender fee/ EMD. Such bidder shall upload in Preliminary proposal a scanned copy of valid certificate, as well as duly filled in and signed 'Bid Securing Declaration' as per format provided in the tender document (Appendix-VIII), failing which the bid shall be considered non-responsive. Such bidders shall upload the scanned copy of valid certificate in Preliminary bid. List of activity related to the subject tender as per National Industrial Classification-2008 for exemption of tender fee and EMD.
- (h) Tender Fee ₹5000.00 (+) 18% GST = ₹5900.00 (In Digital mode of Payment) to be remitted through online transfer in Bank of Baroda account no. 10080100022427 - Deendayal Port Authority - (IFSC code BARB0GANKUT). Scanned copy of RTGS no. and date of transfer may be uploaded on (n) procure website;
- (i) Bidder shall comply with the provisions of (Appendix-VI) regarding Integrity Pact (IP) and the Integrity Pact (IP) duly signed by Authorised signatory shall be submitted by the Bidder with the RFP Bid & shall be part of the Contract Agreement;
- (j) An undertaking from the person having PoA referred to in Sub. Clause-(b) above that they agree and abide by the Bid documents uploaded by Deendayal Port Authority and amendments uploaded, if any; and
- (k) Annexure-VII of Appendix – IA showing details of all ongoing project works.
- (l) Copy of Memorandum and Articles of Association, if the Bidder is a body corporate, and if a partnership then a copy of its partnership deed.
- (m) Copies of duly audited complete annual accounts of the Bidder or of each member (in case of Joint Venture) for preceding 5 years.

Financial Bid

- (n) Appendix-IB (Letter comprising the Financial Bid) shall be submitted online through e-procurement portal on or before hrs IST on.....

- 2.11.2 The Bidder shall submit the following documents physically within 7 days from the bid due date:
- a) Appendix-IA (Letter comprising the Technical Bid) including Annexure I-VI and supporting certificates / documents.
 - b) Power of Attorney for signing the BID as per the format at Appendix-III;
 - c) if applicable, Power of Attorney for Lead Member of Joint Venture as per the format at Appendix-IV;
 - d) if applicable, Joint Bidding Agreement for Joint Venture as per the format at Appendix-V;
 - e) Earnest money Deposit (EMD) shall be ₹50.00 Lakhs to be submitted in form of Bank guarantee in favour of Deendayal Port Authority. EMD in any other form shall not be accepted. Micro and Small Enterprises shall be exempted from submission of EMD as indicated in the NIT conditions.
 - f) Tender Fee ₹5000.00 (+) 18% GST = ₹5900.00 (In Digital mode of Payment) to be remitted through online transfer in Bank of Baroda account no. 10080100022427 - Deendayal Port Authority - (IFSC code BARB0GANKUT). Scanned copy of RTGS no. and date of transfer may be uploaded on (n) procure website;
 - g) Integrity Pact (IP) duly signed by Authorised signatory shall be submitted by the Bidder with the RFP Bid & shall be part of the Contract Agreement;
 - h) An undertaking from the person having PoA referred to in Sub. Clause-(b) above that they agree and abide by the Bid documents uploaded by Deendayal Port Authority and amendments uploaded, if any; and
 - i) Annexure-VII of Appendix – IA showing details of all ongoing project works.
 - j) Copy of Memorandum and Articles of Association, if the Bidder is a body corporate, and if a partnership then a copy of its partnership deed.
 - k) Copies of duly audited complete annual accounts of the Bidder or of each member (in case of Joint Venture) for preceding 5 years.
- 2.11.3 The documents listed at clause 2.11.2 shall be placed in an envelope, which shall be sealed. The envelope shall clearly bear the identification “**BID for the Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat on EPC Mode**” and shall clearly indicate the name and address of the Bidder. In addition, the BID Due Date should be indicated on the right hand top corner of the envelope.
- 2.11.4 The envelope shall be addressed to the following officer and shall be submitted at the respective address:
- Executive Engineer (TD),
TD Division
Administrative Office Building
Room No – 105, Annexe, Post Box-50
Gandhidham-370201
Kutch District, Gujarat, India
Email: tddivisionkpt@gmail.com

2.11.5 If the envelope is not sealed and marked as instructed above, the Authority assumes no responsibility for the misplacement or premature opening of the contents of the BID submitted and consequent losses, if any, suffered by the Bidder.

2.11.6 BIDs submitted by fax, telex, telegram or e-mail shall not be entertained and shall be summarily rejected.

2.12 BID Due Date

Financial BID comprising of the documents listed at clause 2.11.1 of the RFP shall be submitted online through e-procurement website <https://tender.nprocure.com/> on or before hrs IST on Documents listed at clause 2.11.2 of the RFP shall be physically submitted on or hrs IST on at the address provided in Clause 2.11.4 in the manner and form as detailed in this RFP.

2.13 Late BIDs

E-procurement portal website <https://tender.nprocure.com/> shall not allow submission of any Bid after the prescribed date and time at clause 2.12. Physical receipt of documents listed at clause 2.11.2 of the RFP after the prescribed date and time at clause 2.12 shall not be considered and the bid shall be summarily rejected.

2.14 Submission of bids

2.14.1 Accessing/ Purchasing of BID documents

In case bidders need any clarifications or if training is required to participate in online tenders, they can contact (n) Procure Support team at following address: -

(n) code Solutions – A division of GNFC Ltd., (n)Procure Cell,

403, GNFC Info tower, S.G. Road, Bodakdev, Ahmedabad – 380054 (Gujarat).

Contact Details :

Airtel : +91-79-40007501, 40007512, 40007516, 40007517, 40007525

BSNL : +91-79-2684511, 26854512, 26854513 (EXT: 501, 512, 516, 517, 525)

Reliance : +91-79-30181689

Fax : +91-79-26857321, 40007533

E-mail : nprocure@gnvfc.net

TOLL FREE NUMBER : 1-800-233-1010 (EXT: 501, 512, 516, 517, 525)

2.14.2 Preparation & Submission of BIDs:

2.14.2.1 The Bidder may be submitted his Bid online following the instruction appearing

on the n procure website.

- 2.14.2.2 Bid must be submitted online only through e-procurement portal of DPA <https://tender.nprocure.com/> the digital signature of authorised representative of the Bidder on before __/__/2024. (up to 1500 hours IST).

2.14.3 Modifications/ Substitution/ withdrawal of BIDs

- 2.14.3.1 The Bidder may modify, substitute or withdraw its e- BID after submission prior to the BID Due Date. No BID can be modified, substituted or withdrawn by the Bidder on or after the BID Due Date & Time.

- 2.14.3.2 For modification of e-BID, Bidder has to detach its old BID from e-procurement portal and upload / resubmit digitally signed modified BID. For withdrawal of BID, bidder has to click on withdrawal icon at e-procurement portal and can withdraw its e-BID. Before withdrawal of a BID, it may specifically be noted that after withdrawal of a BID for any reason, Bidder cannot re-submit e-BID again.

2.15 Online Opening of BIDs.

- 2.15.1 Opening of BIDs will be done through online process.

- 2.15.2 The DPA shall on-line open Preliminary Bid / Technical BIDs on __/__/2024 at 1530 hours IST, in the presence of the authorized representatives of the Bidders, who choose to attend. Technical BID of only those bidders shall be online opened whose documents listed at clause 2.11.2 of the RFP have been physically received. The DPA will subsequently examine and evaluate the BIDs in accordance with the provisions of Section 3 of RFP.

2.16 Rejection of BIDs

- 2.16.1 Notwithstanding anything contained in this RFP, the Authority reserves the right to reject any BID and to annul the Bidding Process and reject all BIDs at any time without any liability or any obligation for such acceptance, rejection or annulment, and without assigning any reasons thereof. In the event that the Authority rejects or annuls all the BIDs, it may, in its discretion, invite all eligible Bidders to submit fresh BIDs hereunder.

- 2.16.2 The Authority reserves the right not to proceed with the Bidding Process at any time, without notice or liability, and to reject any BID without assigning any reasons.

2.17 Validity of BIDs

The BIDs shall be valid for a period of not less than 120 (one hundred and twenty) days from the BID Due Date. The validity of BIDs may be extended by mutual consent of the respective Bidders and the Authority.

2.18 Confidentiality

Information relating to the examination, clarification, evaluation and

recommendation for the Bidders shall not be disclosed to any person who is not officially concerned with the process or is not a retained professional advisor advising the Authority in relation to, or matters arising out of, or concerning the Bidding Process. The Authority will treat all information, submitted as part of the BID, in confidence and will require all those who have access to such material to treat the same in confidence. The Authority may not divulge any such information unless it is directed to do so by any statutory entity that has the power under law to require its disclosure or is to enforce or assert any right or privilege of the statutory entity and / or the Authority or as may be required by law or in connection with any legal process.

2.19 Correspondence with the Bidder

Save and except as provided in this RFP, the Authority shall not entertain any correspondence with any Bidder in relation to acceptance or rejection of any BID.

D. BID SECURITY

2.20 BID Security

1. Earnest money Deposit (EMD) shall be ₹50.00 Lakhs to be submitted in form of Bank guarantee in favour of Deendayal Port Authority. EMD in any other form shall not be accepted. Micro and Small Enterprises shall be exempted from submission of EMD as indicated in the NIT conditions.
2. The EMD up to Rs. 5 lakhs be payable by Digital transfer. EMD beyond Rs.5 lakhs be payable in the form of Bank Guarantee for the entire amount from any Nationalized / Scheduled Bank (Except Co-Operative Banks) from any branch in India preferably from the local branch where the port is situated. Bank Guarantee submitted as Earnest Money shall be valid for 28 days beyond the validity of the bid. Bank Guarantee shall be verified independently by the Port with the bank before finalization of technical offer. In the event of lack of confirmation of issue of the Bank Guarantee by the Bank, the bid shall stand disqualified.
3. EMD of unsuccessful bidders other than L1 and L2 be refunded immediately after ranking of price bids. Earnest Money of L2 be refunded immediately after entering into agreement with L1 and acceptance of Performance Guarantee from L1.
4. In case of Micro and Small Enterprise (MSMEs) holding valid certificate issued by any agencies/ organization under the Ministry of Micro, Small and Medium Enterprise indicating the list of activity related to the subject tender ONLY shall become eligible for exemption from payment of tender fee/ EMD. Such bidder shall upload in Preliminary proposal a scanned copy of valid certificate, as well as duly filled in and signed 'Bid Securing Declaration' as per format provided in the tender document (Appendix VIII), failing which the bid shall be considered nonresponsive. Such bidders shall upload the scanned copy of valid certificate in Preliminary bid. List of activity related to the subject tender as per National Industrial Classification-2008 for exemption of tender fee and EMD are listed below"

NIC codes regarding related activity are mentioned below:

Level	Description
Section F	Construction
Division 42	Civil engineering
Group 421	Construction of roads and railways

5. EMD shall be refunded suo-motto without any application from the bidders.
6. The Bid Security of the successful bidder will be discharged after he has signed the Agreement and furnished the required Performance Security.
7. Forfeiture of earnest money.

Bid security (Earnest Money) shall be forfeited, if

- a. The bidder withdraws the bid after bid opening during the period of bid validity.
- b. The bidder does not accept the correction of the Bid price, if any.
- c. The Selected bidder fails within the specified time limit to
 - i. Sign the Agreement or
 - ii. Furnish the required Performance security.
 - iii. In case the contractor fails to commence the work within stipulated time.

2.21 Performance Security

- 2.21.1 Security Deposit shall be 10% of Contract price of which 5% of contract price should be submitted as Bank Guarantee/Digital transfer/FDR within 21 days of receipt of Letter of Acceptance and balance 5% recovered as Retention Money from Running Bills. Recovery of 5% of Retention Money to commence from the first bill onwards @ 5% of bill value from each bill. Retention Money be refunded within 14 days from the date of payment of final bill. Balance SD to be refunded immediately not later than 14 days from completion of Maintenance Period & NOC from Geology Department.
- 2.21.2 Failure of the successful Bidder to comply with the requirements of Sub-Clause 2.21.1 shall constitute sufficient grounds for cancellation of the award of work and forfeiture of the Bid security.
- 2.21.3 The documentary evidence (copy of paid Challan in Govt. Treasury) of Welfare Cess @ 1% of work done or as amended by Statutory Authority from time to time, paid on final bill shall be submitted before releasing the Performance Guarantee.

SECTION-3
EVALUATION OF TECHNICAL BIDS AND OPENING & EVALUATION OF
FINANCIAL BIDS

3.1 Evaluation of Technical Bids

- 3.1.1 The Authority shall open the BIDs received online at **hours IST on**, at the place specified in Clause 2.11.4; and in the presence of the Bidders who choose to attend. Technical BID of only those Bidders shall be online opened whose documents listed at clause 2.11 of the RFP have been received physically.
- 3.1.2 Technical Bids of those Bidders who have not submitted their Bid online, shall not be considered for opening and evaluation.
- 3.1.3 If any information furnished by the Bidder is found to be incomplete, or contained in formats other than those specified herein, the Authority may, in its sole discretion, exclude the relevant information for consideration of eligibility and qualification of the Bidder.
- 3.1.4 To facilitate evaluation of Technical BIDs, the Authority may, at its sole discretion, seek clarifications in writing from any Bidder regarding its Technical BID. Such clarification(s) shall be provided within the time specified by the Authority for this purpose. Any request for clarification(s) and all clarification(s) in response thereto shall be in writing. The bids will be examined and evaluated in accordance with the provisions set out in this Section 3. The Authority will subsequently flag issues, if any with the data updated by the Bidders.
- 3.1.5 If a Bidder does not provide clarifications sought under Clause 3.1.4 above within the prescribed time, its Bid may be liable to be rejected. In case the Bid is not rejected, the Authority may proceed to evaluate the Bid by construing the particulars requiring clarification to the best of its understanding, and the Bidder shall be barred from subsequently questioning such interpretation of the Authority.
- 3.1.6 Tests of responsiveness
- 3.1.6.1 As a first step towards evaluation of Technical BIDs, the Authority shall determine whether each Technical BID is responsive to the requirements of this RFP. A Technical BID shall be considered responsive only if:
- (a) Technical BID is received online as per the format at Appendix-IA including Annexure I, IV, V and VI(Bid Capacity format);
 - (b) Documents listed at clause 2.11 are received as mentioned;
 - (c) Technical Bid is accompanied by the BID Security as specified in Clause 1.2.4 and 2.20;
 - (d) The Power of Attorney is uploaded on e-procurement portal as specified in Clauses 2.1.5;

- (e) Technical Bid is accompanied by Power of Attorney for Lead Member of Joint Venture and the Joint Bidding Agreement as specified in Clause 2.1.6, if so required;
- (f) Technical Bid contains all the information (complete in all respects);
- (g) Technical Bid does not contain any condition or qualification; and
- (h) Copy of Online receipt ₹5000.00 (+) 18% GST=₹5900.00 (In Digital mode of Payment at Bank of Baroda Gandhidham Branch Account No.-10080100022427 IFSC code – BARB0GANKUT) towards payment of cost of Bid document.;

3.1.6.2 The Authority reserves the right to reject any Technical BID which is non-responsive and no request for alteration, modification, substitution or withdrawal shall be entertained by the Authority in respect of such BID.

3.1.7 In the event that a Bidder claims credit for an Eligible Project, and such claim is determined by the Authority as incorrect or erroneous, the Authority may reject / correct such claim for the purpose of qualification requirements.

3.1.8 The Authority will get the BID security verified from the issuing authority.

3.1.9 After evaluation of Technical Bids, the Authority will inform to Technically Responsive Bidders whose financial bids shall be opened. The Authority shall notify other Bidders that they have not been technically responsive. The Authority will not entertain any query or clarification from Applicants who fail to qualify.

3.2 Opening and Evaluation of Financial Bids

The Authority shall inform the venue and time of online opening of the Financial Bids to the technically responsive Bidders through e-procurement portal and e-mail. The Authority shall open the online Financial Bids of the technically responsive Bidders only on scheduled date and time in the presence of the authorised representatives of the Bidders who may choose to attend. The Authority shall publicly announce the Bid Prices quoted by the technically responsive Bidder. Thereafter, the Authority shall prepare a record of opening of Financial Bids.

3.3 Selection of Bidder

3.3.1 Subject to the provisions of Clause 2.16.1, the Bidder whose BID is adjudged as responsive in terms of Clause 3.1.6 and who quotes lowest price shall be declared as the selected Bidder (the “**Selected Bidder**”).

3.3.2 In the event that two or more Bidders quote the same BID Price (the “**Tie BIDs**”), the Authority shall identify the Selected Bidder by draw of lots, which shall be conducted, with prior notice, in the presence of the Tie Bidders who choose to attend.

3.3.3 In the event that the Lowest Bidder is not selected for any reason except the reason mentioned in Clause 2.1.12 (b) (4), the Authority shall annul the Bidding Process and

invite fresh BIDs. In the event that the Authority rejects or annuls all the BIDs, it may, in its discretion, invite all eligible Bidders to submit fresh BIDs hereunder.

- 3.3.4 After selection, a Letter of Acceptance (the “**LOA**”) shall be issued in the format set forth in Appendix-VIII, in duplicate, by the Authority to the Selected Bidder and the Selected Bidder shall, within 7(seven) days of the receipt of the LOA, sign and return the duplicate copy of the LOA in acknowledgement thereof. In the event the duplicate copy of the LOA duly signed by the Selected Bidder is not received by the stipulated date, the Authority may, unless it consents to extension of time for submission thereof, appropriate the BID Security of such Bidder as Damages on account of failure of the Selected Bidder to acknowledge the LOA.
- 3.3.5 After acknowledgement of the LOA as aforesaid by the Selected Bidder, it shall cause the Bidder to submit Performance Security and Additional Performance Security (if any) within the period prescribed/extended by Authority and then execute the Agreement within the period prescribed in Clause 1.3. The Selected Bidder shall not be entitled to seek any deviation, modification or amendment in the Agreement.
- 3.3.6 EMD of unsuccessful bidders other than L1 and L2 be refunded immediately after ranking of price bids. Earnest Money of L2 be refunded immediately after entering into agreement with L1 and acceptance of Performance Guarantee from L1.

3.4 Contacts during BID Evaluation

BIDs shall be deemed to be under consideration immediately after they are opened and until such time the Authority makes official intimation of award/ rejection to the Bidders. While the BIDs are under consideration, Bidders and/ or their representatives or other interested parties are advised to refrain, save and except as required under the Bidding Documents, from contacting by any means, the Authority and/ or their employees/ representatives on matters related to the BIDs under consideration.

3.5 Correspondence with Bidder

Save and except as provided in this RFP, the Authority shall not entertain any correspondence with any Bidder in relation to the acceptance or rejection of any Bid.

- 3.6 Any information contained in the Bid shall not in any way be construed as binding on the Authority, its agents, successors or assigns, but shall be binding against the Bidder if the Project is subsequently awarded to it on the basis of such information.

SECTION-4

FRAUD AND CORRUPT PRACTICES

- 4.1 The Bidders and their respective officers, employees, agents and advisers shall observe the highest standard of ethics during the Bidding Process and subsequent to the issue of the LOA and during the subsistence of the Agreement. Notwithstanding anything to the contrary contained herein, or in the LOA or the Agreement, the Authority may reject a BID, withdraw the LOA, or terminate the Agreement, as the case may be, without being liable in any manner whatsoever to the Bidder, if it determines that the Bidder, directly or indirectly or through an agent, engaged in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice in the Bidding Process. In such an event, the Authority shall be entitled to forfeit and appropriate the BID Security or Performance Security, as the case may be, as Damages, without prejudice to any other right or remedy that may be available to the Authority under the Bidding Documents and/ or the Agreement, or otherwise.
- 4.2 Without prejudice to the rights of the Authority under Clause 4.1 hereinabove and the rights and remedies which the Authority may have under the LOA or the Agreement, or otherwise if a Bidder or Contractor, as the case may be, is found by the Authority to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice during the Bidding Process, or after the issue of the LOA or the execution of the Agreement, such Bidder shall not be eligible to participate in any tender or RFP issued by the Authority during a period of 2 (two) years from the date such Bidder, or Contractor, as the case may be, is found by the Authority to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practices, as the case may be.
- 4.3 For the purposes of this Section 4, the following terms shall have the meaning hereinafter respectively assigned to them:
- (a) “corrupt practice” means the offering, giving, receiving or soliciting of anything of value, pressurizing to influence the action of a public official in the process of tendering and execution of the project;
 - (b) “fraudulent practice” means a misrepresentation or omission of facts or suppression of facts or disclosure of incomplete facts, in order to influence the Bidding Process;
 - (c) “coercive practice” means impairing or harming, or threatening to impair or harm, directly or indirectly, any person or property to influence any person’s participation or action in the Bidding Process;
 - (d) “undesirable practice” means (i) establishing contact with any person connected with or employed or engaged by the Authority with the objective of canvassing, lobbying or in any manner influencing or attempting to influence the Bidding Process; or (ii) having a Conflict of Interest; and
 - (e) “restrictive practice” means forming a cartel or arriving at any understanding or arrangement among Bidders with the objective of restricting or manipulating a full and fair competition in the Bidding Process.

SECTION-5

PRE-BID CONFERENCE

- 5.1 Pre-BID conference of the Bidders shall be held online only at designated date & time. From 18.03.2024 on 16:00 Hrs Link : <https://meet.google.com/mgs-aycm-ejx>
- 5.2 During the course of Pre-Bid conference(s), the Bidders will be free to seek clarifications on email id: tddivisionkpt@gmail.com and make suggestions for consideration of the Authority. The Authority shall endeavor to provide clarifications and such further information as it may, in its sole discretion, consider appropriate for facilitating a fair, transparent and competitive Bidding Process.

SECTION-6
MISCELLANEOUS

- 6.1 The Bidding Process shall be governed by, and construed in accordance with, the laws of India and the Courts at Gandhidham shall have exclusive jurisdiction over all disputes arising under, pursuant to and/ or in connection with the Bidding Process.
- 6.2 The Authority, in its sole discretion and without incurring any obligation or liability, reserves the right, at any time, to;
- (a) suspend and/ or cancel the Bidding Process and/ or amend and/ or supplement the Bidding Process or modify the dates or other terms and conditions relating thereto;
 - (b) consult with any Bidder in order to receive clarification or further information;
 - (c) retain any information and/ or evidence submitted to the Authority by, on behalf of, and/ or in relation to any Bidder; and/ or
 - (d) independently verify, disqualify, reject and/ or accept any and all submissions or other information and/ or evidence submitted by or on behalf of any Bidder.
- 6.3 It shall be deemed that by submitting the Bid, the Bidder agrees and releases the Authority, its employees, agents and advisers, irrevocably, unconditionally, fully and finally from any and all liability for claims, losses, damages, costs, expenses or liabilities in any way related to or arising from the exercise of any rights and/ or performance of any obligations hereunder, pursuant hereto and/ or in connection with the Bidding Process and waives, to the fullest extent permitted by applicable laws, any and all rights and/ or claims it may have in this respect, whether actual or contingent, whether present or in future.

APPENDIX -IA
LETTER COMPRISING THE TECHNICAL BID
(Refer Clause 2.1.4, 2.11 and 3.1.6)

To,
Executive Engineer (TD),
TD Division,
Administrative Office Building
Room No – 105, Annexe, Post Box-50
Gandhidham-370201
Kutch District -Gujarat, India
Email: tddivisionkpt@gmail.com

Sub: BID for “Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat on EPC Mode”.

Dear Sir,

With reference to your RFP document dated *** **\$, I/we, having examined the Bidding Documents and understood their contents, hereby submit my/our BID for the aforesaid Project. The BID is unconditional and unqualified.

2. I/ We acknowledge that the Authority will be relying on the information provided in the BID and the documents accompanying the BID for selection of the Contractor for the aforesaid Project, and we certify that all information provided in the Bid and its the Annexure I to VI along with the supporting documents are true and correct; nothing has been omitted which renders such information misleading; and all documents accompanying the BID are true copies of their respective originals.
3. This statement is made for the express purpose of our selection as EPC Contractor for the development, construction, rehabilitation and augmentation of the aforesaid Project and maintenance of the Project during the Defect Liability Period.
4. I/ We shall make available to the Authority any additional information it may find necessary or require to supplement or authenticate the BID.
5. I/ We acknowledge the right of the Authority to reject our BID without assigning any reason or otherwise and hereby waive, to the fullest extent permitted by applicable law, our right to challenge the same on any account whatsoever.
6. I/ We certify that in the last two years, we/ any of the JV partners have neither failed to perform for the works of Expressways, National Highways, ISC & EI works,, as evidenced by imposition of a penalty by an arbitral or judicial authority or a judicial pronouncement or arbitration award against us, nor been expelled or terminated by DEENDAYAL PORT AUTHORITY or its implementing agencies for breach on our part.

7. I/ We declare that:
- (a) I/ We have examined and have no reservations to the Bidding Documents, including any Addendum issued by the Authority; and
 - (b) I/We do not have any conflict of interest in accordance with Clauses 2.2.1 (c) and 2.6.4 of the RFP document; and
 - (c) I/We have not directly or indirectly or through an agent engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice, as defined in Clause 4.3 of the RFP document, in respect of any tender or request for proposal issued by or any Agreement entered into with the Authority or any other public sector enterprise or any government, Central or State; and
 - (d) I/ We hereby certify that we have taken steps to ensure that in conformity with the provisions of Section 4 of the RFP, no person acting for us or on our behalf has engaged or will engage in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice; and
 - (e) the undertakings given by us along with the Application in response to the RFP for the Project and information mentioned for the evaluation of the BID Capacity in Annexure VI were true and correct as on the date of making the Application and are also true and correct as on the BID Due Date and I/we shall continue to abide by them.
8. I/ We understand that you may cancel the Bidding Process at any time and that you are neither bound to accept any BID that you may receive nor to invite the Bidders to BID for the Project, without incurring any liability to the Bidders, in accordance with Clause 2.16.2 of the RFP document.
9. I/We believe that we/our Joint Venture satisfy(s) the Threshold Technical Capacity, Net Worth criteria and meet(s) the requirements as specified in the RFP document.
10. I/ We declare that we/ any Member of the Joint Venture or our/Joint Venture member, are not a Member of any other Joint Venture submitting a BID for the Project.
11. I/ We certify that in regard to matters other than security and integrity of the country, we/ any Member of the Joint Venture or any of our/their Joint venture member have not been convicted by a Court of Law or indicted or adverse orders passed by a regulatory authority which could cast a doubt on our ability to undertake the Project or which relates to a grave offence that outrages the moral sense of the community.
12. I/ We further certify that in regard to matters relating to security and integrity of the country, we/ any Member of the Joint Venture or any of our/their Joint venture member have not been charge-sheeted by any agency of the Government or convicted by a Court of Law.
13. I/ We further certify that no investigation by a regulatory authority is pending either

against us/any member of Joint Venture or against our CEO or any of our directors/ managers/ employees.

14. I/ We further certify that we are not disqualified in terms of the additional criteria specified by the Department of Disinvestment in their OM No. 6/4/2001-DD-II dated 13.7.01, a copy of which forms part of the RFP at Annexure VII of Appendix-IA thereof.
15. I/ We undertake that in case due to any change in facts or circumstances during the Bidding Process, we are attracted by the provisions of disqualification in terms of the guidelines referred to above, we shall intimate the Authority of the same immediately.
16. I/We further acknowledge and agree that in the event such change in control occurs after signing of the Agreement upto its validity. It would, notwithstanding anything to the contrary contained in the Agreement, be deemed a breach thereof, and the Agreement shall be liable to be terminated without the Authority being liable to us in any manner whatsoever.
17. I/ We hereby irrevocably waive any right or remedy which we may have at any stage at law or howsoever otherwise arising to challenge or question any decision taken by the Authority in connection with the selection of the Bidder, or in connection with the Bidding Process itself, in respect of the above mentioned Project and the terms and implementation thereof.
18. In the event of my/ our being declared as the Selected Bidder, I/we agree to enter into a Agreement in accordance with the draft that has been provided to me/us prior to the BID Due Date. We agree not to seek any changes in the aforesaid draft and agree to abide by the same.
19. I/ We have studied all the Bidding Documents carefully and also surveyed the [project highway and the traffic]. We understand that except to the extent as expressly set forth in the Agreement, we shall have no claim, right or title arising out of any documents or information provided to us by the Authority or in respect of any matter arising out of or relating to the Bidding Process including the award of Agreement.
20. I/ We offer a BID Security of ₹50.00 Lakhs (Rupees Fifty Lakhs only) to the Authority in accordance with the RFP Document.
21. The BID Security in the form of a Bank Guarantee is attached.
22. The documents accompanying the Technical BID, as specified in Clause 2.11.1 of the RFP, have been submitted in separate files.
23. I/ We agree and understand that the BID is subject to the provisions of the Bidding Documents. In no case, I/we shall have any claim or right of whatsoever nature if the

Project / Contract is not awarded to me/us or our BID is not opened or rejected.

24. The BID Price has been quoted by me/us after taking into consideration all the terms and conditions stated in the RFP, draft Agreement, our own estimates of costs and after a careful assessment of the site and all the conditions that may affect the project cost and implementation of the project.
25. I/ We agree and undertake to abide by all the terms and conditions of the RFP document.
26. {We, the Joint Venture agree and undertake to be jointly and severally liable for. all the obligations of the EPC Contractor under the Contract Agreement}.
27. I/ We shall keep this offer valid for 120 (one hundred and twenty) days from the BID Due Date specified in the RFP.
28. I/ We hereby submit our BID and offer a BID Price as indicated in Financial Bid for undertaking the aforesaid Project in accordance with the Bidding Documents and the Agreement.

In witness thereof, I/we submit this BID under and in accordance with the terms of the RFP document.

Yours faithfully,

Date:

Place:

(Signature, name and designation
of the Authorised signatory)

Name & seal of Bidder/Lead Member

Note: Paragraphs in curly parenthesis may be omitted by the Bidder, if not applicable to it, and 'Deleted' may be indicated there

APPENDIX - IB
Letter comprising the Financial BID
(Refer Clauses 2.1.4, 2.11 and 3.1.6)

Dated:

To,
Executive Engineer (TD),
TD Division,
Administrative Office Building
Room No – 105, Annexe, Post Box-50
Gandhidham-370201
Kutch District -Gujarat, India
Email: tddivisionkpt@gmail.com

Sub: BID for “Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat on EPC Mode”.

Dear Sir,

With reference to your RFP document dated *** **, I/we, having examined the Bidding Documents and understood their contents, hereby submit my/our BID for the aforesaid Project. The BID is unconditional and unqualified.

2. I/ We acknowledge that the Authority will be relying on the information provided in the BID and the documents accompanying the BID for selection of the Contractor for the aforesaid Project, and we certify that all information provided in the Bid are true and correct; nothing has been omitted which renders such information misleading; and all documents accompanying the BID are true copies of their respective originals.
3. The BID Price has been quoted by me/us after taking into consideration all the terms and conditions stated in the RFP, draft Agreement, our own estimates of costs and after a careful assessment of the site and all the conditions that may affect the project cost and implementation of the project.
4. I/ We acknowledge the right of the Authority to reject our BID without assigning any reason or otherwise and hereby waive, to the fullest extent permitted by applicable law, our right to challenge the same on any account whatsoever.
5. In the event of my/ our being declared as the Selected Bidder, I/we agree to enter into a Agreement in accordance with the draft that has been provided to me/us prior to the BID Due Date. We agree not to seek any changes in the aforesaid draft and agree to abide by the same.
6. I/ We shall keep this offer valid for 120 (one hundred and twenty) days from the BID Due Date specified in the RFP.
7. I/ We hereby submit our BID and offer a BID Price Rs.....
(Rs..... in words) (+GST) for undertaking the aforesaid Project in accordance with the Bidding Documents and the Agreement.

Yours faithfully,

Date:
Place:

(Signature, name and designation of the
Authorised Signatory)
Name & seal of Bidder/Signatory

ANNEX-I Details of Bidder

1.
 - (a) Name
 - (b) Country of incorporation:
 - (c) Address of the corporate headquarters and its branch office(s), if any, in India
 - (d) Date of incorporation and/ or commencement of business:
2. Brief description of the Bidder including details of its main lines of business and proposed role and responsibilities in this Project:
3. Details of individual(s) who will serve as the point of contact/ communication for the Authority:
 - (a) Name:
 - (b) Designation:
 - (c) Company:
 - (d) Address:
 - (e) Telephone Number:
 - (f) E-Mail Address:
 - (g) Fax Number:
4. Particulars of the Authorised Signatory of the Bidder:
 - (a) Name:
 - (b) Designation:
 - (c) Address:
 - (d) Phone Number:
 - (e) Fax Number:
 - (f) Class III Digital Signature Certificate ID number
5. In case of a Joint Venture:
 - (a) The information above (1-4) should be provided for all the Members of the Joint Venture.
 - (b) A copy of the Jt. Bidding Agreement, as envisaged in Clause 2.1.11(f) should be attached to the Application.
 - (c) Information regarding the role of each Member should be provided as per table below:

Sl.	Name of Member	Role* {Refer Clause 2.1.11(d)} ^{\$}	Share of work in the Project {Refer Clauses 2.1.11(a), (f) & (g)}
1.			
2.			
3.			

* The role of each Member, as may be determined by the Applicant, should

be indicated in accordance with instruction 4 at Annex-IV.

(d) The following information shall also be provided w.r.t para 2.1.14 for each Member of the Joint Venture:

Name of Applicant/ member of Joint Venture:

Sl. No.	Criteria	Yes/No
1.	Has the Bidder/ constituent of the Joint Venture been barred by the DEENDAYAL PORT AUTHORITY or its implementing agencies for the works of Expressways, National Highways, ISC and EI works, from participating in bidding.	
2	If the answer to 1 is yes, does the bar subsist as on BID due date.	

6(a) I/ We certify that in the last two years, we/ any of the JV partners have neither failed to perform for the works of Expressways, National Highways, ISC & EI works, as evidenced by imposition of a penalty by an arbitral or judicial authority or a judicial pronouncement or arbitral award against us, nor been expelled or terminated by DEENDAYAL PORT AUTHORITY or its implementing agencies for breach on our part.

(b) I/ We certify that we/ any of the JV partners do not fall in any of the categories of being a Non-Performing entity given at Clause 2.1.14 of Instructions to Bidders in the projects of Expressways, National Highways, ISC and EI works of DEENDAYAL PORT AUTHORITY or its implementing agencies and furnished the complete details.

7(a) I/ We further certify that no investigation by a regulatory authority is pending either against us/any member of Joint Venture or our sister concern or against our CEO or any of our directors/managers/employees.

(b) I/ We further certify that no investigation by any investigating agency in India or outside is pending either against us/ any member of Joint Venture or our sister concern or against our CEO or any of our directors/managers/employees.

A statement by the Bidder and each of the Members of its Joint Venture (where applicable) disclosing material non-performance or contractual non-compliance in current projects, as on bid due date is given below (attach extra sheets, if necessary) w.r.t. para 2.1.14.

Name of the Bidder /Member of JV: _____

Sr. No.	Categories of Non-Performer	Project 1	Project 2
(i)	Fails to complete or has missed more than two milestones in already awarded two or more projects, even after lapse of 6 months from the scheduled completion date, unless Extension of Time has been allowed on the recommendations of the Independent Engineer due to Authority's default;		
(ii)	Fails to complete a project, as per revised schedule, for which One Time Fund Infusion (OTFI) has been sanctioned by the Authority;		
(iii)	Physical progress on any project is not commensurate with the funds released (equity+ debt+grant) from the escrow account and such variation is more than 25% in last one year as observed by the Independent Engineer in one or more projects;		
(iv)	Punch List Items in respect of any project are pending due to Bidder's default in two or more Projects even after lapse of the prescribed time for completion of such items;		
(v)	Fails to fulfil its obligations to maintain a highway in a satisfactory condition inspite of two rectification notices issued in this behalf;		
(vi)	Fails to attend to Non Conformity Reports (NCRs) issued by the Independent/ Authority's Engineer on the designs/ works constructed by the Bidder pending for more than one year in two or more projects.		
(vii)	Fails to make premium payments excluding the current instalment in one or more projects.		
(viii)	Damages/Penalties recommended by the Independent/ Authority's Engineer on the Bidder during O&M period and the remedial works are not taken up in two or more projects.		
(ix)	Fails to achieve financial closure in two or more projects within the given or extended period (which shall not be more than six months in any case).		
(x)	Fails to submit the Performance Security within the permissible period in more than one project(s).		

(xi)	Rated as an unsatisfactory performing entity/ non-performing entity by an independent third party agency and so notified on the website of the Authority.		
------	---	--	--

I/ We certify that the list is complete and covers all the projects of Expressways, National Highways, ISC and EI works of DEENDAYAL PORT AUTHORITY or its implementing agencies and that we/ any of the JV partners do not fall in any of the above categories of being a Non-Performing entity.

(Signature, name and designation of the authorised signatory) For and on behalf of.....

Appendix IA
Annex-II
ANNEX-II

Technical Capacity of the Bidder@

(Refer to Clauses 2.2.2.2, 2.2.2.5 and 2.2.2.7 of the RFP)

Applicant type	Project Code*	Category\$	Experience** (Equivalent Rs. crore)\$§		Technical Experience£
			Payments received for construction of Eligible Projects in Categories 3 & 4	Value of self-construction in Eligible Projects in Categories 1 and 2	
(1)	(2)	(3)	(4)	(5)	(6)
Single entity Bidder or Lead Member including other members of the Joint Venture	a				
	b				
	c				
	d				
	e				
	f				
Aggregate Technical Experience =					

@ Provide details of only those projects that have been undertaken by the Applicant, or its Lead member including members in case of joint venture, under its own name separately and/ or by a project company eligible under Clause 2.2.2.6(i)(b). In case of Categories 1 and 2, include only those projects which have an estimated capital cost exceeding the amount specified in Clause 2.2.2.6(i)(c) and for Categories 3 and 4, include only those projects where the payments received exceed the amount specified in Clause 2.2.2.6(ii). In case the Bid Due Date falls within 3 (three) months of the close of the latest financial year, refer to Clause 2.1.13.

* Refer Annex-IV of this Appendix-I. Add more rows if necessary.

\$ Refer Clause 2.2.2.5(i)

** Construction shall not include supply of goods or equipment except when such goods or equipment form part of a turn-key construction contract/ EPC contract for the project. In no case shall the cost of maintenance and repair, operation of Highways and land be included while computing the Experience Score of an Eligible Project.

§§ For conversion of US Dollars to Rupees, the rate of conversion shall be Rupees ** (**) ¹³ to a US Dollar.

£. In the case of an Eligible Project situated in an OECD country, the Experience Score so arrived at shall be further multiplied by 0.5, in accordance with the provisions of Clause 2.2.2.5(ii) and the product thereof shall be the Experience Score for such Eligible Projects.

¹³ The conversion rate of USD into Rupees shall be the daily representative exchange rates published by the Reserve Bank of India for the relevant date. Where relevant date should be as on the date 28 (twenty eight) days

prior to the Bid Due Date.

NOTE: In case of a Joint Venture, information in Annex-II and Annex-IV of Appendix-I A shall be provided separately for other Members so as to establish that each such Member has 20 percent or more of the Threshold Technical Capacity. *(Refer Clause 2.2.2.4).*

Appendix IA
Annex-III
ANNEX-III
Financial Capacity of the Bidder
(Refer to Clauses 2.2.2.3, 2.2.2.9(i), 2.2.2.8(iii) of the RFP)
(In Rs. crore[§])

Bidder type	Net Cash Accruals					Net Worth [£]
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 1
Single entity Bidder or Lead Member including other members of the Joint Venture						
TOTAL						

Bidder type	Annual Turnover										Average
	Year 1		Year 2		Year 3		Year 4		Year 5		Annual
	(Rs.)	Updatio n factor	(Rs.)	Updatio n factor	(Rs.)	Updatio n factor	(Rs.)	Updatio n factor	(Rs.)	Updatio n factor	Turnover (In Rs. crore\$)
1	2	3	4	5	6	7	8	9	10	11	(2x3+4x5+6 x 7+8x9+10x 11)/5
Single entity Bidder or Lead Member including other members of the Joint Venture		1.00		1.09		1.24		1.25		1.27	

Name & address of Bidder's Bankers:

[§] For conversion of other currencies into rupees, see note below Annex-II of Appendix-I.

[£] The Bidder should provide details of its own Financial Capacity.

Instructions:

- The Bidder shall attach copies of the balance sheets, financial statements and Annual Reports for 5 (five) years preceding the Bid Due Date. The financial statements shall:
 - reflect the financial situation of the Bidder;
 - be audited by a statutory auditor;
 - be complete, including all notes to the financial statements; and
 - correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

2. Net Cash Accruals shall mean Profit After Tax + Depreciation.
3. Net Worth (the “Net worth”) shall means the aggregate value of the paid-up share capital and all reserves created out of the profits and securities premium account, after deducting the aggregate value of the accumulated losses, deferred expenditure and miscellaneous expenditure not written off, as per the audited balance sheet, but does not include reserves created out of revaluation of assets, write-back of depreciation and amalgamation.
4. Year 1 will be the latest completed financial year, preceding the bidding. Year 2 shall be the year immediately preceding Year 1 and so on. In case the Bid Due Date falls within 3 (three) months of the close of the latest financial year, refer to Clause 2.1.13.
5. In the case of a Joint Venture, a copy of the Jt. Bidding Agreement shall be submitted in accordance with Clause 2.1.15 (g) of the RFP document.
6. The Bidder shall also provide the name and address of the Bankers to the Bidder.
7. The Bidder shall provide an Auditor’s Certificate specifying the net worth of the Bidder and also specifying the methodology adopted for calculating such net worth in accordance with Clause 2.2.2.9 (ii) of the RFP document.

Appendix IA

Annex-IV

ANNEX-IV

Details of Eligible Projects

(Refer to Clauses 2.2.2.2, 2.2.2.5 and 2.2.2.7 of the RFP)

Project Code:

Entity: Self/Members:

Item	Refer Instruction	Particulars of the Project
Title & nature of the project		
Category	5	
Year-wise	6	
(a) payments received for construction or work executed and certified by the Engineer-in-charge/Independent Engineer/Authority's Engineer, and/or		
(b) revenues appropriated for self construction under PPP projects		
Entity for which the project was constructed	7	
Location		
Project cost	8	
Date of commencement of project/ contract		
Date of completion/ commissioning	9	
Equity shareholding (with period during which equity was held)	10	

Instructions:

1. Bidders are expected to provide information in respect of each Eligible Projects in this Annex. The projects cited must comply with the eligibility criteria specified in Clause 2.2.2.6 (i) and 2.2.2.6 (ii) of the RFP, as the case may be. Information provided in this section is intended to serve as a back up for information provided in the Application. Applicants should also refer to the Instructions below.
2. The Project Codes would be a, b, c, d etc.
3. A separate sheet should be filled for each Eligible Project.
4. In case the Eligible Project relates to other Members, write "Member".
5. Refer to Clause 2.2.2.5 of the RFP for category number.
6. The total payments received and/or revenues appropriated for self construction for each Eligible Project are to be stated in Annex-II of this Appendix-I. The figures to be provided here should indicate the break-up for the past 5 (five) financial years. Year 1 refers to the financial year immediately preceding the Bid Due Date; Year 2 refers to the year before Year 1, Year 3 refers to the year before Year 2, and so on (Refer Clause 2.1.13). For Categories 1 and 2, expenditure on construction of the project by the Applicant itself should be provided, but only in respect of projects having an estimated capital cost exceeding the amount specified in Clause 2.2.2.6(i)(c). In case of Categories 3 and 4, payments received only in respect of construction should be provided, but only if the amount received exceeds the minimum specified in Clause 2.2.2.6(ii). Receipts for construction works should only include capital expenditure, and should not include expenditure on maintenance & repair and operation of Highways.

7. In case of projects in Categories 1 and 2, particulars such as name, address and contact details of owner/ Authority/ Agency (i.e. concession grantor, counter party to concession, etc.) may be provided. In case of projects in Categories 3 and 4, similar particulars of the client need to be provided.
8. Provide the estimated capital cost of Eligible Project. Refer to Clauses 2.2.2.6(i) and 2.2.2.6(ii)
9. For Categories 1 and 2, the date of commissioning of the project, upon completion, should be indicated. In case of Categories 3 and 4, date of completion of construction should be indicated. In the case of projects under construction, the likely date of completion or commissioning, as the case may be, shall be indicated.
10. For Categories 1 and 2, the equity shareholding of the Bidder, in the company owning the Eligible Project, held continuously during the period for which Eligible Experience is claimed, needs to be given (Refer Clause 2.2.2.6(i)).
11. Experience for any activity relating to an Eligible Project shall not be claimed twice. In other words, no double counting in respect of the same experience shall be permitted in any manner whatsoever.
12. Certificate from the Bidder's statutory auditor\$ or its respective clients must be furnished as per formats below for each Eligible Project. In jurisdictions that do not have statutory auditors, the auditors who audit the annual accounts of the Bidder may provide the requisite certification.
13. If the Bidder is claiming experience under Categories 1 & 2£, it should provide a certificate from its statutory auditor in the format below as per Clause 2.2.2.6 (i) (d) :

Certificate from the Statutory Auditor regarding PPP projects^Φ

Based on its books of accounts and other published information authenticated by it, this is to certify that (*name of the Bidder*) is/ was an equity shareholder in

..... (*title of the project company*) and holds/held Rs. cr. (Rupees crore) of equity (which constitutes.....%[£] of the total paid up and

subscribed equity capital) of the project company from (*date*) to (*date*)[¥]The project was/is commenced on(*date*) and likely to be commissioned on

..... (*date of commissioning of the project*).

We further certify that the total estimated capital cost of the project is Rs. cr. (Rupees

..... crore), of which the applicant has itself undertaken the construction of project

of Rs.(Rupees..... Crores) excluding any part of the project for which any contractor,

sub-contractor or other agent was appointed for the purpose of construction as per Clause 2.2.2.6 (i) - (d) by the aforesaid Applicant itself, during the past five financial years as per year-wise details noted below:

.....

..... Name of the audit firm:

Seal of the audit firm: (Signature, name and designation Date: of the authorised signatory)

[§] In case duly certified audited annual financial statements containing the requisite details are provided, a separate certification by statutory auditors would not be necessary.

[£] Refer Clause 2.2.2.5 of the RFP.

^Φ Provide Certificate as per this format only. Attach Explanatory Notes to the Certificate, if necessary. Statutory auditor means the entity that audits and certifies the annual accounts of the company.

[€] Refer instruction no. 10 in this Annex-IV.

[¥] In case the project is owned by the Applicant company, this language may be suitably modified to read: “It is certified that (name of Applicant) constructed and/ or owned the.....(name of project) from

..... (date) to (date).”^{*} Refer Clauses 2.2.2.5 and 2.2.2.6(ii) of the RFP

14. If the Bidder is claiming experience under Category 3 & 4□, as per Clauses 2.2.2.5 and 2.2.2.6(ii) of the RFP, it should provide a certificate from its Statutory Auditor/client/ Engineer-in charge/ Independent Engineer/Authority’s Engineer in the format below:

Certificate regarding construction works^Φ

Based on its books of accounts and other published information authenticated by it, This is to certify that(name of the Bidder) was engaged by(title of the project company) to execute (name of project)

for(nature of project). The construction of the project commenced on

.....(date) and the project was/ is likely to be commissioned on

..... (date,

if any). It is certified that Bidder received payments from its Clients for Construction Works executed by them or work executed and certified by the Engineer-in-charge/Independent Engineer/Authority’s Engineer, in the aforesaid construction works. We further certify that the total estimated capital cost of the project is Rs.

..... cr. (Rupees

.....crore), of which the Applicant received or has executed the work as certified by the Engineer-in-charge/Independent Engineer/Authority’s Engineer Rs.

..... cr. (Rupees.....crore), during the past five financial years as

per year-wise details noted below:

.....

.....

It is further certified that the receipts indicated above are restricted to the share of the

Applicant who undertook these works as a partner or a member of joint venture. ♠

We further certify that applicant has a share of _____% in the Joint Venture/Consortium.

(Authorized Signatory)

Date:

15. It may be noted that in the absence of any detail in the above certificates, the information would be considered inadequate and could lead to exclusion of the relevant project in computation of Experience.

* Refer Clauses 2.2.2.5 and 2.2.2.6(ii) of the RFP.

Φ Provide Certificate as per this format only. Attach Explanatory Notes to the Certificate, if necessary. Statutory auditor means the entity that audits and certifies the annual accounts of the company. However, in case the work of other member(s) is also executed by the applicant, then this fact should also be certified by the Statutory Auditor and accordingly the language may be suitably modified.

♠ This certification should be strike out in case of jobs/ contracts, which are executed a sole firm. The payments indicated in the certificate should be restricted to the share of Applicant in such partnership/ joint venture. This portion may be omitted if the contract did not involve a partnership/ joint venture. In case where work is not executed by partnership/ joint venture, this paragraph may be deleted.

Appendix -IA
Annex-V

ANNEX-V
Statement of Legal Capacity
(To be forwarded on the letterhead of the Applicant/ Lead Member of Joint Venture)

Ref. Date:

To,

Dear Sir,

We hereby confirm that we/ our members in the Joint Venture (constitution of which has been described in the application) satisfy the terms and conditions laid out in the RFP document.

We have agreed that(insert member's name) will act as the Lead Member of our Joint Venture.*

We have agreed that(insert individual's name) will act as our representative/ will act as the representative of the Joint Venture on its behalf* and has been duly authorized to submit the RFP. Further, the authorised signatory is vested with requisite powers to furnish such letter and authenticate the same.

Thanking you,

Yours faithfully, (Signature, name and designation of the authorised signatory) For
and on behalf of.....
**Please strike out whichever is not applicable.*

Appendix - IA
Annexure-VI

Information required to evaluate the BID Capacity under clause 2.2.2.1:

To calculate the value of “A” and “C”

1. A table containing value of Civil Engineering Works in respect of EPC Projects (Turnkey projects / Item rate contract/ Construction works) undertaken by the Bidder during the last 5 years is as follows (the amount of bonus received, if any, shall be indicated separately):

Sl. No.	Year	Value of Civil Engg. Works undertaken w.r.t. EPC Projects including bonus, if any (Rs. in Crores)	Amount of bonus (Rs. in Crores)	Net Value excluding bonus (Rs. in Crores)
1	2022-23			
2	2021-22			
3	2020-21			
4	2019-20			
5	2018-19			

2. Maximum value of projects that have been undertaken during the F.Y. out of the last 5 years and value excluding amount of bonus thereof is Rs. Crores (Rupees). Further, value updated to the price level of the year indicated in Appendix is as follows:
Rs. Crores x (Updation Factor as per Appendix) = Rs. Crores (Rupees)
3. Amount of bonus received, if any, in EPC Projects during the last 5 years (updated to the price level of the year indicated in Appendix):

Sl. No.	F.Y. / Calendar Year	Amount of Bonus (Rs. in Crores)	Updation Factor	Updated Amount of Bonus (Rs. in Crores)
1	2022-23		1.00	
2	2021-22		1.09	
3	2020-21		1.24	
4	2019-20		1.25	
5	2018-19		1.27	
			Total (C)=	

<p>.....</p> <p>.....</p> <p>Name of the Statutory Auditor's firm:</p> <p>Seal of the audit firm: (Signature, name and designation and Membership No. of authorised signatory)</p>	<p>.....</p> <p>.....</p> <p>Signature, name and designation of Authorised Signatory</p> <p>For and on behalf of (Name of the</p>
--	---

--	--

Date: _____ Place: _____

To calculate the value of “B”

A table containing value of all the existing commitments and on-going works to be completed during the next ** years is as follows:

Sl. No.	Name of Project/ Work	Percentage of participation of Bidder in the project	Dater of start / appointed date of project	Construction period as per Agreement/ LOA	Value of contract as per Agreement /LOA ^β	Value of work completed	Balance value of work to be completed	Anticipated date of completion	Balance value of work at 2022-23 price level
					Rs. in Crore	Rs. in Crore	Rs. in Crore		Rs. in Crore
1	2	3	4	5	6	7	8= (6-7)	9	10(3x 8x #)

Updation Factor as given below:

For Year	F.Y. / Calendar Year	Updation Factor
1	2022-23	1.00
2	2021-22	1.09
3	2020-21	1.24
4	2019-20	1.25
5	2018-19	1.27

The Statement showing the value of all existing commitments, anticipated value of work to be completed in the period of construction of the project for which bid is invited and ongoing works as well as the stipulated period of completion remaining for each of the works mentioned above is verified from the certificate issued that has been countersigned by the Client or its Engineer- in-charge not below the rank of Executive Engineer or equivalent in respect of EPC Projects **or** Concessionaire / Authorised Signatory of SPV in respect of BOT Projects. No awarded / ongoing works has been left in the aforesaid statement which has been awarded to M/s.....individually / and other member M/s and M/s....., as on bid due date of this RFP.

<p>..... Signature, name and designation of Authorised Signatory</p> <p>For and on behalf of..... (Name of the Bidder)</p>	<p>..... Name of the Statutory Auditor's firm: Seal of the audit firm: (Signature, name and designation and Membership No. of authorised signatory)</p>
--	---

Date: _____ Place: _____

^β In case balance period of construction is less than the value of period of construction of the project for which bid is invited, then full value of contract as per Agreement/LOA to be mentioned, else, anticipated value of work to be completed in the period of construction of the project for which bid is invited is to be mentioned. In the absence of the anticipated value of work to be completed, the proportionate value shall be considered while evaluating the Assessed Available Bid Capacity.

Appendix - IA
Annexure-VII

Details of ongoing works

S. No.	Name of the work	Contract Price (INR Cr)	Appointed Date	Original Scheduled Completion Date	Likely Date of Completion	Reason for Delay [#]
1						
2						
3						
...						

(In the event that the Bidder had failed to achieve the Completion of any project within a period of 90 (ninety) days from the Schedule Completion Date of the project, unless such failure had occurred due to Force Majeure or for reasons solely attributable to the Authority, the Bidder shall be deemed to be ineligible for bidding this project (under bidding), both as the sole party or as one of the parties of Joint Venture/ Consortium, if any, during the period from Scheduled Completion Date to issuance of Completion Certificate for that project. This restriction is applicable if the contract value of the delayed project was not less than Rs. 300 Crore.)

[#]To be supported with valid certificate issued from Independent Engineer / Authority's Engineer
/ Supervision Consultant / Engineer-in-charge

I / We certify that all the information furnished above is true in all respects.

... Name of the Bidder

Signature of the authorized signatory: _____

Name of the Authorised Signatory: _

Date: _

Place:

APPENDIX - II
Bank Guarantee for BID Security (Refer Clauses 2.20)
SPECIMEN BANK GUARANTEE PERFORMANCE

GUARANTEE / SECURITY DEPOSIT

(To be executed on Rs.300/- non-judicial Stamp Paper)

[The bank, as requested by the successful Tenderer, shall fill in this form in accordance with the instruction indicated]

In consideration of the Board of Deendayal Port Authority incorporated by the Major Port Authorities Act, 2021 (hereinafter called “The Board” which expression shall unless excluded by or repugnant to the context or meaning thereof be deemed to include the Board of Deendayal Port Authority of the port its successors and assigns) having agreed to release Performance Guarantee / Security Deposit to (hereinafter called the “contractor”)

(Name of the contractor/s)

from the demand under the terms and condition of the contract, vide from the demand under the condition of the contract, vide 's letter No

(Name of the Department)

Date_____made between the contractors and the Board for execution of Covered under Tender No._____dated (hereinafter called “the said contract”) for the payment of Security Deposit in cash or Lodgment of Government Promissory Loan Notes for the due fulfillment by the said contractors of the terms and condition of the said contract, on production of a bank Guarantee for Rs. _____ (Rupees) only we, the (Name of the Bank and Address)

_____ (here in after Referred to as “the Bank”) at the request of the contractors do here by undertake to pay to the Board an amount not exceeding Rs. _____ (Rupees) only against any loss or damage caused to or suffered by the Board by reason of any breach by the contractors of any of the terms and conditions of the said contract.

1. We, _____, do here by
(Name of Bank) (Name of Branch)

Undertake to pay the amount due and payable under this guarantee without any demur merely on a demand from the Board stating that the amount claimed is due by way of loss or damage caused to or which would be caused to or suffered by the Board by reason of the contractor's failure to perform the said contract. Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this Guarantee. However, our liability under this guarantee shall be restricted to any amount not exceeding Rs.

_____ (Rupees _____) only.

2. We, _____, undertake to pay to the (Name of Bank and Branch)

Board any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the Contractor(s) shall have no claim against us for making such payment.

3. We, _____ further agree with the Board that the (Name of Bank and Branch)

guarantee herein contained shall remain in full force and effect during the period that would be taken for performance of the said contract and that it shall continue to be enforceable till all the dues of the Board under or by virtue of the said contract have been fully paid and its claims satisfied or discharged or till the

(Name of the user department)

of the said certifies that the terms and conditions of the said contract have been fully and properly carried out by the said Contractors and accordingly discharge this guarantee. Provided however that the Bank shall be the request of the Board but at the cost of the Contractors, renew or extend this guarantee for such further period or periods as the Board may require from time to time.

4. We, _____ further agree with the Board that the (Name of Bank and Branch)

Board shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said contract or to

extend the time of performance by the said contract or to extend the time of performance by the said Contractors from time to time or to postpone for any time or from time to time any of the powers exercisable by the board against the said

Contractors and to forebear or enforce any of the terms and conditions relating to the said contract and we shall not be relieved from our liability by reason of any such variation or extensions being granted to the contractors or for any forbearance, act or omission on the part of the Board or any indulgence shown by the board to the

Contractors or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

5. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

6. It is also hereby agreed that the Courts in Gandhidham would have exclusive jurisdiction in respect of claims, if any, under this Guarantee.

7. We, Bank lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Board in writing.

8. Notwithstanding anything contained herein:

(a) Our liability under this Bank Guarantee shall not exceed Rs.

_____ (Rupees _____ only);

(b) This Bank Guarantee shall be valid up to ; and

(c) We are liable to pay the guarantee amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or

before _____ (date of expiry of Guarantee).”

Date _____ day of _____ 20

For (Name of Bank)

(Name)

Signature

APPENDIX-III
Format for Power of Attorney for signing of BID
(Refer Clause 2.1.5)

Know all men by these presents, We..... (name of the firm and address of the registered office) do hereby irrevocably constitute, nominate, appoint and authorize Mr./ Ms (name), son/daughter/wife of and presently residing at, who is presently employed with us/ the Lead Member of our Joint Venture and holding the position of, as our true and lawful attorney (hereinafter referred to as the “Attorney”) to do in our name and on our behalf, all such acts, deeds and things as are necessary or required in connection with or incidental to submission of our BID for the project of “Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat on EPC Mode” or being developed by the Deendayal Port Authority (the “Authority”) including but not limited to signing and submission of all applications, BIDs and other documents and writings, participate in Pre-BID and other conferences and providing information/ responses to the Authority, representing us in all matters before the Authority, signing and execution of all contracts including the agreement and undertakings consequent to acceptance of our BID, and generally dealing with the Authority in all matters in connection with or relating to or arising out of our BID for the said Project and/ or upon award thereof to us and/or until the entering into of the EPC Contract with the Authority.

AND we hereby agree to ratify and confirm and do hereby ratify and confirm all acts, deeds and things done or caused to be done by our said Attorney pursuant to and in exercise of the powers conferred by this Power of Attorney and that all acts, deeds and things done by our said Attorney in exercise of the powers hereby conferred shall and shall always be deemed to have been done by us.

IN WITNESS WHEREOF WE,, THE ABOVE NAMED PRINCIPAL HAVE EXECUTED THIS POWER OF ATTORNEY ON THIS DAY OF 2.....

For (Signature, name, designation and address) of person authorized by Board Resolution

(in case of Firm/ Company)/ partner in case of

Witnesses: Partnership firm

1.

2.

Accepted

..... (Signature)

(Name, Title and Address of the Attorney)

(Notarised)

Person identified by me/ personally appeared before me/

Attested/ Authenticated* (*Notary to specify as applicable) (Signature Name and Address of the Notary)

Seal of the Notary Registration No. of the Notary

Date:.....

Notes:

- *The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the*

executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.

- *Wherever required, the Bidder should submit for verification the extract of the charter documents and documents such as a board or shareholders' resolution/ power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Bidder.*
- *For a Power of Attorney executed and issued overseas, the document will also have to be legalised by the Indian Embassy and notarised in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Bidders from countries that have signed the Hague Legislation Convention 1961 are not required to be legalised by the Indian Embassy if it carries a conforming Appostille certificate.*

APPENDIX-IV

Format for Power of Attorney for Lead Member of Joint Venture

(Refer Clause 2.1.6)

Whereas the Deendayal Port Authority (“the Authority”) has invited BIDs for the the project of “Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat on EPC Mode” or being developed by the Deendayal Port Authority (the “Project”).

Whereas,, and
.....(collectively the
“Joint Venture”) being Members of the Joint Venture are interested in bidding for the Project in accordance with the terms and conditions of the Request for Proposal (RFP) and other BID documents including agreement in respect of the Project, and

Whereas, it is necessary for the Members of the Joint Venture to designate one of them as the Lead Member with all necessary power and authority to do for and on behalf of the Joint Venture, all acts, deeds and things as may be necessary in connection with the Joint Venture’s BID for the Project and its execution.

NOW THEREFORE KNOW ALL MEN BY THESE PRESENTS

We, having our registered office at, M/s. having our registered office at ..., M/s. ... having our registered office at, and having our registered office at, (hereinafter

collectively referred to as the “Principals”) do hereby irrevocably designate, nominate, constitute, appoint and authorize M/S having its registered office at, being one of the Members of the Joint Venture, as the Lead Member and true and lawful attorney of the Joint Venture (hereinafter referred to as the “Attorney”). We hereby irrevocably authorize the Attorney (with power to sub-delegate) to conduct all business for and on behalf of the Joint Venture and any one of us during the bidding process and, in the event the Joint Venture is awarded the contract, during the execution of the Project and in this regard, to do on our behalf and on behalf of the Joint Venture, all or any of such acts, deeds or things as are necessary or required or incidental to the pre-qualification of the Joint Venture and submission of its BID for the Project, including but not limited to signing and submission of all applications, BIDs and other documents and writings, participate in pre BID and other conferences, respond to queries, submit information/ documents, sign and execute contracts and undertakings consequent to acceptance of the BID of the Joint Venture and generally to represent the Joint Venture in all its dealings with the Authority, and/ or any other Government Agency or any person, in all matters in connection with or relating to or arising out of the Joint Venture’s BID for the in all respect Project and/ or upon award thereof till the EPC Contract is entered into with the Authority & Compelled.

AND hereby agree to ratify and confirm and do hereby ratify and confirm all acts, deeds and things done or caused to be done by our said Attorney pursuant to and in exercise of the powers conferred by this Power of Attorney and that all acts, deeds and things done by our said Attorney in exercise of the powers hereby conferred shall and shall always be deemed to have

been done by us/ Joint Venture.

IN WITNESS WHEREOF WE THE PRINCIPALS ABOVE NAMED
HAVE EXECUTED THIS POWER OF ATTORNEY ON THIS
..... DAY OF 2.....

For (Signature) (Name & Title)	For (Signature) (Name & Title)	For (Signature) (Name & Title)
---	---	---

(Executants)

(To be executed by all the Members of the Joint Venture)

Witnesses:

- 1.
- 2.

Notes:

- *The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.*
- *Also, wherever required, the Bidder should submit for verification the extract of the charter documents and documents such as a board or shareholders' resolution/ power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Bidder.*
- *For a Power of Attorney executed and issued overseas, the document will also have to be legalised by the Indian Embassy and notarised in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Bidders from countries that have signed the Hague Legislation Convention 1961 are not required to be legalised by the Indian Embassy if it carries a conforming Appostille certificate.*

APPENDIX V

Format for Joint Bidding Agreement for Joint Venture (Not Applicable)

(Refer Clause 2.1.11)

~~(To be submitted on Non-judicial Stamp Paper of appropriate value)~~

~~This Joint Venture /Consortium Agreement is made and entered into on this~~
~~..... day of2024 by and between (i) M/s. (Name of the firm to be filled-~~
~~in).....(ii) M/s.....(Name of the firm to be filled in),~~
~~....., primarily for the work under the Deendayal Port Authority.~~

~~All the partners of the Joint Venture /Consortium hereinafter individually referred to as the~~
~~parties and collectively as the Joint Venture/Consortium‘.~~

~~1. Formation of Joint Venture/Consortium~~

~~(i) M/s. (Name of the firm to be filled in) is engaged in..... (Details of the~~
~~works~~
~~undertaken by the party)~~

~~(ii) M/s. (Name of the firm to be filled in) is engaged in..... (Details of the~~
~~works~~
~~undertaken by the party)~~

~~(iii)~~

~~1.1. On behalf of Board of Authority of Deendayal Port (here in after referred to~~
~~as Employer), the Chief Engineer, Deendayal Port Authority has invited bids from the experienced,~~
~~resourceful and bonafide Developers with proven technical and financial capabilities of executing the~~
~~work of “Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting~~
~~to NH 8A in the state of Gujarat on EPC Mode”.~~

~~1.2. The parties have been exploring together the ways and means of collaboration for the~~
~~purpose of an offer to be made for the said project of the Deendayal Port Authority and have mutually~~
~~agreed to enter into a Joint Venture/Consortium Agreement to submit a common bid for the project and~~
~~to carry out the project works in the event of award of the contract, in association with each other and~~
~~(.....Name of Partner to be filled in.....) shall be the Lead Partner and (i) (.....Name of Partner~~
~~to be filled in.....), (ii) (.....Name of Partner to be filled in.....), shall be the other partner (s).~~

~~NOW THEREFORE IT HAS BEEN AGREED TO BETWEEN THE PARTIES AS~~
~~FOLLOWS~~

~~1.3. The Joint Venture/Consortium will be known as... (.....Name of JV to be filled~~
~~in.....) and shall consist of (i) (.....Name of the firm to be filled in.....), (ii)~~
~~(.....Name of the firm to be filled in.....),~~

parties to the present agreement.

1.4. _____ The recitals are true and correct and form an integral part of this agreement and are representations of the parties to which they relate and have been relied upon by the parties to enter into the present agreement. Notwithstanding the date of signature of this agreement, its effective date will be the date of submission of bid.

1.5. _____ All costs incurred by the parties before the date of award of contract will be borne by the parties concerned. All costs in implementation of this Joint Venture/Consortium Agreement after award of contract till the expiry of this agreement will be borne by the parties as here in after provided.

1.6. _____ The Joint Venture/Consortium will be dissolved and this agreement will cease to have effect on completion of this project, maintenance and fulfilment of all other conditions under the contract, upon receipt of payment of all amounts from the Employer and on settlement of accounts between the parties as hereinafter provided.

1.7. _____ The contract, if awarded by the Employer, Letter of Acceptance shall be issued in the name of (.....**Name of JV/Consortium to be filled in**.....) and the Contract shall be signed by legally authorized signatories of all the parties.

1.8. _____ All the parties of the JV/Consortium shall be jointly and severally liable during the bidding process and the bid document shall be signed by legally authorized signatory of all the parties.

1.9. _____ The financial contribution of each partner to the JV/Consortium operation shall be:

(i) _____ M/s..... (Name of the partner to be filled in)

(ii) _____ **M/s..... (Name of the partner to be filled in)**

(iii) _____

1.10. _____ All the parties of the JV/Consortium shall be jointly and severally liable for the execution of the project in accordance with the Contract terms, in the event of award of contract. The delineation of duties, responsibilities and scope of work shall be:

a) _____ The Lead Partner shall provide suitable experienced personnel at site, for general planning, site management and equipment operations, during entire period of contract execution.

b) _____ (.....**Name of Partner to be filled in**) shall carry out the following works

c) _____ (.....**Name of Partner to be filled in**) shall carry out the following works

d) _____
.....
....

1.11. _____ The parties hereto agreed that each of them shall duly and properly perform all the functions and all costs related to their respective works.

1.12. _____ The parties hereto shall be at liberty to enter into liaison work/correspondence with statutory and local authorities as the circumstances warrant individually or collectively.

1.13. _____ It is hereby agreed and undertaken that, all the parties are jointly and severally liable to the Board of Port of Deendayal for the performance of the contract.

1.14. ~~Notwithstanding demarcation or allotment of work between JV/Consortium partners, JV/Consortium each partner shall be liable for non performance of the whole contract irrespective of their demarcation or share of work.~~

1.15. ~~The Lead Partner shall be authorized to act on behalf of the JV/Consortium.~~

1.16. ~~All the correspondences between the Employer and the JV /Consortium shall be routed through the Lead Partner.~~

1.17. ~~The Lead Partner is authorized: (a) to submit bid, negotiate and conclude contract and incur all liabilities therewith on behalf of the partner(s) of the JV /Consortium during the bidding process; and (b) in the event of a successful bid, to incur liabilities and receive instructions for and on behalf of the partner(s) of the JV/Consortium and to carry out the entire execution of the contract including payment, exclusively through Lead Partner.~~

1.18. ~~In the event of default of the Lead Partner, it shall be construed as default of the Developer/Contractor; and Employer shall be entitled to take action under relevant clause(s) of the Department Bid Document and/or Conditions of Contract.~~

1.19. ~~All the parties of the JV/Consortium shall be jointly and severally liable for due performance, recourse/sanctions within the joint venture in the event of default of any partner and arrangements for providing the required indemnities.~~

1.20. ~~The JV/ Consortium shall have a separate JV/Consortium Bank account (distinct from the Bank account of the individual partners) to which individual partners shall contribute their share capital / or working capital. The financial obligation of the consortium shall be discharged through the said JV/ Consortium Bank account only and also all payment received by consortium from the Deendayal Port Authority shall be through that account only.~~

~~The parties hereto have mutually agreed to the terms and conditions set forth herein above and have assured each other to duly perform the reciprocal promises and obligations on either side for effective implementation of the JV/Consortium for proper and due completion of the works envisaged, in the event of award of contract to the JV/Consortium and have affixed their signature in this indenture on this theday of.....20..~~

(i) ~~Signature Name Designation seal & Common seal of the firm~~

(ii) ~~Signature Name Designation seal & Common seal of the firm Witness 1~~

~~Witness 2~~

Notes:

1. ~~The mode of the execution of the Joint Bidding Agreement should be in accordance with the procedure, if any, laid down by the Applicable Law and the charter documents of the executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.~~

2. ~~Each Joint Bidding Agreement should attach a copy of the extract of the charter documents and documents such as resolution / power of attorney in favour of the person executing this Agreement for the delegation of power and authority to execute this Agreement on behalf of the Joint Venture Member.~~

~~3. For a Joint Bidding Agreement executed and issued overseas, the document shall be legalised by the Indian Embassy and notarized in the jurisdiction where the Power of Attorney has been executed.~~

PROFORMA OF POWER- OF-ATTORNEY FOR LEADMEMBER OF JV/ CONSORTIUM

(To be submitted on Non-judicial Stamp Paper of appropriate value)

By this Power-of-Attorney executed on thisday of(month) of 2024, we,

(i) (Name of legally authorized signatory of first partner to be filled in.....), (ii) (.....Name of legally authorized signatory of second partner to be filled in),

..... hereby jointly authorize and agree the Lead Partner, M/s (... Name of the lead partner to be filled *in*.....), (a) to submit bid, negotiate and conclude contract and incur all liabilities therewith on behalf of the partner(s) of the JV /Consortium during the bidding process; and (b) in the event of a successful bid, to incur liabilities and receive instructions for and on behalf of the partner(s) of the JV /Consortium and to carry out the entire execution of the contract including payment for the work of “**Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat on EPC Mode**” exclusively through Lead Partner.

(i) Signature Name Designation seal & Common seal of the firm

(ii) Signature Name Designation seal & Common seal of the firm

.....

.....

Signature, name and seal of the certifying authority/Notary Public

APPENDIX VI

INTEGRITY PACT IN DEENDAYAL PORT AUTHORITY

The Central Vigilance Commission (CVC) has been promoting integrity, transparency, equity and competitiveness in transactions by various organizations of the Government of India. Public procurement is an area of concern for the CVC, and many steps have been taken to put proper systems in place. In this context, Integrity Pact (IP), a tool conceptualized and promoted by Transparency International, an international NGO, aimed at preventing corruption in public contracting, has been found useful. It has been decided by Ministry of Shipping that all organizations under the Ministry will implement IP. IP should cover every tender / procurement above a specified threshold value. The threshold value of contracts / procurements / transactions incorporating IP would be such that it covers 90% by value of all contracts / procurements / transactions of the organization in the last 3 years. Presently the threshold is fixed as Rs. 3.00 crore. IP essentially envisages an agreement between prospective vendors / bidders, and DEENDAYAL PORT AUTHORITY, committing the persons / officials of both sides not to resort to any corrupt practice in any aspect of the contract at any stage. Only those vendors / bidders, who commit themselves to IP with DPA, would be considered competent to participate in the bid process. Any violation would entail disqualification of the bidders and exclusion from future business dealings. IP, in respect of a particular contract should cover all phases of the contract, from the stage of Notice Inviting Tender (NIT) / pre-bid stage, till the conclusion of the contract, i.e. final payment or the warranty / guarantee period. IP would be implemented through Independent External Monitor (IEM), who are eminent persons appointed by the organization, with approval of CVC. The term of appointment for an IEM would be 3 years. Name of the IEM will be mentioned in NIT. The IEM would review independently and objectively assess, as to whether and to what extent parties have complied with their obligations under the IP. IEM would have access to all contract documents, whenever required. The bidders may raise disputes / complaints if any, with the IEM. The IEM would examine complaints received by them and give their recommendations / views to the Chairman of Port Trust. Recommendations of IEM would be in the nature of advice and would not be legally binding. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization. Shri S K Sarkar, IAS (Retd.) and Shri Saurabh Candra, IAS(Retd.) Ex- Member has been appointed IEM by DPA. Draft condition to be incorporated in the Draft Tender Papers (1) Then bidder has to execute Integrity Pact agreement with DEENDAYAL PORT AUTHORITY (As per Appendix) Shri S K Sarkar, IAS (Retd.) and Shri Saurabh Candra, IAS(Retd.) has been nominated as Independent External Monitor for Integrity Pact whose address is as under:

(1) Shri S.K.Sarkar, IAS (ReRD.)

B-104, Nayantara Aptt.,
Plot No.08-B, Sec-07, Dwarka,
New Delhi – 110 075

Email :- sksarkar1979@gmail.com

(2) Shri Saurabh Chandra, IAS (ReRD.)

A-9, Sector-30,
Noida (UP) 201301

Email: saurabh7678@yahoo.co.in

Note: Integrity Pact document need to be submitted in Preliminary bid duly scanned, stamped, signed and dated along with both witness signatures as per format available in Appendix-VI in the tender document failing which bid submitted by the bidder will be considered non-responsive.

**Format for
INTEGRITY PACT
BETWEEN**

**Deendayal Port Authority (DPA) hereinafter referred to as “The Principal”
AND**

**(Name of the bidder and consortium members)
hereinafter referred to as “the Bidder/Contractor”**

Preamble: The Principal intends to award, under laid down organizational procedures, contract/concession for Tender No. ____/2024. The Principal values full compliance with all relevant laws and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidders. The Central Vigilance Commission (CVC) has been promoting Integrity, transparency, equity and competitiveness in Government / PSU transactions and as a part of Vigilance administration and superintendence, CVC has, recommended adoption of Integrity Pact and provided basic guidelines for its implementation in respect of major procurements in the Government Organizations in pursuance of the same, the Principal agrees to appoint an external independent Monitor who will monitor the execution of the contract for compliance with the principles mentioned above.

Section 1 - Commitments of the Principal

(1) The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles: -

(a) No employee of the Principal, personally or through family members, will in connection with the execution of a contract, demand, take a promise for or accept, for him/herself or third person, any material or immaterial benefit which he/she is not legally entitled to.

(b) The Principal will, during the pre-contract stage, treat all BIDDERS alike, and will provide to all BIDDERS the same information and will not provide any such information to any particular BIDDER which could afford an advantage to that particular BIDDER in comparison to other BIDDERS.

(c) The Principal will exclude from the process all known prejudicial persons.

(2) If the Principal obtains information on the conduct of any of its employees which is a criminal offence under the relevant Anti-Corruption Laws of India, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions. In such a case, while an enquiry is being conducted by the Principal, the proceedings under the contract would not be stalled.

Section 2 - Commitments of the Bidder/Contractor

(1) The Bidder/Contractor commits themselves to take all measures necessary to prevent corrupt practices, unfair means and illegal activities, during pre-contract as well as post contract stages. He commits himself to observe the following principles during the contract execution.

a. The Bidder/Contractor will not, directly or through any other person or firm, offer, promise or give to any of the Principal's employees involved in the execution of the contract or to any third person any material or immaterial benefit, which he/she is not legally entitled to, in order to obtain in exchange of advantage of any kind, whatsoever during the execution of the contract.

b. The Bidder/Contractor will not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices,

specifications, certifications, subsidiary contracts, submission or non-submission of bids, or any other actions to restrict competitiveness, or to introduce cartelization in the bidding process.

c. The Bidder/Contractor will not commit any offence, under the relevant Anticorruption Laws of India; further the Bidder/Contractor will not use improperly, for purposes of competition, or personal gain, or pass on to others, any information or document provided by the Principal, as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

d. The Bidder will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

e. The Bidder/Contractor will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries, in connection with the award of the contract.

f. The Bidder commits to refrain from giving any compliant directly or through any other manner without supporting it with full and verifiable facts. g. The Bidder shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee of the Principal.

(2) The Bidder/Contractor will not instigate third persons to commit offences outlined above or be an accessory to such offences.

Section-3 Disqualification from or exclusion from future contracts

1. If the Bidder, before award of contract, has committed a transgression, through a violation of Section-2 or in any other form, such as to put his reliability as Bidder, into question, the principal is entitled to disqualify the Bidder, from the tender process, or to terminate the contract, if already signed, for such reason.

2. If the Bidder/Contractor has committed a transgression, through a violation of Section-2, such as to put his reliability, or credibility into question, the Principal is entitled to disqualify the Bidder/Contractor from the tender process, terminate the contract if already awarded and also, to exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of the transgression. The severity will be determined, by the circumstances of the case, in particular the number of transgressions, the position of the transgressions, within the company hierarchy of the Bidder and the amount of the damage. The execution will be imposed for a minimum of 6 months and maximum of 3 years.

Note: A transgression is considered to have occurred, if in the light of available evidence, no reasonable doubt is possible.

3. The Bidder accepts and undertakes to respect and uphold, the principal's Absolute right to resort to and impose such exclusion and further accepts and undertakes, not to challenge or question such exclusion, on any ground, including the lack of any hearing before the decision, to resort to such exclusion is taken. This undertaking is given freely and after obtaining independent legal advice.

4. If the Bidder/Contractor can prove that, he has restored/recouped the Damage caused by him and has installed a suitable corruption prevention system, the Principal may revoke

the exclusion prematurely.

Section-4 Compensation for Damages

1. If the Principal has disqualified the Bidder, from the tender process prior to the award, according to Section-3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/Bid Security.
2. If the Principal has terminated the contract according to Section-3, or if the Principal is entitled to terminate the contract according to Section-3, the Principal shall be entitled to demand and recover from the Contractor, liquidated damages equivalent to 5% of the contract value, or the amount equivalent to Security Deposit/Performance Bank Guarantee, whichever is higher.
3. The Bidder agrees and undertakes to pay the said amounts, without protest or demur, subject only to condition that, if the Bidder/Contractor can prove and establish that the termination of the contract, after the contract award has caused no damage or less damage than the amount of the liquidated damages, the Bidder/Contractor shall compensate the principal, only to the extent of the damage in the amount proved.

Section-5 Previous transgression

1. The Bidder declares that, no previous transgression has occurred in the last 3 years, with any other company, in any country, or with any other Public Sector Enterprises in India, that could justify his exclusion from the award of the contract.
2. If the Bidder makes incorrect statement on this subject, it can be declared disqualified for the purpose of the contract and the same can be terminated for such reason.

Section-6 Equal treatment of all bidders/Contractors/Subcontractors

1. The Bidder/Contractor undertakes to demand from all subcontractors, a commitment in conformity with this Integrity Pact, and to submit it to the Principal before contract signing.
2. The Principal will enter into agreements with identical conditions as this one which all Bidders, Contractors and Subcontractors.
3. The Principal will disqualify from the tender process all Bidders, who do not sign this part or violates its provisions.

Section-7 Criminal charges against violating Bidders / Contractors Sub - contractors

If the principal obtains knowledge of conduct of a Bidder/Contractor or Subcontractor, or of an employee, or a representative, or an associate of a Bidder/Contractor, or Subcontractor, which constitutes corruption, or if the Principal has substantive suspicion, in this regard, the Principal will inform the Vigilance office.

Section-8 External Independent Monitor

1. Pursuant to the need to implement and operate this Integrity Pact the Principal has appointed Shri S. K. Sarkar, IAS (Retd.) and Shri Saurabh Chandra IAS (Retd), independent Monitor, for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent, the parties comply with the obligations under this agreement.

2. The Monitor is not subject to instructions, by the representative of the parties to the Chairperson of the Board of the Principal.
3. The Bidder/Contractor accepts that, the monitor has the right to access, without restriction to all Project documentation of the Principal, including that provided by the Contractor. The Bidder/Contractor will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access, to the project documentation. The same is applicable to Subcontractors. The monitor is under contractual obligation, to treat the information and documents of the Bidder/Contractor/Subcontractor with confidentiality.
4. The Principal will provide to the Monitor, sufficient information about all meetings, among the parties related to the Project, provided such meetings could have an impact, on the contractual relations between the Principal and the Bidder/Contractor. The parties offer to the Monitor the option to participate in such meetings.
5. As soon as the Monitor notices a violation of this agreement, he will so inform the Management of the Principal and request the management to discontinue, or heal the violation. Or to take other relevant action.
6. The Monitor can in this regard submit nonbinding recommendations. Beyond this, the Monitor has no right to demand from the parties, that they act in a specific manner, refrain from action or tolerate action.
7. The Monitor will submit a written report, to the Chairperson of the Board of the Principal, within 8 to 10 weeks, from the date of reference of intimation to him by the 'Principal' and, should the occasion arise, submit proposals for correcting problematic situations.
8. If the Monitor has reported to the Chairperson of the Board, a substantiate suspension of an offence, under relevant Anti-Corruption Laws of India, and the Chairperson has not, within reasonable time, taken visible action to proceed against such offence, or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

Section-9 Pact Duration

This Pact begins when both parties have signed it. It expires 12 months after the last payment under the contract Agreement is made. If any claim is made/lodged during this time, the same shall be binding and continue be valid, despite the lapse of this Pact, as specified above, unless it is discharged/determined Chairperson of the Principal. The Pact duration in respect of unsuccessful Bidders shall expire after 3 months of the award of the contract.

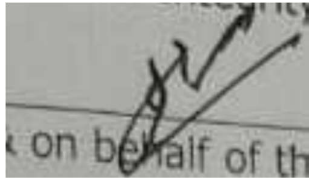
Section-10 Other Provisions

1. This agreement is subject to Indian Law. Place of performance and jurisdiction is the Registered Office of the Principal, i.e. Gandhidham, Gujarat.

2. Changes and supplements as well as termination notices, need to be made in writing, before they become effective and binding on the both parties.

3. If the Bidder / Contractor is a partnership or a consortium, this agreement must be, signed by all partners or consortium members.

4. Should one or several provisions of this agreement, turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement, to their original intentions.



(For & on behalf of the Principal)

(Office Seal)

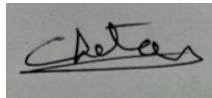
(For & on behalf of the Bidder/Contractor)

(Office Seal)

Place : Gandhidham

Date : ____/____/2024

Witness-1:



(Signature)____
Chetan Bauddh
JE Gr-I (Civil)

(Name & Address) _____

Witness-2 :

(Signature) _____

(Name & Address) _____

Place:

Dated:

Appendix-VII
(See Clauses 3.3.4)
Format of LOA
LETTER OF ACCEPTANCE
(On letterhead paper of the port)

_____(date)

TO:____
(Name and address of the contractor)

Dear Sirs,

Tender no. 03-TD/2024

Sub: **“Widening and Improvement of Existing 2/4 lane carriageway of KK Road Connecting to NH-8A in the state of Gujarat on EPC Mode”**

Ref: Your bid dated and [list the correspondence with the bidder]

This is to notify you that your bid dated____for execution of the _____ (name of the contract and identification number, as given in the instructions to bidders) for the contract price of rupees____(amount in words and figures as corrected and modified) in accordance with the tender document is here by accepted by the employer/Board. You are hereby requested to furnish performance security, in the form detailed in tender document for an amount of Rs. _____within {_____} days of the receipt of this letter of acceptance valid up to 28 days from the date of completion obligations expiry of taking over certificate subject to removal of defects period i.e. up to and also sign the contract agreement within {__} days of the receipt of this letter of acceptance, failing which action as stated in the tender document will be taken.

Detailed letter of acceptance will follow. Please acknowledge receipt.

Yours faithfully

Authorized signature

Appendix VIII
FORMAT OF BID SECURITY DECLARATION FROM BIDDERS
(On Bidders Letter head)
Bid Security Declaration Form

Date: _____ Tender No.

To (insert complete name and address of the Employer/ Purchaser)

I/We. The undersigned, declare that:

I/We understand that, according to your conditions, bids must be supported by a Bid Securing Declaration.

I/We accept that I/We may be disqualified from bidding for any contract with you for a period of three year from the date of notification if I am /We are in a breach of any obligation under the bid conditions, because I/We

a) have withdrawn/modified/amended, impairs or derogates from the tender, my/our Bid during the period of bid validity specified in the form of Bid; or

b) having been notified of the acceptance of our Bid by the purchaser during the period of bid validity (i) fail or reuse to execute the contract, if required, or (ii) fail or refuse to furnish the Performance Security, in accordance with the Instructions to Bidders.

I/We understand this Bid Securing Declaration shall cease to be valid if I am/we are not the successful Bidder, upon the earlier of (i) the receipt of your notification of the name of the successful Bidder; or (ii) thirty days after the expiration of the validity of my/our Bid.

Signed: (insert signature of person whose name and capacity are shown) in the capacity of (insert legal capacity of person signing the Bid Securing Declaration)

Name: (insert complete name of person signing the Bid Securing Declaration)

Duly authorized to sign the bid for an on behalf of (insert complete name of Bidder)

Dated on _____ day of _____ (insert date of signing)

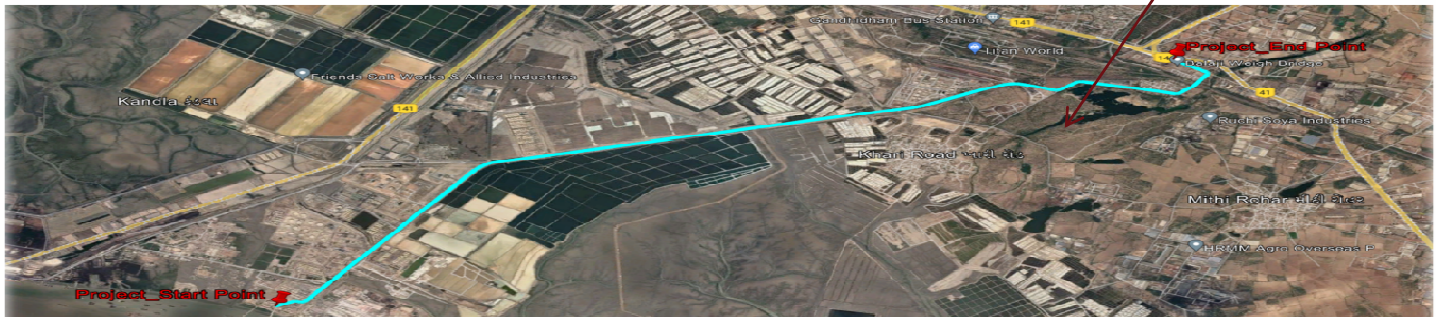
Corporate Seal (where appropriate).

****END****



DEENDAYAL PORT AUTHORITY
ISO 9001:2008 | ISO 14001 | ISPS compliant port

Consultancy Service for Preparation of Details Project Report for widening & Improvement of Existing 2/4-lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)



FINAL DETAILED PROJECT REPORT

MATERIALS AND GEOTECHNICAL [VOLUME - III]



MONARCH

SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.

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MATERIALS AND GEOTECHNICAL

1.1. Methodology

The project involves a series of inter related activities, both in the field and in the design office. Methodology for carrying out these activities is described in the following paragraphs.

1.2. Inventory and Condition Survey of Road

a) Road Inventory

Inventory of the existing road shall cover all existing physical features such as terrain, land-use, roadway, carriageway, type of cross section (cut or fill), utility lines passing along or crossing the highway, roadside facilities and all other features that may have influence on the project preparation.

b) Road Condition Survey

Inventory of the existing road shall cover all existing physical features such as terrain, land use, roadway, carriageway, type of cross section (cut or fill), utility lines passing along or crossing the highway, roadside facilities and all other features that may have influence on the project preparation.



Fig-1: 1 Road Inventory

Detailed field study shall be carried out for road and pavement surface conditions covering the following:

- i. pavement condition (surface distress type and extent);

- ii. shoulder condition;
- iii. embankment condition; and

The process ensures that complete information on condition of existing pavement and shoulder is collected so that design parameters related to pavement can be established. The information collected shall consist of the details of cracking (narrow and wide), rut depth, raveling, potholing, patching in the form of percentage area as well as edge break in terms of length and rut depth in mm. affected of the existing pavement; and paved shoulder material loss, rut depth,



Fig-1: 2 Structure Inventory

corrugation, edge etc. in the case of unpaved shoulders. The study shall identify defects and road section with similar characteristics i.e. homogeneous sections.

1.3. Sub-grade Characteristics and Strength

- a) Division of project road into homogeneous sections with respect to pavement condition and structural strength. The delineation of segments homogeneous with respect to roughness and strength should be done using the cumulative difference approach (AASHTO, 1993).
- b) For the widening of existing road within the ROW, sampling and testing of at least 3 sub-grade soil samples for each homogeneous road sections or 3 samples for each soil type encountered, whichever is higher.
- c) In case of new alignments, the test pits for sub-grade soil shall be @ 5 km interval or for each soil type, whichever is more. A minimum of three samples should be tested corresponding to each homogeneous segment.
- d) The testing for sub-grade soils shall include the following :
 - i) In situ density and moisture content at each test pit
 - ii) Field CBR using DCP at each test pit.

- iii) Characterization (Grain size and Atterberg Limit test) for each test pit sample.
- iv) Laboratory moisture density characteristics (modified AASHTO compaction).
- v) Laboratory CBR (un-soak and 4-day soak compacted at three energy levels) and swell.
- vi) Apart from the above, permeability and consolidation test shall be carried out for problematic soils along project corridor.

1.4. Material Investigation

The activities included:

- i) Identification of potential sources (including use of fly-ash/slag), quarry sites and borrow areas.
- ii) Collection of samples and conducting relevant laboratory tests.
- iii) Evaluation of test results and assesses the suitability thereof for incorporation in various works and making recommendation on the use of the materials from different sources based on techno-economic principles.
- iv) Assess adequacy of quality and quantities of various construction materials available
- v) No material shall be used from the ROW except by way of leveling the ground as required from construction point of view or for landscaping and planting of trees. Environmental restrictions, if any and feasibility of availability of these sites to perspective civil works contractors should be duly taken into account.
- vi) Preparation of mass haul diagram and quarry charts indicating the location of selected borrow areas, quarries and the respective estimated quantities.
- vii) Recommend on how to make good this borrow and quarry areas after the exploitation of materials for construction of works.
- viii) Preparation and testing of bituminous mixes for various layers and concrete mixes of different grades using suitable materials (binders, aggregates, sand fillers etc.) as identified during material investigation to conform to latest MORT&H specifications.

1.5. Test Pit for Sub-grade Investigations

The test pit for sub-grade investigations was dug to carry out the following tests:

- in-situ density and moisture content
- field CBR using DCP at each test pit
- characterization at each test pit
- Laboratory moisture-density characteristics
- Laboratory CBR (un-soaked and 4-day soaked compacted at 3 energy levels) and swell.

The following pavement investigation has been carried as per the TOR.

Pavement Composition – Test pit will be dug at every 500m and also along each homogeneous road segment made to ascertain the pavement composition and the sub-grade type and condition.

Pavement Condition Survey - Detailed field studies will be carried out to collect road and pavement conditions such as cracking, raveling, rutting, potholes and drainage.

Pavement structural Strength – To carry out the deflection test, mainline shall be carried out at every 500m and control line shall be carried out at each 100m long homogeneous road segment along the road sections of the existing pavement. Benkelman Beam Deflection Tests will be carried out as per the procedure in IRC: 81 –1997.

Riding Quality - Riding quality will be assessed through the roughness test by using Bump Integrator or similar instrument. The calibration of the instrument shall be done as per the procedure given in IRC and duly authenticated by established laboratory/institution acceptable to the client. The survey shall be carried out along the outer wheel paths. The survey shall cover a minimum of two runs along the wheel paths for each direction.

Test pit activities were conducted at three locations. Location-1 (near Minor bridge), Location-2 (Near existing rotary) and Location-3 (Near IFFCO Gate)



Fig-1: 3 Test Pit Activities

1.6. Existing Pavement Composition

The pavement composition is as shown in table given below:

Table-1: 1 Existing Pavement Composition

Locations	Chainage (km)	BC	DBM	Overlay	WMM	GSB	Sub-grade	Remarks
1	6+000	250			200	300 to 500		Near Minor Bridge
2	3+000	80		-	75	200		Near Rotary
		90		-	150	200		Re-surface-1
			30	-	150			Old Layer
3	0+800	95		-	150	200		Near Iffco Gate
		80		-	170	200		

1.7. Laboratory Tests on Test Samples

The soil samples of the Existing sub-grade collected from the test pits are tested in the laboratory and the test results viz. Grain size classification, Atterberg limits, MDD, corresponding OMC and CBR values etc. are given in the following.

Table-1: 2 Trial Pit Details

Trial pit No.	Depth, m	42Q, Co-ordinates, m	
		N	E
TP – 01	2.00	2554341	0617594
TP – 02	2.00	2554252	0617927
TP – 03	2.00	2551655	0619321
TP – 04	2.00	2550640	0620031
TP – 05	2.00	2547819	0623548
TP - 06	2.00	2551892	0619131

Table-1: 3 FIELD CBR Details

CBR No.	Depth, m	42Q, Co-ordinates, m	
		N	E
1	0.500	2554341	0617594
2	0.200	2554252	0617927

CBR No.	Depth, m	42Q, Co-ordinates, m	
		N	E
3	0.200	2551655	0619321
4	0.200	2550640	0620031
5	0.200	2547819	0623548
6	0.200	2551892	0619131

1.8. Standard Penetration Test (SPT)

The SPT has been conducted in accordance with IS 2131:1981 (Reaffirmed-2016) Method for Standard Penetration Test for Soils, in boreholes starting from 0.5 m depth from EGL at every change in strata or an interval of 1.50 m depth in uniform strata. The split spoon sampler has been seated 15 cm with the blows of the hammer weighing 63.5 kg, falling freely through the height of 75 cm. Thereafter the split spoon sampler was further driven by 30 cm. The number of blows required to drive each 15 cm penetration has been recorded. The number of blows for the first 15 cm penetration is termed as a seating drive. The last 30 cm penetration is termed as penetration resistance N-Value.

Table-1: 4 Co-relation of SPT value for cohesionless soil

SPT (N) value	0 – 4	4 – 10	10 – 30	30 – 50	>50
Consistency of soil	Very Loose	Loose	Medium	Dense	Very Dense

Table-1: 5 Co-relation of SPT value for cohesive soil

SPT (N) value	0 – 2	2 – 4	4 – 8	8 – 15	15 – 30	>30
Consistency of soil	Very Soft	Soft	Medium	Stiff	Very Stiff	Hard

Note: Refer Geotechnical report for findings of test carried out in project area.

1.9. Material Investigations

Study has been conducted to determine the location from where construction materials in adequate quantity could be available for use on works for the project. The sites viz. borrow / quarry areas for soil, granular sub-base material, stone metal etc. has been visited & samples collected for carrying out appropriate tests to determine their suitability. Possible location of new borrow areas for the materials has been investigated in consultation with the client and suitable tests has been conducted like gradation tests, Atterberg's limits compaction & CBR tests in accordance with IS: 2720. Following tests has been conducted on aggregates to determine their suitability in various pavements layers.

- Aggregate impact value
- Combined flakiness and elongation indices (Total)
- Soundness viz.
- Water absorption

Similarly, the sources of supply for cement, steel and bitumen has been found out and all the information has been suitably documented. A comprehensive report on material investigations has been prepared which would include the sources of the materials, their leads, available quantities and their suitability for construction. This information will become an input to the rate Analysis and further to Cost Estimation

1.10. Type of Materials

The objective of material investigations is to identify the source of natural materials like soil, sand, stone, etc. near and along the alignment of the project road as required for the construction of the embankment and sub-grade under the pavement and as also the source of aggregates/stones and sand for the construction of road pavement, embankment, bridges, culverts and other structures.

1.11. Soil Borrow Sources

Suitable soil conforming to MORT&H/DPA specifications in huge quantities will be required to construct embankment, sub-grade and earthen shoulder. An investigation to identify potential soil borrow sources have confirmed the availability of suitable soil at number of locations along the project road corridor. The soil can be imported from the land near to the project road which is suitable with nature of the type of the soil. The identification of borrow areas were done mainly through local inquiries and contacting the Villagers and Local (Panchayat) bodies. A total of four

soils borrow sources which define the type and nature of soil in that area. The results are presented in table below-

Table-1: 6 Lead Chart/Table of sources of Material

Sr No	Material Description (Not Required from Supplier, required directly from the source)	Source Address / details
1	Coarse Aggregate	Anjar
a)	10mm	
b)	20mm	
c)	40mm	
d)	60mm	
2	Fine Aggregate	Anjar
a)	Natural sand or crushed sand	
3	Murum	Anjar
4	Manufacturing Material	
a)	cement	TBI
b)	steel	TBI
c)	bitumen	Anjar
d)	Fly ash	NTPC, Bhuj
5	Water Source	
6	Identify borrow area (Soil or Murum) near to project location	
7	Identify quarry (All Types of Aggregate) location, Lead distance from Alignment, Location	

1.12. Results of modified Proctor test & CBR test

At the above mentioned locations Proctor and CBR Test has been carried out and result has been tabulated below.

Table-1: 7 Modified Proctor Test Results & Lab CBR Test Results

Sr. No	Trial Pit No.	Depth from EGL, m	Type of Soil	M.D.D, g/cc	O.M.C, %	CBR Value, %	
						Soaked	Unsoaked

1	1	0.5	SM	2.151	7.0	17.2	23.8
2	2	0.5	SM	2.112	7.8	13.8	24.8
3	3	0.5	SM	2.100	7.8	11.4	22.4
4	4	0.5	ML	1.903	14.4	11.0	21.5
5	5	0.5	CI	1.705	16.8	6.7	12.9
6	6	0.5	SC	2.128	6.8	15.7	21.9

Table-1: 8 Field CBR Test Results

Sr. No.	CBR	Depth from EGL, m	Type of Soil	Unsoaked CBR Value, %
1	1	0.500	SM	14.74
2	2	0.200	Filling Material	14.17
3	3	0.200	Filling Material	30.52
4	4	0.200	Filling Material	21.18
5	5	0.200	Filling Material	3.58
6	6	0.200	Filling Material	28.81

1.13. Geo-Technical Investigation for Bridges

Subsoil an investigation has been carried out at all bridges/grade separators/viaducts etc., as per the specified stipulated in IRC: 78 - 2000. Efforts will be made to collect at least one undisturbed sample from each strata encountered in each borehole and at suitable interval in the same strata based on our experience. Disturbed soil samples will be collected at every 1.5m depth up to 10 m depth and thereafter at 3m interval and at change of each stratum. Directions contained in IRC: 78– 2000 and DPA specifications will be kept in view. In case of rocky strata, cores shall be collected where available. Standard penetration tests / vane shear tests will be conducted at each 1.5m depth. The soil samples collected will be subjected to appropriate laboratory tests viz.

- Gradation tests
- Atterberg's limits
- Shearing strength tests- tri-axial or box shear

- Consolidation tests where necessary

1.13.1. Purpose

The objective of the geotechnical investigation was to explore the subsoil profile up to a predetermined depth and to work out the bearing capacity/allowable pressure on the soil beneath at a required foundation depth for the proposed type of foundation. Complete geotechnical investigation work was undertaken to obtain the required subsurface information to study and define the nature and behavior of soil, under the application of loads of proposed structures. Such information was obtained through the following steps:

- ✓ Drilling boreholes and collecting disturbed and undisturbed soil samples.
- ✓ Performing in-situ tests (e.g. SPT, Trial pit F-CBR) and conducting laboratory tests to classify and determine the physical and engineering properties of soils.

1.13.2. Scope of the Work

Exploration at various locations of the proposed site and conduct requisite in-situ tests. Laboratory testing of representative samples obtained during the field investigation to evaluate relevant engineering parameters of the subsurface soils.

Preparation of this report includes:

- Bore logs and trial pits cross-sections
- Results of laboratory tests and field tests
- Recommendation of foundation types and depths

Table-1: 9 List of Test

Sr. No.	Description	Quantity
1	Boreholes	2 Nos. of 30.45 m depth 1 No. of 20.10 m depth 1 No. of 21.45 m depth 1 No. of 25.45 m depth
2	Trial Pits	6 Nos. of 2.00 m depth
3	Field CBR Test	6 Nos
4	Laboratory Tests, Analysis, and Submission of report.	

1.13.3. Liquefaction Potential

Liquefaction of soils is phenomenon which occurs in saturated cohesionless soil (i.e. sand stratum) during dynamic conditions in earthquakes.

Table-1: 10 Zone wise N-Value

Seismic Zone	Depth (m) below Ground Level	N Values	Remarks
III, IV and V	≤ 5	15	For values of depths between 5 m and 10 m, linear interpolation is recommended
	≥ 10	25	
II	≤ 5	10	
	≥ 10	20	

According to IS-1893, Part-1, Cl. 3.16 “Liquefaction is a state in saturated cohesionless soil” and Cl. 6.3.5.2 states “In soil deposits consisting of submerged loose sands and soils falling under classification SP with standard penetration N-values less than 15 in seismic Zones III, IV, V and less than 10 in seismic

Zone II, the vibration caused by earthquake may cause liquefaction or excessive total and differential settlements. Such sites should preferably be avoided while locating new settlements or important projects. Otherwise, this aspect of the problem needs to be investigated and appropriate methods of compaction or stabilization adopted to achieve suitable N-values as indicated below”. The seismic zone factor (Z) 0.36 and maximum earthquake magnitude (Mw) 7.5 has been considered for Bhuj city. The evaluation of the liquefaction potential in case of cohesionless soils shall be computed based on Annex-F from IS1893 (Part-1): 2016. The same in case of clayey soils is given by Seed and Idriss (1982) who stated that clayey soils (i.e. plots above the A-line on the plasticity chart) could be susceptible to liquefaction only if all three of the following conditions are met: (1) Percent less than 5 mm $< 15\%$, (2) $LL < 35$, and (3) $w_c/LL > 0.9$. Due to its origin, this standard is known in the literature as the “Chinese Criteria”.

1.13.4. Field Investigation

1.13.4.1. Drilling Work

The rotary drilling machine was mobilised at the site. The safety mechanisms were developed for the technical team and workers.

Five boreholes of 150 mm diameter were drilled to determine the sub-soil stratification and to test the samples of various depths for the physical and the engineering properties. The undisturbed samples were collected as per IS 1892:1979 (RA-2016) Code of practice for subsurface investigations for foundations. The boreholes were terminated at the termination criteria given in the specifications.

1.13.4.2. Groundwater Condition

The groundwater level was checked in the test boreholes after 24 hours of completion of drilling work. Ground water was encountered from 3.0 to 7.0m depth below EGL during subsurface investigation work carried out in the month of December, '2022. It may differ depending on the period of year and climatic conditions.

Table-1: 11 Borehole Details

BH.No.	Depth below EGL, m	Chainage	Groundwater below EGL, m	42Q, Co-ordinates, m	
				N	E
1	30.45	10 + 900	6.00	2554306	617720
2	30.45	10 + 800	6.00	2554251	617921
3	20.10	7 + 700	4.50	2551643	619336
4	21.45	6 + 200	7.00	2550611	620057
5	25.45	1 + 600	3.00	2547814	623579

Table-1: 12 Trial Pit Details

Trial pit No.	Depth, m	42Q, Co-ordinates, m	
		N	E
TP – 01	2.00	2554341	0617594
TP – 02	2.00	2554252	0617927
TP – 03	2.00	2551655	0619321
TP – 04	2.00	2550640	0620031
TP – 05	2.00	2547819	0623548
TP - 06	2.00	2551892	0619131

Table-1: 13 FIELD CBR Details

CBR No.	Depth, m	42Q, Co-ordinates, m	
		N	E
1	0.500	2554341	0617594
2	0.200	2554252	0617927

3	0.200	2551655	0619321
4	0.200	2550640	0620031
5	0.200	2547819	0623548
6	0.200	2551892	0619131

1.13.4.3. Sampling Description

The disturbed samples were collected from the borehole and the undisturbed samples were collected using a Shelby tube. The soil samples were visually identified and described in accordance with relevant IS codes and thereafter packed, labeled, sealed, and dispatched to our laboratory. The soil samples were transported to our laboratory in Gandhidham for testing.

1.13.4.4. Disturbed Soil Samples

The disturbed soil samples were collected during the boring and also from the split spoon sampler. The samples recovered were labeled and placed in polythene bags and transported to the laboratory for testing.

1.13.4.5. Undisturbed Soil Samples

The undisturbed soil samples were collected in accordance with IS 2132:1986 (Reaffirmed- 2016) Code of Practice for Thin-walled Tubed Sampling of Soil. The sampler used for sampling had a smooth surface, appropriate area ratio, and cutting edge angle thereby minimizing disturbance of the soil during sampling. The samples were collected starting from 1.50m depth at every 3.00m depth from EGL till hard strata have been recovered. The coating of oil was applied on both sides of the sampler to obtain undisturbed samples in the best possible manner. The sampler was then lowered into the borehole on a string of drill rods at a pre-determined level. The disturbed material in the upper end of the sampler, if any, was completely removed. The soil at the lower end of the sampler was trimmed to about 10 to 15 mm. The samples were sealed using the wax, labeled, and transported to our laboratory at Gandhidham for testing.

1.13.4.6. Standard Penetration Test (SPT)

The SPT has been conducted in accordance with IS 2131:1981 (Reaffirmed-2016) Method for Standard Penetration Test for Soils, in boreholes starting from 0.5 m depth from EGL at every change in strata or an interval of 1.50 m depth in uniform strata. The split spoon sampler has been seated 15 cm with the blows of the hammer weighing 63.5 kg, falling freely through the height of

75 cm. Thereafter the split spoon sampler was further driven by 30 cm. The number of blows required to drive each 15 cm penetration has been recorded. The number of blows for the first 15 cm penetration is termed as a seating drive. The last 30 cm penetration is termed as penetration resistance N-Value.

Table-1: 14 Co-relation of SPT value for cohesionless soil

SPT (N) value	0 – 4	4 – 10	10 – 30	30 – 50	>50
Consistency of soil	Very Loose	Loose	Medium	Dense	Very Dense

Table-1: 15 Co-relation of SPT value for cohesive soil

SPT (N) value	0 – 2	2 – 4	4 – 8	8 – 15	15 – 30	>30
Consistency of soil	Very Soft	Soft	Medium	Stiff	Very Stiff	Hard

1.13.4.7. Field California Bearing Ratio (CBR) Test

The field CBR test has been carried out at 0.200 m to 0.500 m depth from EGL as per methodology given in IS 2720, Part-31:1990 RA 2010. This standard covers the method for the determination of bearing ratio of soils in place for the evaluation of strengths of subgrade and bases for road pavements. The bearing ratio generally is known as CBR (California Bearing Ratio) is the ratio of force per unit area required to penetrate a soil mass with a standard circular piston at the rate of 1.25 mm/min to that required for corresponding penetration of a standard material.

$$\text{Bearing Ratio} = \frac{P_t}{P_s} \times 100 (\%)$$

P_t = Corrected unit (or total) test load corresponding to chosen penetration value read from the total penetration curve, in MPa or N.

P_s = Unit (or total) standard load for the same depth of penetration as per P_t , in MPa or N.

1.13.4.8. LABORATORY TESTING

The laboratory tests were performed in accordance with relevant IS codes along with the technical specification of the project, at our laboratory in Gandhidham. The summary of the laboratory test results of all boreholes is presented in Annexure.

Table-1: 16 Laboratory Tests

Laboratory Test	IS Code
Moisture Content	IS 2720 Part 2:1973, RA-2020
Specific Gravity	IS 2720 Part 3:1980, RA-2016
Grain Size Analysis	IS 2720 Part 4:1985, RA-2020
Hydrometer	IS 2720 Part 4:1985, RA-2020
Atterberg's Limits	IS 2720 Part 5:1985, RA-2020
Modified Proctor	IS 2720 Part 8:1983, RA-2020
Unconfined Compressive Strength	IS 2720 Part 10:1991, RA-2020
Shear Parameters i.e. $c - \phi$	IS 2720 Part 11:1981, RA-2016 IS 2720 Part 13:1986, RA-2016
California Bearing Ratio	IS 2720 Part 16:1987, RA-2016
Free Swell Index	IS 2720 Part 40, RA-2016
pH	IS 2720 Part 26
Chlorides	IS 2720 and 3025 Part 32
Sulphate	IS 2720 Part 27

Table-1: 17 Sub-Soil Profile

BH. No.	Depth, m		Soil description	Type of Soil
	From	To		
1	0	2.1	Brownish Fine to Medium Grained Sand Mixed with Non- Plastic Fines and Little Gravels	SM
	2.1	3.45	Brownish Clayey Sand of Low Plasticity Mixed with Gravels	SC

BH.	Depth, m		Soil description	Type of Soil
	No.	From To		
	3.45	15.5	Brownish Medium to Coarse Grained Sand Mixed with Little Gravels	SW-SM
	15.5	20.1	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed with Sand Particles and Little Gravels	CH
	20.1	21.5	Brownish Over Consolidated Clayey Sand of Low Plasticity Mixed with Gravels	SC
	21.5	27.5	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed with Sand Particles and Little Gravels	CH
	27.5	30.5	Brownish Over Consolidated Clay of Intermediate Plasticity Mixed with Little Gravels	CI
2	0	0.4	Filled up	
	0.4	0.95	Greyish Fine to Medium Grained Sand Mixed with Non - Plastic Fines and Gravels	SM
	0.95	3.45	Brownish Clayey Sand of Low Plasticity Mixed with Gravels	SC
	3.45	8.1	Brownish Medium to Coarse Grained Sand Mixed with Little Gravels	SW-SM
	8.1	11.1	Brownish Clay of High Plasticity Mixed with Sand Particles and Gravels	CH
	11.1	14.1	Brownish Clayey Sand of Low Plasticity Mixed with Gravels	SC
	14.1	23.1	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed with Sand Particles and Little Gravels	CH
	23.1	26.1	Reddish Over Consolidated Clayey Sand of High Plasticity Mixed with Little Gravels	SC
	26.1	29.1	Reddish Over Consolidated Clay of High Plasticity Mixed with Sand Particles and Little Gravels	CH
	29.1	30.5	Reddish Over Consolidated Clay of Intermediate Plasticity Mixed with Sand Particles and Little Gravels	CI
3	0	0.4	Filled up	
	0.4	2.1	Brownish Poorly Graded Medium Grained Sand	SP

BH.	Depth, m		Soil description	Type of Soil
	No.	From To		
			Mixed with Little Gravels	
	2.1	8.1	Brownish Medium to Coarse Grained Sand Mixed with Little Gravels	SW-SM
	8.1	9.45	Brownish Clayey Sand of Intermediate Plasticity Mixed with Little Gravels	SC
	9.45	12.5	Brownish Poorly Graded Gravels – Sand Mixture with Little Fines	GP
	12.5	20.1	Reddish Brownish Over Consolidated Clayey Sand of Intermediate to High Plasticity Mixed With Little Gravels	SC
4	0	0.4	Greyish Brownish Fine to Medium Grained Sand Mixed with Non - Plastic Fines and Gravels	SM
	0.4	3.45	Greyish Silty Clay of Low Plasticity Mixed with Little Fine- Grained Sand Particles	CL
	3.45	6.45	Greyish Clay of High Plasticity Mixed with Little Sand Particles and Gravels	CH
	6.45	17.1	Brownish Reddish Consolidated Clayey Sand of High Plasticity Mixed with Little Gravels	SC
	17.1	21.5	Reddish Over Consolidated Clayey Sand of Low to Intermediate Plasticity	SC
5	0	0.4	Greyish Fine to Medium Grained Sand Mixed with Non - Plastic Fines and Gravels	SM
	0.4	3.45	Greyish Clay of High Plasticity Mixed with Little Fine- Grained Sand Particles	CH
	3.45	6.45	Greyish Non - Plastic Silt Mixed with Non-Plastic Fines	ML
	6.45	12.5	Greyish Silty Clay of Low Plasticity Mixed with Little Sand Particles and Gravels	CL
	12.5	15.5	Greyish Clayey Sand of High Plasticity Mixed with Gravels	SC

BH.	Depth, m		Soil description	Type of Soil
No.	From	To		
	15.5	18.5	Brownish Silty Clay of High Plasticity Mixed with Little Gravels	CH
	18.5	23	Greyish Clayey Sand of High Plasticity Mixed With Gravels	SC
	23	25.5	Brownish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Little Gravels	SM

1.13.4.9. Laboratory and Field Test Results

Table-1: 18 Chemical Test Results of Soil

Sr. No.	Bore Hole	Depth from EGL, m	pH	Chloride, mg/L	Sulphate, %	Organic Matter, %
1	1	22.5	8.47	35	0.2560	0.0194
2	2	18.5	8.44	31	0.1660	0.0129
3	3	4.5	8.49	730	0.4490	0.7293
4	4	7.5	9.13	2909	0.7123	1.2568
5	5	10.5	8.93	1999	0.5221	1.1101
Reference			As per IS 456 Table – 4 Class IV			

Table-1: 19 Chemical Test Results of Water

Sr. No.	Bore Hole	pH	Chloride, mg/L	Sulphate, mg/L	Organic Matter, mg/l
1	1	7.68	358	412	525
2	2	7.58	452	435	632
3	3	7.87	412	425	690
4	4	7.79	383	404	460
5	5	7.47	365	413	546

Sr. No.	Bore Hole	pH	Chloride, mg/L	Sulphate, mg/L	Organic Matter, mg/l
IS 456 – 2005 RA:2016		> 6.00	500 mg/L Max (for RCC Work)	400 mg/L Max	--

Table-1: 20 Modified Proctor Test Results & Lab CBR Test Results

Sr. No	Trial Pit No.	Depth from EGL, m	Type of Soil	M.D.D, g/cc	O.M.C, %	CBR Value, %	
						Soaked	Unsoaked
1	1	0.5	SM	2.151	7.0	17.2	23.8
2	2	0.5	SM	2.112	7.8	13.8	24.8
3	3	0.5	SM	2.100	7.8	11.4	22.4
4	4	0.5	ML	1.903	14.4	11.0	21.5
5	5	0.5	CI	1.705	16.8	6.7	12.9
6	6	0.5	SC	2.128	6.8	15.7	21.9

Table-1: 21 Field CBR Test Results

Sr. No.	CBR	Depth from EGL, m	Type of Soil	Unsoaked CBR Value, %
1	1	0.500	SM	14.74
2	2	0.200	Filling Material	14.17
3	3	0.200	Filling Material	30.52
4	4	0.200	Filling Material	21.18
5	5	0.200	Filling Material	3.58
6	6	0.200	Filling Material	28.81

1.13.4.10. Foundation Recommendations

Design of Pile:

Bored Cast *In-Situ* Pile design as per IS: 2911 (Part 1/Sec II)

For Non-Cohesive Soils (Clause No. 6.3.1.1 – Appendix B 1)

$$Q_u = A_p(0.5 D \gamma N_\gamma + P_d N_q) + K P_D \tan \delta A_s$$

For Cohesive Soils (Clause No. 6.3.1.1 – Appendix B 2)

$$Q_u = (A_p N_c C_p + \alpha C_s A_s)$$

Where,	A_p	=	Cross-sectional area of pile toe, m ²
	D	=	Diameter of the stem, m
	γ	=	Effective unit weight of soil at pile toe, kN/m ³
	P_d	=	Effective overburden pressure at pile toe, kN/m ²
	P_D	=	Effective overburden pressure at around stem, kN/m ²
	$N_q \text{ \& } N$	=	Bearing capacity factors
	K	=	Coefficient of earth pressure
	δ	=	Angle of wall friction between pile & soil
	A_s	=	Surface area of pile stem, m ²
	C_p	=	Average cohesion around pile toe, kN/m ²
	α	=	Reduction factor
	C_s	=	Average cohesion around pile stem, kN/m ²

Summary of the load-carrying capacity of the pile: Looking to the characteristics and behavior of soil, the capacity of the pile foundation is tabulated in the table below. The size and depth of the pile foundation may be selected as per the site feasibility.

Table-1: 22 Parameters for the load capacity of a pile

Sr. No.	Depth from EGL, m		Type of soil	Bulk density, g/cc	Cohesion, kg/cm ²	Angle of internal friction, ϕ
	From	To				
	0		SM	1.627		
	0	0.5	SM	1.627		
	0.5	2.1	SM	1.627	Liquefiable	
	2.1	3.45	SC	1.907	0	28
BH-1	3.45	15.5	SW-SM	1.907	0	28

Sr. No.	Depth from EGL, m		Type of soil	Bulk density, g/cc	Cohesion, kg/cm ²	Angle of internal friction, ϕ
	From	To				
	15.5	18	CH	1.944	0.61	15
BH-1	18	20	CH	1.944	0.61	15
	0		Filling	1.881		
	0	0.95	SM	1.881	Liquefiable	
	0.95	3.45	SC	1.881	0.12	18
	3.45	8.1	SW-SM	1.911	0	29
	8.1	11.1	CH	2.032	0.69	12
BH-2	11.1	14.1	SC	2.054	0.19	26
	14.1	18	CH	2.124	0.65	15
	18	20	CH	2.124	0.65	15
	0		Filling	1.801		
	0	2.1	SP	1.801	Liquefiable	
	2.1	8.1	SW-SM	2.043	0	31
	8.1	9.45	SC	2.043	0	31
	9.45	12.5	GP	2.052	0	31
BH-3	12.5	15	SC	2.052	0.28	25
	15	18	SC	2.052	0.28	25
	0		SM	1.673	Liquefiable	
	0	2.1	CL	1.673	SPT < 5	
	2.1	3.45	CL	1.91	0.37	0
	3.45	6.45	CH	1.99	0.65	10
BH-4	6.45	15	SC	1.99	0.35	18
	15	18	SC	20.52	0.35	18
	0		SM	1.594	Liquefiable	
	0	3.45	CH	1.594	SPT < 5	
	3.45	6.45	ML	1.59	Liquefiable	
	6.45	12.5	CL	1.769	0.38	11
	12.5	15.5	SC	2.032	0.62	14

Sr. No.	Depth from EGL, m		Type of soil	Bulk density, g/cc	Cohesion, kg/cm ²	Angle of internal friction, ϕ
	From	To				
BH-5	15.5	18	CH	2.032	0.62	14
	18	18.5	CH	2.032	0.62	14
	18.5	20	SC	2.032	0.62	14

Table-1: 23 Load carrying capacity of a Pile

Pile Type	Bore Hole No.	Length of pile Below EGL, m	Pile Dia.,mm	Pile Capacity, MT						
				Vertical			Lateral			
							With Lique.		Without Lique.	
				With Lique.	Without Lique.	Uplift	Fixed Head	Free Head	Fixed Head	Free Head
		18		153.4	155.5	121.6				
		20	1000	173.4	175.6	140.5	11.3	4	23.2	9
		18		201.9	204.4	154.6				
		20	1200	228.2	230.7	179.7	16.7	5.9	31.2	12.1
	BH-01	18		269.4	272.6	202.4				
		20	1500	308.6	311.8	235.6	26.4	9.4	44.5	17.3
		18		172.7	173.5	134.4				
		20	1000	193.8	194.6	154.2	17.2	6.3	25.7	10
		18		224.9	225.8	168.4				
		20	1200	252.9	253.8	194.9	24.3	9	34.5	13.4
	BH-02	18		300.1	301.2	219.8				
		20	1500	342.5	343.6	254.9	36.6	13.6	49.3	19.2
		15		177.1	180.5	120.6				
		18	1000	227.7	231	166.1	8.1	2.9	46	17.9
		15		226.8	230.8	149.1				
		18	1200	306.7	310.7	208.6	11.9	4.2	61.6	23.9

Pile Type	Bore Hole No.	Length of pile Below EGL, m	Pile Dia.,mm	Pile Capacity, MT						
				Vertical			Lateral			
							With Lique.		Without Lique.	
				With Lique.	Without Lique.	Uplift	Fixed Head	Free Head	Fixed Head	Free Head
	BH-03	15		310.8	315.8	194.6				
		18	1500	415.2	420.2	270.4	18.6	6.7	88.1	34.2
		15		148.9	148.9	114.1				
		18	1000	188	188	149.9	3.5	1.3	7.6	2.9
		15		186.9	186.9	141.2				
		18	1200	244.8	244.8	187.9	4.8	1.8	10.2	4
Bored Cast In-Situ Pile	BH-04	15		249.8	249.8	184.7				
		18	1500	324.2	324.2	244.6	7	2.7	14.6	5.7
		18		110.7	121.5	98.4				
		20	1000	131.6	142.4	118	2.3	0.7	6	2.3
		18		147.9	160.8	125.7				
		20	1200	176.2	189.1	152.4	3.7	1.2	8	3.1
	BH-05	18		200.4	216.6	167.3				
		20	1500	242.5	258.7	202.9	6.4	2.1	11.4	4.4

1.13.5. Discussion & Recommendations

- Pile capacity shall be considered from table 14.
- The water table is considered at 0.0 m, i.e. at EGL, for the pile calculation purpose.
- The groundwater table was encountered from 3.0 to 7.0 m depth from EGL at the time of

field investigation in the month of December 2022. It should be noted; that the groundwater levels are subject to variation caused by seasonal variations or local drainage/pumping conditions and so may be significantly different from those measured during the investigation.

- The factor of safety for vertical and uplift capacity is considered as 2.5 and 3.0 respectively.
- Adequacy of pile capacity shall be checked by a static pile load test at 2.5 times of design load.
- Lateral capacity is evaluated for permissible deflection of 5 mm.
- The working pile shall be checked at 1.5 times the design load for the permissible settlement as per IS 2911 Part-4, 2013.
- The negative skin friction for pile-cap is accounted in the computation of pile capacity.
- Field unsoaked California Bearing Ratio (CBR) value at depth 0.200 m to 0.500 from E.G.L varies from 3.58% to 30.52% and lab soaked CBR value varies from 6.7% to 15.7%, given in table 11 and 12.
- From Table 9 and 10, based on chemical test results, due to high chloride and sulphate content in soil, it is recommended to use OPC cement with C3A content from 5%-8% shall be used in concrete. Alternatively, Portland Slag Cement conforming to IS 455 having more than 50% slag or a blend of OPC & slag may be used. Alternatively, Sulphate resisting Portland cement or Supersulphated cement with protective coatings can be used with maximum water-cement ratio of 0.45 and minimum cement content shall be 370 kg/m³ as per IS: 456 Table 4 (Class - IV).
- It is recommended that suitable corrosion protection measures such as use of higher grade of concrete, increase in concrete cover, CRS steel as reinforcement, HDPE sheets below foundation, etc. (as per recommendations of Design Engineer) can be implemented to minimize deterioration of concrete and corrosion of reinforcement.
- The report presented is representative of the bore locations and does not represent the entire area of construction as a whole.

1.13.6. General Remarks

- i. During excavation for the foundation, it is suggested to verify the subsoil stratum for any variation and the same shall be reported for any further recommendations or amendments.
- ii. The comments are given in this report and the opinion expressed is based on the

ground conditions encountered during the site work and based on the results of tests made on-site and in the laboratory. There may, however, special conditions prevailing at the site which may not have been disclosed by the investigation and which may not have been taken in to account in the report. Any variation in stratification in any of the foundation location shall be studied thoroughly before executing the foundation work.

ANNEXURE 2: BORELOGS

BH-01																										
Name of Owner : Monarch Surveyors and Engineering Consultants Pvt. Ltd.										Date Started : 28-12-2022										Type of Bit used : TC Bit						
Name of Project : Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)										Date Completed : 29-12-2022										Bearing of Hole : 90° with Horizontal Plane						
Bore Hole No. : BH-01 Chainage: 10 + 900										Diameter of Boring : 150 mm										Type of Boring : Rotary Drilling						
Top of Water Level Below EGL : 6.00 m										Depth of Boring : 30.45 m										Co-ordinates, m : 42 Q, N 2554306, E 617720						
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling			SPT N-Value	Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Grain Size Analysis			Hydrometer		Atterberg's Limit			Specific Gravity	Type of Test	Cohesion, C, kg/cm²	Angle of internal friction Ø	Free Swell Index, %	UCS, kg/cm²	CLASSIFICATION	
				Type	Lab.No.	Depth (m)					% Gravel > 4.75 mm	% Sand 4.75-0.075 mm	% Silt & Clay < 0.075 mm	% Silt	% Clay	Liquid Limit, %	Plastic Limit, %	Plasticity Index, %								
						From																				To
0.00	Brownish Fine to Medium Grained Sand Mixed With Non-Plastic Fines and Little Gravels	SM	2.10	DS	165-01-01	0.00	0.50	--	--	--	16	57	26	--	24.4	NP	--	--	--	--	--	--	--	--	SM	
0.50				SPT	165-01-02	0.50	0.95	4	--	--	3	79	18	--	23.1	NP	--	--	--	--	--	--	--	--	SM	
1.00				UDS	165-01-03	1.50	2.10	--	1.627	1.417	14.8	6	79	14	--	23.7	NP	2.654	--	--	--	Nil	--	--	SM	
1.50																										
2.00																										
2.50	Brownish Clayey Sand of Low Plasticity Mixed With Gravels (SC)		1.35	SPT	165-01-04	3.00	3.45	30	--	--	12	70	18	--	30.6	15.2	15.4	2.649	--	--	--	10	--	--	SC	
3.00																										
3.50																										
4.00																										
4.50																										
5.00	Brownish Medium to Coarse Grained Sand Mixed With Little Gravels	SW-SM	12.00	UDS-F + SPT	165-01-05	4.50	5.10	32	1.907	1.674	13.9	6	85	9	--	NP	2.664	DUU	0	28	--	--	--	SW-SM		
5.50				SPT	165-01-06	6.00	6.45	41	--	--	7	82	11	--	NP	--	--	--	--	--	--	--	SW-SM			
6.00																										
6.50																										
7.00																										
7.50				UDS-F + SPT	165-01-07	7.50	8.10	58	--	--	5	86	9	--	NP	--	--	--	--	--	--	--	--	SW-SM		
8.00																										
8.50																										
9.00				SPT	165-01-08	9.00	9.45	63	--	--	4	90	6	--	NP	2.671	--	--	--	Nil	--	--	SW-SM			
9.50																										
10.00																										
10.50	UDS-F + SPT	165-01-09	10.50	11.10	>100 (9 cm)	--	--	5	86	9	--	NP	--	--	--	--	--	--	--	--	SW-SM					
11.00																										
11.50																										
12.00	SPT	165-01-10	12.00	12.45	51	--	--	6	88	6	--	NP	--	--	--	--	--	--	--	--	SW-SM					
12.50																										
13.00																										
13.50	UDS-F + SPT	165-01-11	13.50	14.10	58	--	--	3	86	11	--	NP	--	--	--	--	--	--	--	--	SW-SM					
14.00																										
14.50																										
15.00	SPT	165-01-12	15.00	15.45	51	--	--	4	86	10	--	NP	--	--	--	--	--	--	--	--	SW-SM					
15.50																										
16.00	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed With Sand Particles and Little Gravels	CH	4.65	UDS	165-01-13	16.50	17.10	--	1.944	1.602	21.4	10	39	51	31	20	53.6	21.6	32.0	2.639	TUU	0.61	15	50	--	CH
16.50																										
17.00				SPT	165-01-14	18.00	18.45	>100 (8 cm)	--	--	8	33	59	--	67.9	23.9	44.0	--	--	--	--	--	--	CH		
17.50																										
18.00																										
18.50																										
19.00																										
19.50	UDS-F + SPT	165-01-15	19.50	20.10	>100 (11 cm)	--	--	0	29	71	48	23	58.8	23.2	35.6	--	--	--	--	--	CH					
20.00																										
20.50																										
21.00	Brownish Over Consolidated Clayey Sand of Low Plasticity Mixed With Gravels (SC)		1.35	SPT	165-01-16	21.00	21.45	>100 (10 cm)	--	--	12	42	46	--	51.2	22.2	29.0	2.647	--	--	--	40	--	SC		
21.50																										
22.00	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed With Sand Particles and Little Gravels	CH	6.00	UDS-F + SPT	165-01-17	22.50	23.10	>100 (7 cm)	--	--	3	29	68	44	24	75.8	25.1	50.7	--	--	--	--	--	CH		
22.50																										
23.00																										
23.50				SPT	165-01-18	24.00	24.45	>100 (9 cm)	--	--	2	32	66	--	75.1	25.3	49.8	--	--	--	--	--	CH			
24.00																										
24.50																										
25.00				UDS-F + SPT	165-01-19	25.50	26.10	>100 (10 cm)	--	--	1	39	60	39	21	56.2	23.9	32.3	--	--	--	--	--	CH		
25.50																										
26.00																										
26.50																										
27.00	SPT	165-01-20	27.00	27.45	>100 (8 cm)	--	--	1	35	64	--	56.4	24.4	32.0	2.651	--	--	--	55	--	CH					
27.50																										
28.00	Brownish Over Consolidated Clay of Intermediate Plasticity Mixed With Little Gravels	CI	3.00	UDS-F + SPT	165-01-21	28.50	29.10	>100 (11 cm)	--	--	4	45	51	35	16	42.2	18.9	23.3	--	--	--	--	--	CI		
28.50																										
29.00																										
29.50																										
30.00	SPT	165-01-22	30.00	30.45	>100 (7 cm)	--	--	0	24	76	--	38.7	16.9	21.8	--	--	--	--	--	--	CI					
30.50																										
DS : Disturbed sample SPT : Standard Penetration Value UDS : Undisturbed Sample																										
Note 1: Bulk Density at 4.5m depth considered as per SPT Value (Ref. Table-3-4 of Foundation analysis and design by Joseph E. Bowles -5th edition)																										

BH-02																																													
Name of Owner : Monarch Surveyors and Engineering Consultants Pvt. Ltd.														Date Started : 26-12-2022				Type of Bit used : TC Bit																											
Name of Project : Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)														Date Completed : 27-12-2022				Bearing of Hole : 90° with Horizontal Plane																											
Bore Hole No. : BH-02 Chainage: 10 + 800														Diameter of Boring : 150 mm				Type of Boring : Rotary Drilling																											
Top of Water Level Below EGL : 6.00 m														Depth of Boring : 30.45 m				Co-ordinates, m : 42 Q, N 2554251, E 617921																											
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling			SPT N-Value	Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Grain Size Analysis			Hydrometer		Atterberg's Limit			Specific Gravity	Type of Test	Cohesion, C, kg/cm ²	Angle of Internal friction Ø	Free Swell Index, %	UCS, kg/cm ²	CLASSIFICATION																				
				Type	Lab.No.	Depth (m) From To					% Gravel > 4.75 mm	% Sand 4.75-0.075 mm	% Silt & Clay < 0.075 mm	% Silt	% Clay	Liquid Limit, %	Plastic Limit, %	Plasticity Index, %																											
0.00	Filling Material		0.40	DS	165-02-01	0.00	0.50	--	--	--	--				--	--			--	--	--	--	--	--	--																				
0.50	Greyish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Gravels (SM)		0.55	SPT	165-02-02	0.50	0.95	6	--	--	--	0	85	15	--	--	21.6	NP	--	--	--	--	--	--	SM																				
1.00																																													
1.50				Brownish Clayey Sand of Low Plasticity Mixed With Gravels	SC	2.50	UDS	165-02-03	1.50	2.10	--	1.881	1.582	18.9	16	54	30	--	--	33.4	16.5	16.9	2.632	TUU	0.13	18	15	--	SC																
2.00																																													
2.50																																													
3.00	Brownish Medium to Coarse Grained Sand Mixed With Little Gravels	SW-SM	4.65	SPT	165-02-04	3.00	3.45	31	--	--	--	9	59	32	19	13	32.6	16.3	16.3	--	--	--	--	--	SC																				
3.50																																													
4.00				UDS-F + SPT	165-02-05	4.50	5.10	42	1.911	1.682	13.6	9	84	7	--	NP	2.667	DUU	0	29	Nil	--	SW-SM																						
4.50																																													
5.00																																													
5.50	Brownish Medium to Coarse Grained Sand Mixed With Little Gravels	SW-SM	4.65	SPT	165-02-06	6.00	6.45	50	--	--	--	8	82	10	--	--	NP	--	--	--	--	--	--	--	SW-SM																				
6.00																																													
6.50				UDS-F + SPT	165-02-07	7.50	8.10	53	--	--	--	7	85	8	--	NP	--	--	--	--	--	--	SW-SM																						
7.00																																													
7.50																																													
8.00	Brownish Clay of High Plasticity Mixed With Sand Particles and Gravels	CH	3.00	SPT	165-02-08	9.00	9.45	54	--	--	--	2	34	64	39	25	70.8	26.2	44.6	--	--	--	--	--	CH																				
9.00																																													
9.50				UDS	165-02-09	10.50	11.10	--	2.032	1.652	23.0	10	28	62	--	61.4	25.3	36.1	2.638	TUU	0.69	12	46	--	CH																				
10.00																																													
10.50																																													
11.00	Brownish Clayey Sand of Low Plasticity Mixed With Gravels	SC	3.00	SPT	165-02-10	12.00	12.45	71	--	--	--	6	71	23	--	--	29.6	15.3	14.3	--	--	--	--	--	SC																				
12.00																																													
12.50																																													
13.00	Brownish Clayey Sand of Low Plasticity Mixed With Gravels	SC	3.00	UDS	165-02-11	13.50	14.10	--	2.054	1.768	16.2	3	69	28	--	--	30.2	16.9	13.3	2.650	TUU	0.19	26	10	--	SC																			
13.50																																													
14.00																																													
14.50	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed With Sand Particles and Little Gravels	CH	9.00	SPT	165-02-12	15.00	15.45	>100 (11 cm)	--	--	--	10	37	53	33	20	56.6	21.2	35.4	--	--	--	--	--	CH																				
15.00																																													
15.50				UDS	165-02-13	16.50	17.10	--	2.124	1.698	25.1	0	42	58	--	57.0	25.2	31.8	2.636	TUU	0.65	15	--	--	--	CH																			
16.00																																													
16.50																																													
17.00	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed With Sand Particles and Little Gravels	CH	9.00	SPT	165-02-14	18.00	18.45	>100 (8 cm)	--	--	--	1	23	76	--	--	58.0	25.9	32.1	--	--	--	--	73	--	CH																			
17.50																																													
18.00				UDS-F + SPT	165-02-15	19.50	20.10	>100 (10 cm)	--	--	--	2	28	70	48	22	58.5	26.2	32.3	2.632	--	--	--	--	--	--	CH																		
18.50																																													
19.00																																													
19.50	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed With Sand Particles and Little Gravels	CH	9.00	SPT	165-02-16	21.00	21.45	>100 (6 cm)	--	--	--	0	30	70	--	--	66.8	26.6	40.2	--	--	--	--	--	CH																				
20.00																																													
20.50				UDS-F + SPT	165-02-17	22.50	23.10	>100 (11 cm)	--	--	--	0	35	65	--	64.9	25.6	39.3	--	--	--	--	--	--	--	CH																			
21.00																																													
21.50																																													
22.00	Brownish Reddish Over Consolidated Clay of High Plasticity Mixed With Sand Particles and Little Gravels	CH	3.00	SPT	165-02-18	24.00	24.45	>100 (10 cm)	--	--	--	4	63	33	--	--	50.3	23.2	27.1	--	--	--	--	--	SC																				
22.50																																													
23.00				UDS-F + SPT	165-02-19	25.50	26.10	>100 (12 cm)	--	--	--	5	60	35	--	50.9	23.9	27.0	--	--	--	--	--	--	--	SC																			
23.50																																													
24.00																																													
24.50	Reddish Over Consolidated Clayey Sand of High Plasticity Mixed With Little Gravels	SC	3.00	SPT	165-02-20	27.00	27.45	>100 (3 cm)	--	--	--	0	17	83	61	22	63.6	27.1	36.5	--	--	--	--	--	CH																				
25.00																																													
25.50				UDS-F + SPT	165-02-21	28.50	29.10	>100 (11 cm)	--	--	--	8	27	65	--	50.9	22.3	28.6	2.642	--	--	--	--	--	--	CH																			
26.00																																													
26.50																																													
27.00	Reddish Over Consolidated Clay of High Plasticity Mixed With Sand Particles and Little Gravels	CH	3.00	SPT	165-02-22	30.00	30.45	>100 (8 cm)	--	--	--	2	44	55	--	--	47.1	18.1	29.0	--	--	--	--	--	CI																				
27.50																																													
28.00																																													
28.50	Reddish Over Consolidated Clay of Intermediate Plasticity Mixed With Sand Particles and Little Gravels (CI)		1.35	SPT	165-02-22	30.00	30.45	>100 (8 cm)	--	--	--	2	44	55	--	--	47.1	18.1	29.0	--	--	--	--	--	CI																				
29.00																																													
29.50																																													
30.00	Reddish Over Consolidated Clay of Intermediate Plasticity Mixed With Sand Particles and Little Gravels (CI)		1.35	SPT	165-02-22	30.00	30.45	>100 (8 cm)	--	--	--	2	44	55	--	--	47.1	18.1	29.0	--	--	--	--	--	CI																				
30.50																																													
31.00																																													
DS : Disturbed sample														SPT : Standard Penetration Value										UDS : Undisturbed Sample																					
Note 1: Bulk Density at 4.5m depth considered as per SPT Value (Ref. Table-3-4 of Foundation analysis and design by Joseph E. Bowles -5th edition)																																													

DS : Disturbed sample SPT : Standard Penetration Value UDS : Undisturbed Sample

Note 1: Bulk Density at 4.5m depth considered as per SPT Value (Ref. Table-3-4 of Foundation analysis and design by Joseph E. Bowles -5th edition)

BH-03																											
Name of Owner : Monarch Surveyors and Engineering Consultants Pvt. Ltd.				Date Started : 26-12-2022				Type of Bit used : TC Bit																			
Name of Project : Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID: 262)				Date Completed : 26-12-2022				Bearing of Hole : 90 ⁰ with Horizontal Plane																			
Bore Hole No. : BH-03 Chainage: 7 + 700				Diameter of Boring : 150 mm				Type of Boring : Rotary Drilling																			
Top of Water Level Below EGL : 4.50m				Depth of Boring : 20.10 m				Co-ordinates, m : 42 Q, N 2551643, E 619336																			
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling			SPT N-Value	Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content %	Grain Size Analysis			Hydrometer		Atterberg's Limit			Specific Gravity	Type of Test	Cohesion, C, kg/cm ²	Angle of Internal Friction φ	Free Swell Index, %	UCS, kg/cm ²	CLASSIFICATION		
				Type	Lab.No.	Depth (m)					% Gravel	% Sand	% Silt & Clay	% Silt	% Clay	Liquid Limit, %	Plastic Limit, %	Plasticity Index, %									
						From																				To	
0.00	Filling Material		0.40	DS	165-03-01	0.00	0.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
0.50	Brownish Poorly Graded Medium Grained Sand Mixed With Little Gravels	SP	1.70	SPT	165-03-02	0.50	0.95	11	--	--	--	0	98	2	--	--	NP	--	2.674	--	--	--	--	--	--	SP	
1.00																											
1.50				UDS-F + SPT	165-03-03	1.50	2.10	15	1.801	1.618	11.3	1	96	3	--	--	NP	--	--	--	--	Nil	--	--	--	SP	
2.00																											
2.50	Brownish Medium to Coarse Grained Sand Mixed With Little Gravels	SW-SM	6.00	SPT	165-03-04	3.00	3.45	84	--	--	--	17	73	9	--	--	NP	--	2.680	--	--	--	--	--	--	SW-SM	
3.00																											
3.50																											
4.00																											
4.50				UDS-F + SPT	165-03-05	4.50	5.10	84	2.043	1.818	12.4	3	89	8	--	--	NP	--	2.678	--	--	31	--	--	--	SW-SM	
5.00																											
5.50																											
6.00				SPT	165-03-06	6.00	6.45	74	--	--	--	0	95	5	--	--	NP	--	--	--	--	--	--	--	SW-SM		
6.50																											
7.00																											
7.50				UDS-F + SPT	165-03-07	7.50	8.10	86	--	--	--	1	90	9	--	--	NP	--	--	--	--	--	--	--	SW-SM		
8.00																											
8.50																											
9.00	Brownish Clayey Sand of Intermediate Plasticity Mixed With Little Gravels (SC)		1.35	SPT	165-03-08	9.00	9.45	75	--	--	--	5	56	39	26	13	39.6	18.3	21.3	2.650	--	--	--	30	--	SC	
9.50																											
10.00	Brownish Poorly Graded Gravels – Sand Mixture With Little Fines	GP	3.00	UDS-F + DS	165-03-09	10.50	11.10	--	--	--	--	55	41	4	--	--	NP	--	--	--	--	--	--	--	GP		
10.50																											
11.00																											
11.50				SPT - F + DS	165-03-10	12.00	12.45	>100 (8 cm)	--	--	--	92	8	0	--	--	NP	--	--	--	--	--	--	--	GP		
12.00																											
12.50																											
13.00	Reddish Brownish Over Consolidated Clayey Sand of Intermediate to High Plasticity Mixed With Little Gravels	SC	7.65	UDS-F + SPT + DS	165-03-11	13.50	14.10	>100 (7 cm)	2.052	1.755	16.9	0	71	28	--	--	44.2	19.3	24.9	2.644	TUU	0.28	25	--	--	SC	
13.50																											
14.00																											
14.50				SPT	165-03-12	15.00	15.45	>100 (11 cm)	--	--	--	0	70	30	--	--	46.3	20.9	25.4	--	--	--	--	36	--	SC	
15.00																											
15.50																											
16.00				UDS-F + SPT	165-03-13	16.50	17.10	>100 (9 cm)	--	--	--	1	62	37	23	14	44.6	20.7	23.9	2.643	--	--	--	--	--	--	SC
16.50																											
17.00				SPT	165-03-14	18.00	18.45	>100 (12 cm)	--	--	--	0	72	28	--	--	50.7	22.0	28.7	--	--	--	--	--	SC		
17.50																											
18.00																											
18.50																											
19.00																											
19.50				UDS-F + SPT	165-03-15	19.50	20.10	>100 (8 cm)	--	--	--	1	65	34	--	--	54.1	22.8	31.3	--	--	--	--	--	SC		
20.00																											
DS : Disturbed sample SPT : Standard Penetration Value UDS : Undisturbed Sample																											
Note 1: Bulk Density at 1.5 and 4.5m depth considered as per SPT Value (Ref. Table-3-4 of Foundation analysis and design by Joseph E. Bowles -5th edition)																											
Note 2: Shear parameters at 4.5 m depth are obtained based on SPT value 70 % will taken (Ref. Fig.1 Relationship Between φ and N - IS 6403)																											
Note 3: Dry Density at 13.5 m depth is determined from Remoulded sample method																											

DS : Disturbed sample SPT : Standard Penetration Value UDS : Undisturbed Sample

Note 1: Bulk Density at 1.5 and 4.5m depth considered as per SPT Value (Ref. Table-3-4 of Foundation analysis and design by Joseph E. Bowles -5th edition)

Note 2: Shear parameters at 4.5 m depth are obtained based on SPT value 70 % will taken (Ref. Fig.1 Relationship Between φ and N - IS 6403)

Note 3: Dry Density at 13.5 m depth is determined from Remoulded sample method

BH-04																												
Name of Owner : Monarch Surveyors and Engineering Consultants Pvt. Ltd.				Date Started : 25-12-2022				Type of Bit used : TC Bit																				
Name of Project : Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID: 262)				Date Completed : 25-12-2022				Bearing of Hole : 90 ⁰ with Horizontal Plane																				
Bore Hole No. : BH-04				Chainage: 6 + 200				Diameter of Boring : 150 mm				Type of Boring : Rotary Drilling																
Top of Water Level Below EGL : 7.0m				Depth of Boring : 21.45 m				Co-ordinates, m : 42 Q, N 2550611, E 620057																				
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling			SPT N-Value	Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Grain Size Analysis			Hydrometer		Atterberg's Limit			Specific Gravity	Type of Test	Cohesion, C kg/cm ²	Angle of Internal Friction Ø	Free Swell Index, %	UCS, kg/cm ²	CLASSIFICATION			
				Type	Lab.No.	Depth (m)					% Gravel > 4.75 mm	% Sand 4.75-0.075 mm	% Silt & Clay < 0.075 mm	% Silt	% Clay	Liquid Limit, %	Plastic Limit, %	Plasticity Index, %										
						From																				To		
0.00	* Strata-1 (SM)		0.40	DS	165-04-01	0.00	0.50	--	--	--	--	11	45	44	--	27.5	NP	--	--	--	--	--	--	--	SM			
0.50	Greyish Silty Clay of Low Plasticity Mixed With Little Fine Grained Sand Particles	CL	3.05	SPT	165-04-02	0.50	0.95	4	--	--	--	0	3	97	--	34.2	16.8	17.4	--	--	--	--	--	--	--	CL		
1.00				UDS	165-04-03	1.50	2.10	--	1.673	1.305	28.2	0	2	98	84	14	32.6	16.3	16.3	2.658	--	--	--	10	--	CL		
1.50					165-04-04	3.00	3.45	7	--	--	--	0	5	95	--	33.8	19.2	14.7	--	--	--	--	--	--	CL			
2.00				Greyish Clay of High Plasticity Mixed With Little Sand Particles and Gravels	CH	3.00	UDS	165-04-05	4.50	5.10	--	1.910	1.527	25.1	2	6	93	71	22	71.6	26.9	44.7	2.620	TUU	0.65	10	43	--
2.50	SPT	165-04-06	6.00				6.45	8	--	--	--	0	6	94	--	74.1	25.8	48.3	--	--	--	--	--	--	CH			
3.00		165-04-07	7.50				8.10	--	1.990	1.629	22.2	9	52	39	19	20	50.1	22.6	27.5	2.644	TUU	0.35	18	30	--	SC		
3.50	Brownish Reddish Consolidated Clayey Sand of High Plasticity Mixed With Little Gravels	SC	10.65				SPT	165-04-08	9.00	9.45	36	--	--	--	9	46	45	--	54.8	23.2	31.6	--	--	--	--	--	--	SC
4.00				UDS-F + SPT	165-04-09	10.50	11.10	92	--	--	--	3	54	43	--	51.4	22.8	28.6	--	--	--	--	--	--	SC			
4.50				SPT	165-04-10	12.00	12.45	>100 (6 cm)	--	--	--	2	56	42	21	21	51.1	22.5	28.6	2.652	--	--	--	--	--	SC		
5.00					165-04-11	13.50	14.10	>100 (10 cm)	--	--	--	4	57	39	--	50.6	21.8	28.8	--	--	--	--	30	--	SC			
5.50				UDS-F + SPT	165-04-12	15.00	15.45	>100 (13 cm)	--	--	--	2	50	48	--	55.4	23.5	31.9	--	--	--	--	--	--	SC			
6.00					165-04-13	16.50	17.10	>100 (11 cm)	--	--	--	3	53	44	--	53.9	21.5	32.4	--	--	--	--	--	--	SC			
6.50				Reddish Over Consolidated Clayey Sand of Low to Intermediate Plasticity	SC	4.35	SPT	165-04-14	18.00	18.45	>100 (8 cm)	--	--	--	0	73	27	--	33.2	17.6	15.6	--	--	--	--	--	--	SC
7.00							UDS	165-04-15	19.50	20.10	--	2.086	1.765	18.2	0	69	31	17	14	39.3	19.4	19.9	2.654	TUU	0.22	26	27	--
7.50																												
8.00																												
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DS : Disturbed sample SPT : Standard Penetration Value UDS : Undisturbed Sample																												
* Strata-1 - Greyish Brownish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Gravels																												
Note 1 : * C Values obtained from Graph of N-value v/s Cohesion Relationship (Ref: Foundation Design Manual, Nayak N.V.)																												

DS : Disturbed sample SPT : Standard Penetration Value UDS : Undisturbed Sample

* Strata-1 - Greyish Brownish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Gravels

Note 1 : * C Values obtained from Graph of N-value v/s Cohesion Relationship (Ref: Foundation Design Manual, Nayak N.V.)

BH-05																										
Name of Owner : Monarch Surveyors and Engineering Consultants Pvt. Ltd.							Date Started : 24-12-2022							Type of Bit used : TC Bit												
Name of Project : Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)							Date Completed : 25-12-2022							Bearing of Hole : 90° with Horizontal Plane												
Bore Hole No. : BH-05 Chainage: 1 + 600							Diameter of Boring : 150 mm							Type of Boring : Rotary Drilling												
Top of Water Level Below EGL : 3.00 m							Depth of Boring : 25.45 m							Co-ordinates, m : 42 Q, N 2547814, E 623579												
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling				SPT N-Value	Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Grain Size Analysis			Hydrometer		Atterberg's Limit			Specific Gravity	Type of Test	Cohesion, C kg/cm ²	Angle of internal friction Ø	Free Swell Index, %	UCS, kg/cm ²	CLASSIFICATION
				Type	Lab.No.	Depth (m)						% Gravel > 4.75 mm	% Sand 4.75- 0.075 mm	% Silt & Clay < 0.075 mm	% Silt	% Clay	Liquid Limit, %	Plastic Limit, %	Plasticity Index, %							
0.00	* Strata-1 (SM)		0.40	DS	165-05-01	0.00	0.50	--	--	--	--	3	53	44	--	20.9		NP	--	--	--	--	--	--	--	SM
0.50	Greyish Clay of High Plasticity Mixed With Little Fine Grained Sand Particles	CH	3.05	SPT	165-05-02	0.50	0.95	2	--	--	--	0	2	98	--	56.1	24.9	31.2	--	--	--	--	--	--	--	CH
1.00				UDS	165-05-03	1.50	2.10	--	1.594	1.230	29.6	0	1	99	--	57.2	25.1	32.1	2.632	--	--	--	36	--	CH	
1.50				SPT	165-05-04	3.00	3.45	2	--	--	--	0	3	97		97	58.2	25.3	32.9	--	--	--	--	--	--	CH
2.00				UDS-F + SPT	165-05-05	4.50	5.10	5	1.590	1.345	18.2	0	40	60	--	27.7		NP	--	--	--	--	Nil	--	--	ML
2.50				SPT	165-05-06	6.00	6.45	7	--	--	--	0	23	76		76	27.3		NP	--	--	--	--	--	--	ML
3.00	Greyish Non - Plastic Silt Mixed With Non-Plastic Fines	ML	3.00	UDS	165-05-07	7.50	8.10	--	1.750	1.402	24.8	0	14	86	68	18	34.1	18.4	15.7	2.643	--	--	--	10	--	CL
3.50				SPT	165-05-08	9.00	9.45	9	--	--	--	2	21	77	--	34.2	14.8	19.4	--	--	--	--	--	--	CL	
4.00				UDS	165-05-09	10.50	11.10	--	1.787	1.499	19.2	1	34	65	--	30.3	15.6	14.7	2.650	TUU	0.38	11	--	--	CL	
4.50				SPT	165-05-10	12.00	12.45	14	--	--	--	0	43	57	--	31.2	16.5	14.7	--	--	--	--	--	--	CL	
5.00				UDS-F + SPT	165-05-11	13.50	14.10	66	--	--	--	17	38	45	30	15	50.9	22.1	28.8	--	--	--	--	--	--	SC
5.50	Greyish Clayey Sand of High Plasticity Mixed With Gravels	SC	3.00	SPT	165-05-12	15.00	15.45	>100 (11 cm)	--	--	--	21	40	38	--	50.1	22.6	27.5	--	--	--	--	--	--	SC	
6.00				UDS-F + SPT + DS	165-05-13	16.50	17.10	>100 (10 cm)	2.032	1.649	23.2	0	47	53	--	52.2	25.3	26.9	2.627	TUU	0.62	14	40	1.36	CH	
6.50				SPT	165-05-14	18.00	18.45	>100 (9 cm)	--	--	--	0	43	57	--	52.9	25.6	27.3	--	--	--	--	--	--	CH	
7.00				UDS-F + SPT	165-05-15	19.50	20.10	>100 (11 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
7.50				SPT	165-05-16	21.00	21.45	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
8.00	Brownish Silty Clay of High Plasticity Mixed With Little Gravels	CH	3.00	SPT	165-05-17	22.50	22.95	>100 (8 cm)	--	--	--	1	62	37	--	51.5	21.1	30.4	--	--	--	--	--	--	SC	
8.50				SPT	165-05-18	24.00	24.45	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
9.00				SPT	165-05-19	25.00	25.45	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
9.50				UDS	165-05-20	26.50	27.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
10.00				SPT	165-05-21	28.00	28.45	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
10.50	Greyish Clayey Sand of High Plasticity Mixed With Gravels	SC	4.50	SPT	165-05-22	29.50	30.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
11.00				SPT	165-05-23	31.00	31.45	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
11.50				UDS	165-05-24	32.50	33.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
12.00				SPT	165-05-25	34.00	34.45	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
12.50				SPT	165-05-26	35.50	36.00	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
13.00	Brownish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Little Gravels	SM	2.50	SPT	165-05-27	36.50	37.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
13.50				SPT	165-05-28	38.00	38.50	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
14.00				UDS	165-05-29	39.50	40.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
14.50				SPT	165-05-30	41.00	41.50	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
15.00				SPT	165-05-31	42.50	43.00	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
15.50	Greyish Clayey Sand of High Plasticity Mixed With Gravels	SC	4.50	SPT	165-05-32	43.50	44.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
16.00				SPT	165-05-33	45.00	45.50	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
16.50				UDS	165-05-34	46.50	47.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
17.00				SPT	165-05-35	48.00	48.50	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
17.50				SPT	165-05-36	49.50	50.00	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
18.00	Brownish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Little Gravels	SM	2.50	SPT	165-05-37	50.50	51.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
18.50				SPT	165-05-38	52.00	52.50	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
19.00				UDS	165-05-39	53.50	54.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
19.50				SPT	165-05-40	55.00	55.50	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
20.00				SPT	165-05-41	56.50	57.00	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
20.50	Greyish Clayey Sand of High Plasticity Mixed With Gravels	SC	4.50	SPT	165-05-42	57.50	58.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
21.00				SPT	165-05-43	59.00	59.50	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
21.50				UDS	165-05-44	60.50	61.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
22.00				SPT	165-05-45	62.00	62.50	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
22.50				SPT	165-05-46	63.50	64.00	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
23.00	Brownish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Little Gravels	SM	2.50	SPT	165-05-47	64.50	65.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
23.50				SPT	165-05-48	66.00	66.50	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
24.00				UDS	165-05-49	67.50	68.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
24.50				SPT	165-05-50	69.00	69.50	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
25.00				SPT	165-05-51	70.50	71.00	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
25.50	Greyish Clayey Sand of High Plasticity Mixed With Gravels	SC	4.50	SPT	165-05-52	71.50	72.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
26.00				SPT	165-05-53	73.00	73.50	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
26.50				UDS	165-05-54	74.50	75.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
27.00				SPT	165-05-55	76.00	76.50	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
27.50				SPT	165-05-56	77.50	78.00	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
28.00	Brownish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Little Gravels	SM	2.50	SPT	165-05-57	78.50	79.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
28.50				SPT	165-05-58	80.00	80.50	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
29.00				UDS	165-05-59	81.50	82.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
29.50				SPT	165-05-60	83.00	83.50	>100 (12 cm)	--	--	--	0	63	37	--	51.3	20.9	30.4	--	--	--	--	--	--	SC	
30.00				SPT	165-05-61	84.50	85.00	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--	--	SC
30.50	Greyish Clayey Sand of High Plasticity Mixed With Gravels	SC	4.50	SPT	165-05-62	85.50	86.00	>100 (10 cm)	--	--	--	3	79	18	--	23.2		NP	--	--	--	--	--	--	SM	
31.00				SPT	165-05-63	87.00	87.50	>100 (11 cm)	--	--	--	5	76	19	--	23.5		NP	--	--	--	--	--	--	SM	
31.50				UDS	165-05-64	88.50	89.10	>100 (10 cm)	--	--	--	0	61	39	23	16	51.7	20.8	30.8	2.661	--	--	--	--		

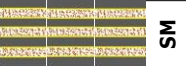

DS : Disturbed sample SPT : Standard Penetration Value UDS : Undisturbed Sample

* Strata-1 - Greyish Fine to Medium Grained Sand Mixed With Non - Plastic Fines and Gravels

Note 1: Bulk Density at 4.5m depth considered as per SPT Value (Ref. Table-3-4 of Foundation analysis and design by Joseph E. Bowles -5th edition)

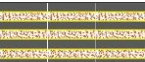
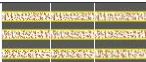

Note 2: Dry Density at 16.5 m depth is determined from Remoulded sample method

ANNEXURE 3: TRIAL PITS

TP - 01																				
Name of Owner : Monarch Surveyors and Engineering Consultants Pvt. Ltd.				Depth of Pit : 2.00 m				Method of Sampling: Excavated Pit												
Name of Project : Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)				Co-Ordinates : 42 Q, N 2554341, E 0617594																
Trial Pit No. : TP-01																				
Depth of water Below EGL : Not Encountered																				
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling			Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Maximum Dry Density, g/cc	Optimum Moisture Content, %	CBR Value, %		Grain Size Analysis			Atterberg's Limit			CLASSIFICATION
				Type	Lab.No.	Depth (m)						Soaked	Unsoaked	% Gravel	% Sand	% Silt & Clay	Liquid limit, %	Plastic limit, %	Plasticity Index, %	
0.00	Brownish Medium to Fine Grained Sand Mixed With Non-Plastic Fines and Little Gravels		1.50	Core + DS	165-01-01	0.5	1.526	1.444	5.7	2.151	7.0	17.2	23.8	3	69	28	21.7	NP		SM
0.25																				
0.50																				
0.75																				
1.00																				
1.25				Core + DS	165-01-02	1.0	1.782	1.632	9.2	--	--	--	0	53	47	21.4	NP		SM	
1.50																				
1.75	Brownish Clayey Sand of Low Plasticity (SC)		0.50	Core + DS	165-01-03	1.5	1.788	1.688	5.9	--	--	--	--	1	74	25	20.7	NP		SM
2.00																				
DS : Disturbed sample																				

TP - 02																			
Name of Owner			: Monarch Surveyors and Engineering Consultants Pvt. Ltd.																
Name of Project			: Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)																
Trial Pit No.			: TP - 02																
Depth of water Below EGL			: Not Encountered																
Name of Owner			: Monarch Surveyors and Engineering Consultants Pvt. Ltd.																
Name of Project			: Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)																
Trial Pit No.			: TP - 02																
Depth of water Below EGL			: Not Encountered																
Description of Strata			Legend																
Stratum Thickness (m)			0.50																
Sampling			Type, Lab.No., Depth (m)																
Bulk Density, g/cc			1.601																
Field Dry Density, g/cc			1.521																
Field Moisture Content, %			5.3																
Maximum Dry Density, g/cc			2.112																
Optimum Moisture Content, %			7.8																
CBR Value, %			13.8																
Grain Size Analysis			22.3																
Atterberg's Limit			NP																
CLASSIFICATION			SM																
SC			13.8																
SC			14.0																
SC			14.3																
SC			16.3																
SC			30.6																
SC			32																
SC			2																
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DS : Disturbed sample

TP - 03																				
Name of Owner		: Monarch Surveyors and Engineering Consultants Pvt. Ltd.																		
Name of Project		: Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)																		
Trial Pit No.		: TP - 03																		
Depth of water Below EGL		: Not Encountered																		
Depth of Pit:		: 2.00 m																		
Method of Sampling:		Excavated Pit																		
Co-Ordinates :		42 Q, N 255/655, E 06/9321																		
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling			Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Maximum Dry Density, g/cc	Optimum Moisture Content, %	CBR Value, %		Grain Size Analysis			Atterberg's Limit			CLASSIFICATION
0.00	Brownish Fine to Medium Grained Sand Mixed With Little Gravels			Type	Lab.No.	Depth (m)	1.748	1.635	6.9	2.100	7.8	11.4	22.4	2	83	15	21.2	NP		SM
0.25																				
0.50																				
0.75																				
1.00																				
1.25	Brownish Medium to Coarse Grained Sand Mixed With Little Gravels (SW-SM)			Core + DS	165-03-02	1.0	1.778	1.702	4.5	--	--	--	16	70	14	20.9	NP		SM	
1.50																				
1.75																				
2.00				Core + DS	165-03-03	1.5	1.783	1.711	4.2	--	--	--	--	1	85	14	20.8	NP		SM
				Core + DS	165-03-04	2.0	1.826	1.755	4.1	--	--	--	--	9	81	9		NP		SW-SM
DS : Disturbed sample																				

TP - 04

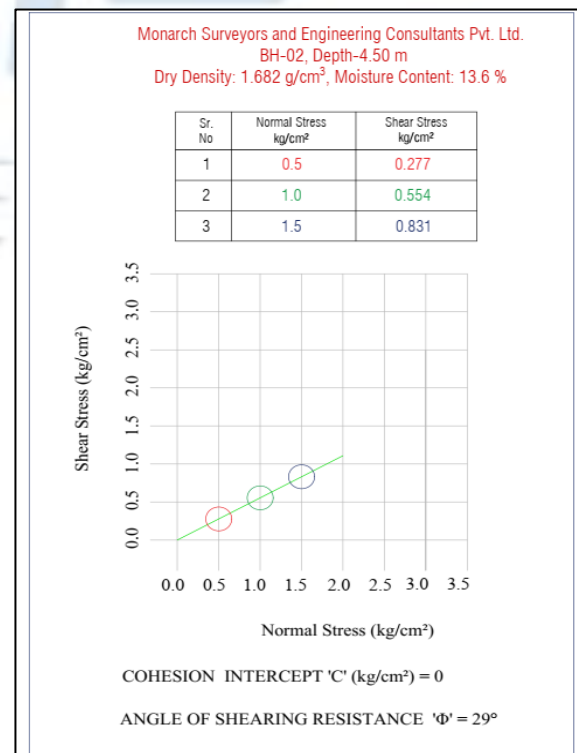
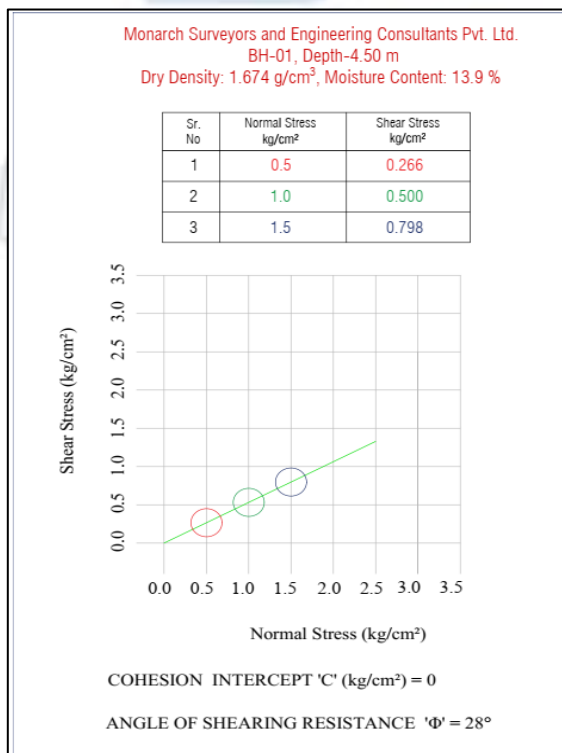
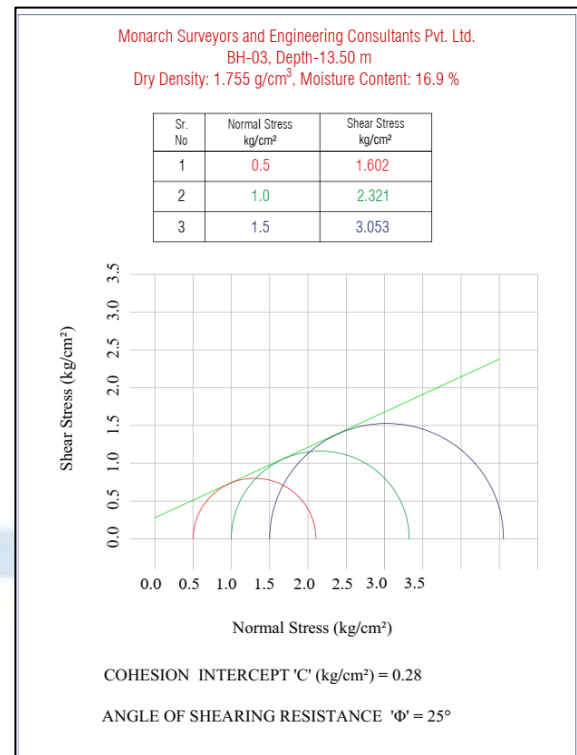
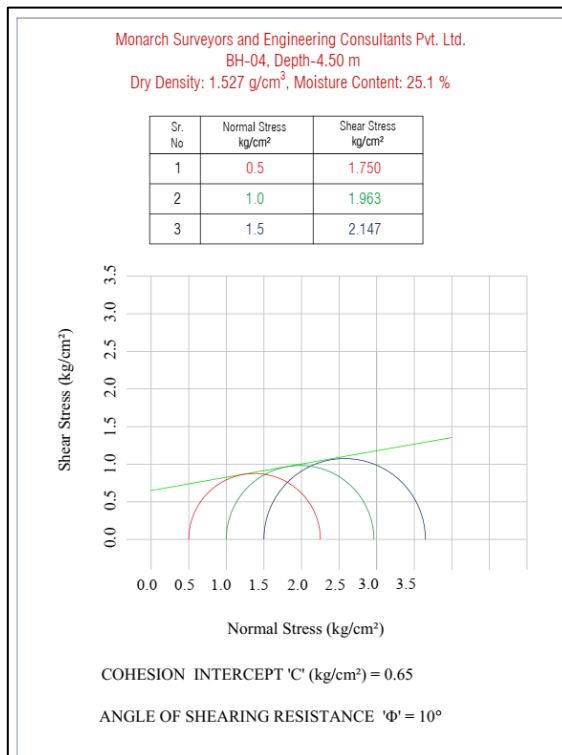
DS : Disturbed sample

TP - 05																				
Name of Owner : Monarch Surveyors and Engineering Consultants Pvt. Ltd.			Depth of Pit: :2.00 m																	
Name of Project : Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)			Method of Sampling: Excavated Pit																	
Trial Pit No. : TP - 05			Co-Ordinates : 42 Q, N 2547819, E 0623548																	
Depth of water Below EGL : Not Encountered																				
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling			Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Maximum Dry Density, g/cc	Optimum Moisture Content, %	CBR Value, %		Grain Size Analysis			Atterberg's Limit			CLASSIFICATION
0.00	Greyish Clay of Intermediate Plasticity Mixed With Little Fine Grained Sand Particles	CI	0.50	Core + DS	165-05-01	0.5	1.562	1.232	26.8	1.705	16.8	6.7	12.9	% Gravel	% Sand	% Silt & Clay	Liquid limit, %	Plastic limit, %	Plasticity Index, %	
0.25																				
0.50																				
0.75	Greyish Clay of High Plasticity Mixed With Little Fine Grained Sand Particles	CH	1.50	Core + DS	165-05-02	1.0	1.608	1.305	23.2	--	--	--	--	0	7	93	57.3	24.1	33.2	
1.00																				
1.25																				
1.50																				
1.75																				
2.00	Core + DS	165-05-03	1.5	1.618	1.342	20.6	--	--	--	--	--	--	0	0	100	50.6	25.1	25.5		
	Core + DS	165-05-04	2.0	1.660	1.402	18.4	--	--	--	--	--	--	0	0	100	60.7	26.6	34.1		
DS : Disturbed sample																				

TP - 06																				
Name of Owner : Monarch Surveyors and Engineering Consultants Pvt. Ltd.			Depth of Pit: : 2.00 m																	
Name of Project : Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)			Method of Sampling: Excavated Pit																	
Trial Pit No. : TP – 06			Co-Ordinates : 42 Q, N 2551892, E 0619131																	
Depth of water Below EGL : Not Encountered																				
Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling			Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Maximum Dry Density, g/cc	Optimum Moisture Content, %	CBR Value, %		% Sand	% Silt & Clay	Atterberg's Limit			CLASSIFICATION	
				Type	Lab.No.	Depth (m)						Soaked	Unsoaked			Liquid limit, %	Plastic limit, %	Plasticity Index, %		
0.00	Brownish Clayey Sand of Low Plasticity Mixed With Little Gravels		2.00	Core + DS	165-06-01	0.5	1.862	1.722	8.1	2.128	6.8	15.7	21.9	5	64	31	28.6	15.6	13.0	SC
0.25																				
0.50																				
0.75																				
1.00			2.00	Core + DS	165-06-02	1.0	1.926	1.795	7.3	--	--	--	--	9	60	31	28.8	15.7	13.1	SC
1.25																				
1.50																				
1.75																				
2.00																				
DS : Disturbed sample																				

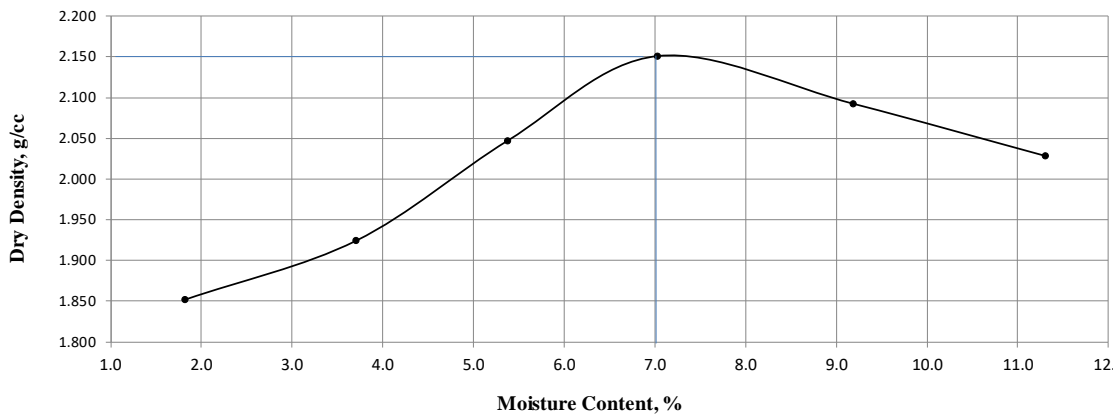
ANNEXURE 4: LABORATORY AND FIELD TEST GRAPHS

SHEAR PARAMETER



PROCTOR AND LABORATORY CBR TEST

TEST REPORT				
Source of Sample & Sample ID :		TP-01 (Depth - 0.5 m) SM		Co-Ordinates:- 42 Q, N 2554341, E 0617594
Modified Proctor		CBR Value, %		
MDD, g/cc	2.151	Soaked	Unsoaked	
OMC, %	7.03	17.2	23.8	

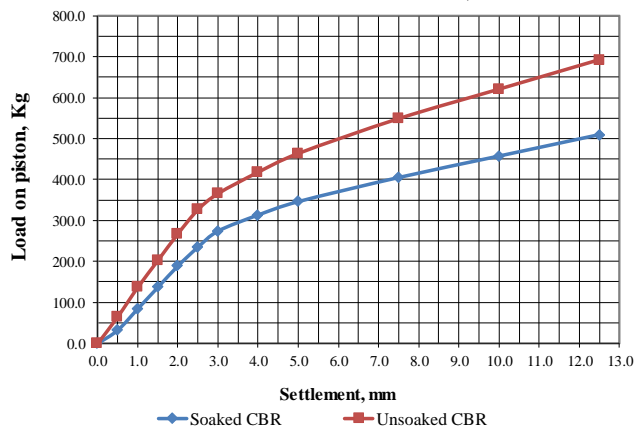
Proctor Graph


Bearing Ratio	CBR Value, %		
	Kg	Soaked	Unsoaked
Bearing Ratio at 2.5mm Penetration	1370.0	17.2	23.8
Bearing Ratio at 5.0mm Penetration	2055.0	16.9	22.6

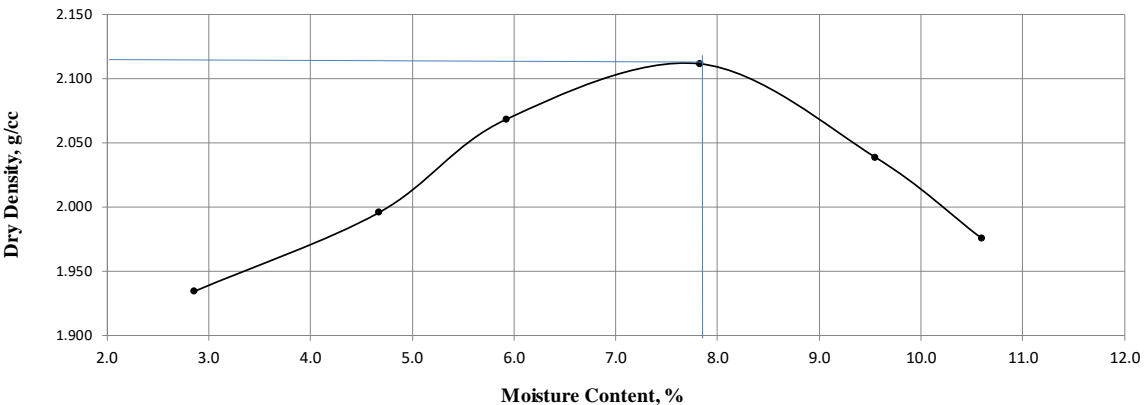
Bearing Ratio : $(P_t / P_s) \times 100$

	Soaked Test	Unsoaked Test
Bearing Ratio at 2.5mm Penetration :	$235.224/1370 \times 100$ 17.17	$326.7/1370 \times 100$ 23.85
Bearing Ratio at 5.0mm Penetration :	$346.302/2055 \times 100$ 16.85	$463.914/2055 \times 100$ 22.57

Dial Gauge Reading	Settlement, mm	Proving ring Reading in Kg (Soaked Test)	Proving ring Reading in Kg (Unsoaked Test)
2000	0.0	0.0	0.0
1950	0.5	32.7	65.3
1900	1.0	84.9	137.2
1850	1.5	137.2	202.6
1800	2.0	189.5	267.9
1750	2.5	235.2	326.7
1700	3.0	274.4	365.9
1600	4.0	313.6	418.2
1500	5.0	346.3	463.9
1250	7.5	405.1	548.9
1000	10.0	457.4	620.7
750	12.5	509.7	692.6

Load V/S Settlement Curve,


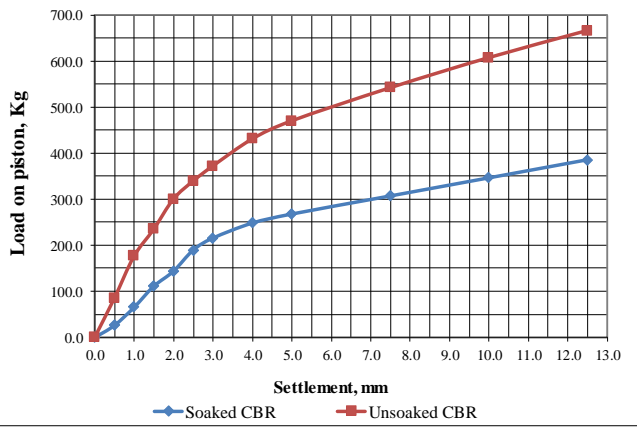
TEST REPORT			
Source of Sample & Sample ID :		TP-02 (Depth - 0.5 m) SM	
		Co-Ordinates:- 42 Q, N 2554252, E 0617927	
Modified Proctor		CBR Value, %	
MDD, g/cc	2.112	Soaked	Unsoaked
OMC, %	7.82	13.8	24.8

Proctor Graph			
			

Bearing Ratio	CBR Value, %		
	Kg	Soaked	Unsoaked
Bearing Ratio at 2.5mm Penetration	1370.0	13.8	24.8
Bearing Ratio at 5.0mm Penetration	2055.0	13.0	22.9

Bearing Ratio : $(P_t / P_s) \times 100$		
Bearing Ratio at 2.5mm Penetration :	Soaked Test	Unsoaked Test
	189.486/1370 x 100 13.83	339.768/1370 x 100 24.80
Bearing Ratio at 5.0mm Penetration :	267.894/2055 x 100 13.04	470.448/2055 x 100 22.89

Dial Gauge Reading	Settlement, mm	Proving ring Reading in Kg (Soaked Test)	Proving ring Reading in Kg (Unsoaked Test)
2000	0.0	0.0	0.0
1950	0.5	26.1	84.9
1900	1.0	65.3	176.4
1850	1.5	111.1	235.2
1800	2.0	143.7	300.6
1750	2.5	189.5	339.8
1700	3.0	215.6	372.4
1600	4.0	248.3	431.2
1500	5.0	267.9	470.4
1250	7.5	307.1	542.3
1000	10.0	346.3	607.7
750	12.5	385.5	666.5

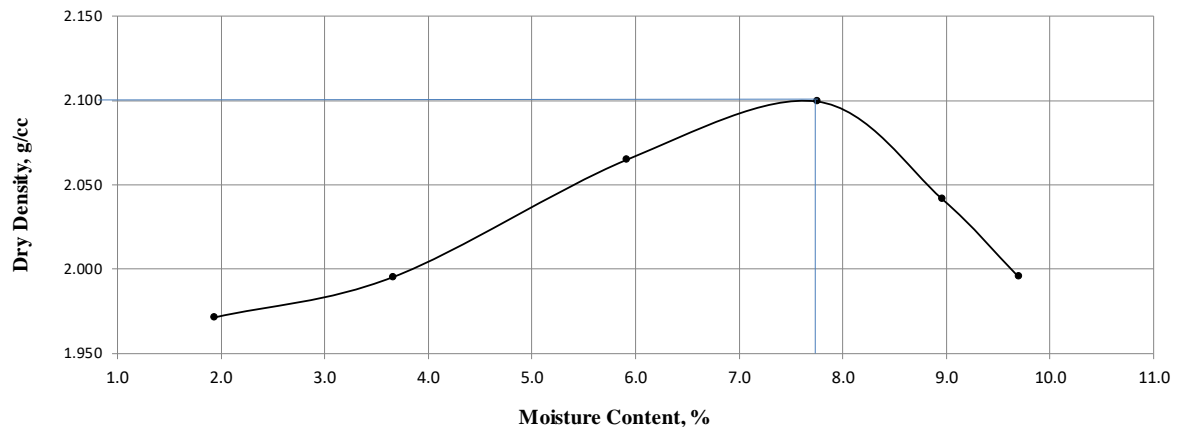
Load V/S Settlement Curve,	
	

TEST REPORT

Source of Sample & Sample ID : TP-03 (Depth - 0.5 m) SM Co-Ordinates:- 42 Q, N 2551655, E 0619321

Modified Proctor		CBR Value, %	
MDD, g/cc	2.100	Soaked	Unsoaked
OMC, %	7.75	11.4	22.4

Proctor Graph



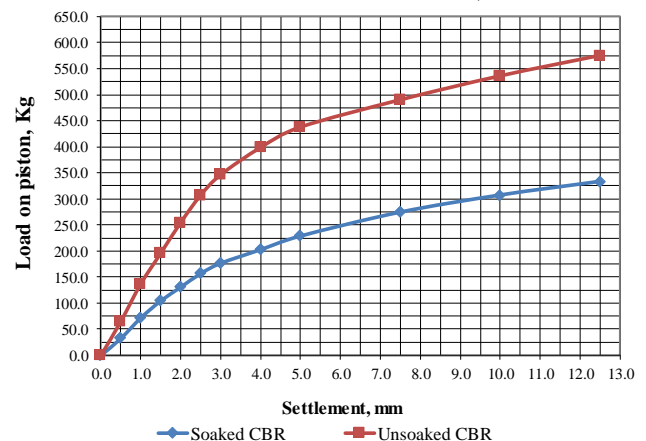
Bearing Ratio	CBR Value, %		
	Kg	Soaked	Unsoaked
Bearing Ratio at 2.5mm Penetration	1370.0	11.4	22.4
Bearing Ratio at 5.0mm Penetration	2055.0	11.1	21.3

Bearing Ratio : $(P_t / P_s) \times 100$

	Soaked Test	Unsoaked Test
Bearing Ratio at 2.5mm Penetration :	$156.816/1370 \times 100$ 11.45	$307.098/1370 \times 100$ 22.42
Bearing Ratio at 5.0mm Penetration :	$228.69/2055 \times 100$ 11.13	$437.778/2055 \times 100$ 21.30

Dial Gauge Reading	Settlement, mm	Proving ring Reading in Kg (Soaked Test)	Proving ring Reading in Kg (Unsoaked Test)
2000	0.0	0.0	0.0
1950	0.5	32.7	65.3
1900	1.0	71.9	137.2
1850	1.5	104.5	196.0
1800	2.0	130.7	254.8
1750	2.5	156.8	307.1
1700	3.0	176.4	346.3
1600	4.0	202.6	398.6
1500	5.0	228.7	437.8
1250	7.5	274.4	490.1
1000	10.0	307.1	535.8
750	12.5	333.2	575.0

Load V/S Settlement Curve,

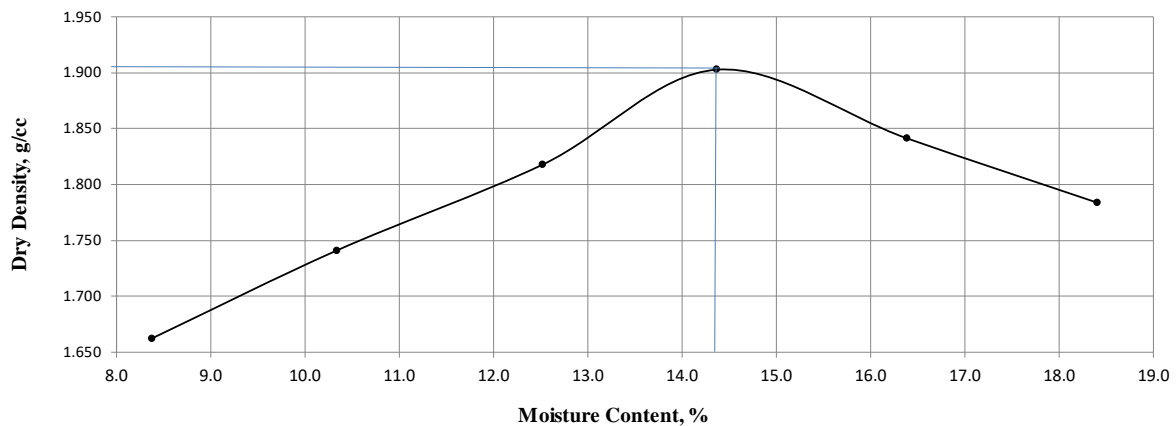


TEST REPORT

Source of Sample & Sample ID : TP-04 (Depth - 0.5 m) ML Co-Ordinates:- 42 Q, N 2550640, E 06233548

Modified Proctor		CBR Value, %	
MDD, g/cc	1.903	Soaked	Unsoaked
OMC, %	14.37	11.0	21.5

Proctor Graph



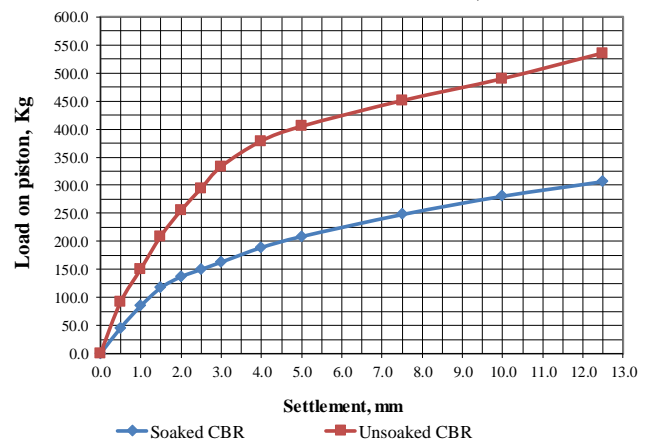
Bearing Ratio	CBR Value, %		
	Kg	Soaked	Unsoaked
Bearing Ratio at 2.5mm Penetration	1370.0	11.0	21.5
Bearing Ratio at 5.0mm Penetration	2055.0	10.2	19.7

Bearing Ratio : $(P_t / P_s) \times 100$

	Soaked Test	Unsoaked Test
Bearing Ratio at 2.5mm Penetration :	$150.282/1370 \times 100$ 10.97	$294.03/1370 \times 100$ 21.46
Bearing Ratio at 5.0mm Penetration :	$209.088/2055 \times 100$ 10.17	$405.108/2055 \times 100$ 19.71

Dial Gauge Reading	Settlement, mm	Proving ring Reading in Kg (Soaked Test)	Proving ring Reading in Kg (Unsoaked Test)
2000	0.0	0.0	0.0
1950	0.5	45.7	91.5
1900	1.0	84.9	150.3
1850	1.5	117.6	209.1
1800	2.0	137.2	254.8
1750	2.5	150.3	294.0
1700	3.0	163.4	333.2
1600	4.0	189.5	379.0
1500	5.0	209.1	405.1
1250	7.5	248.3	450.8
1000	10.0	281.0	490.1
750	12.5	307.1	535.8

Load V/S Settlement Curve,

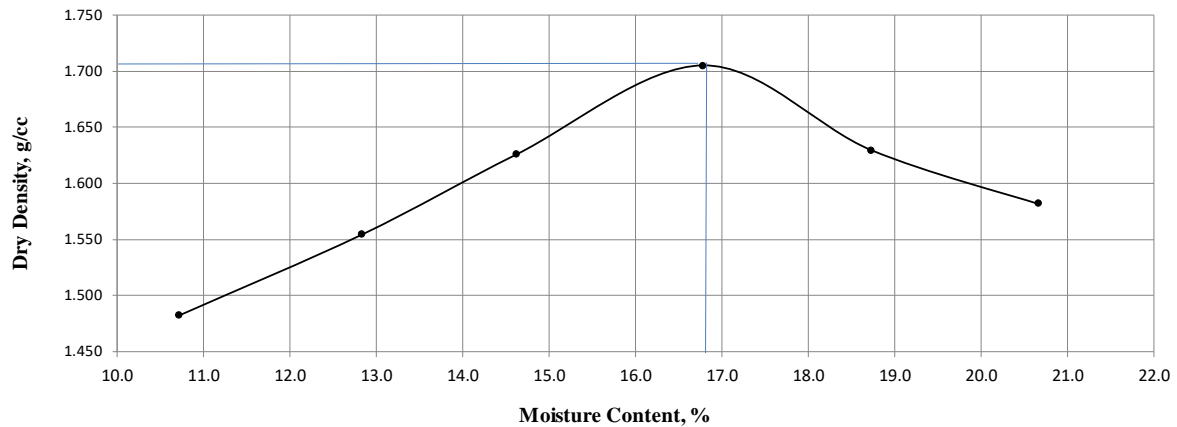


TEST REPORT

Source of Sample & Sample ID : TP-05 (Depth - 0.5 m) CI Co-Ordinates:- 42 Q, N 2547819, E 0623548

Modified Proctor		CBR Value, %	
MDD, g/cc	1.705	Soaked	Unsoaked
OMC, %	16.80	6.7	12.9

Proctor Graph



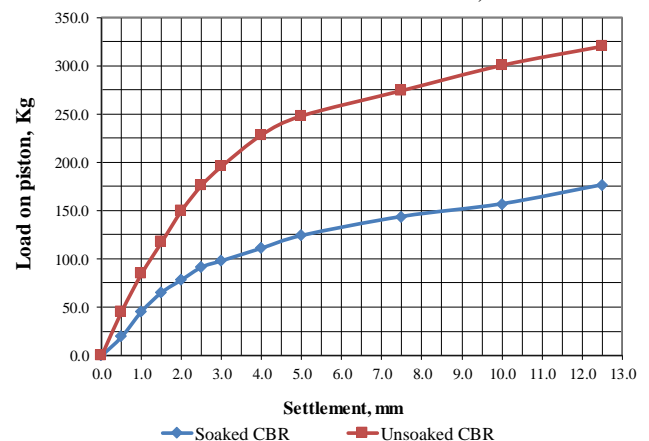
Bearing Ratio	CBR Value, %		
	Kg	Soaked	Unsoaked
Bearing Ratio at 2.5mm Penetration	1370.0	6.7	12.9
Bearing Ratio at 5.0mm Penetration	2055.0	6.0	12.1

Bearing Ratio : $(P_t / P_s) \times 100$

	Soaked Test	Unsoaked Test
Bearing Ratio at 2.5mm Penetration :	$91.476/1370 \times 100$ 6.68	$176.418/1370 \times 100$ 12.88
Bearing Ratio at 5.0mm Penetration :	$124.146/2055 \times 100$ 6.04	$248.292/2055 \times 100$ 12.08

Dial Gauge Reading	Settlement, mm	Proving ring Reading in Kg (Soaked Test)	Proving ring Reading in Kg (Unsoaked Test)
2000	0.0	0.0	0.0
1950	0.5	19.6	45.7
1900	1.0	45.7	84.9
1850	1.5	65.3	117.6
1800	2.0	78.4	150.3
1750	2.5	91.5	176.4
1700	3.0	98.0	196.0
1600	4.0	111.1	228.7
1500	5.0	124.1	248.3
1250	7.5	143.7	274.4
1000	10.0	156.8	300.6
750	12.5	176.4	320.2

Load V/S Settlement Curve,

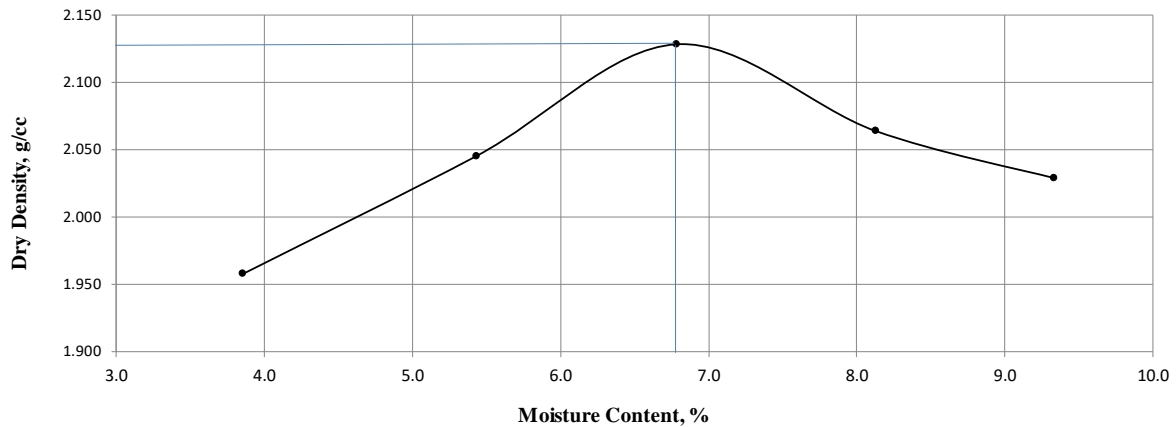


TEST REPORT

Source of Sample & Sample ID : TP-06 (Depth - 0.5 m) SC Co-Ordinates:- 42 Q, N 2551892, E 0619131

Modified Proctor		CBR Value, %	
MDD, g/cc	2.128	Soaked	Unsoaked
OMC, %	6.78	15.7	21.9

Proctor Graph



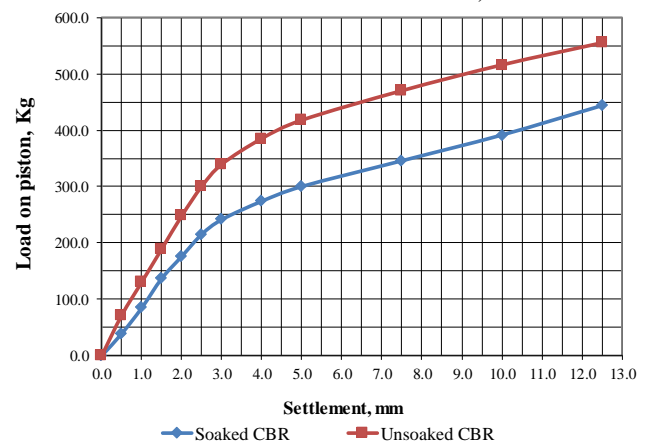
Bearing Ratio	CBR Value, %		
	Kg	Soaked	Unsoaked
Bearing Ratio at 2.5mm Penetration	1370.0	15.7	21.9
Bearing Ratio at 5.0mm Penetration	2055.0	14.6	20.3

Bearing Ratio : $(P_t / P_s) \times 100$

	Soaked Test	Unsoaked Test
Bearing Ratio at 2.5mm Penetration :	$215.622/1370 \times 100$ 15.74	$300.564/1370 \times 100$ 21.94
Bearing Ratio at 5.0mm Penetration :	$300.564/2055 \times 100$ 14.63	$418.176/2055 \times 100$ 20.35

Dial Gauge Reading	Settlement, mm	Proving ring Reading in Kg (Soaked Test)	Proving ring Reading in Kg (Unsoaked Test)
2000	0.0	0.0	0.0
1950	0.5	39.2	71.9
1900	1.0	84.9	130.7
1850	1.5	137.2	189.5
1800	2.0	176.4	248.3
1750	2.5	215.6	300.6
1700	3.0	241.8	339.8
1600	4.0	274.4	385.5
1500	5.0	300.6	418.2
1250	7.5	346.3	470.4
1000	10.0	392.0	516.2
750	12.5	444.3	555.4

Load V/S Settlement Curve,

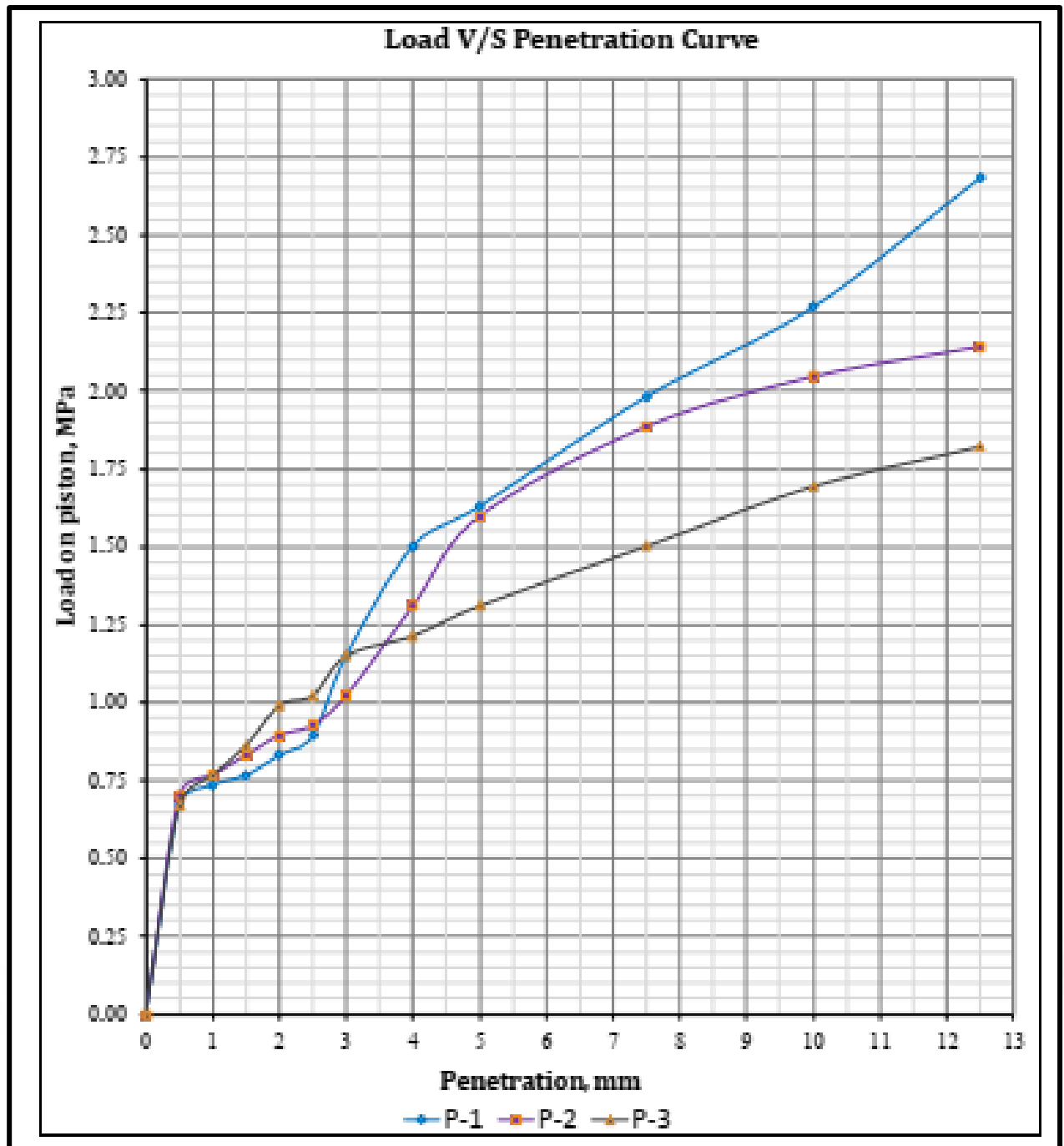


F-CBR

CBR-1: -

Location	: CBR-1	Date: 25-12-2022				
Co-ordinate	: N-2554341, E-0617594					
Depth	: 500 mm below from OGL (On Filling Material)					
CBR Value (Unsoaked),%	: 14.74					
Field Dry Density	: 1.444 g/cc , Moisture Content	: 5.71 %				
Bearing Ratio	P-1		P-2		P-3	
	Kg	CBR Value, %	Kg	CBR Value, %	Kg	CBR Value, %
Bearing Ratio at 2.5mm Penetration	1370.0	13.08	1370.0	13.55	1370.0	14.95
Bearing Ratio at 5.0mm Penetration	2055.0	15.88	2055.0	15.57	2055.0	12.77

Dial Gauge Reading	Settlement, mm	P-1, Proving ring Reading in Kg	P-1, Reading in MPa	P-2, Proving ring Reading in Kg	P-2, Reading in MPa	P-3, Proving ring Reading in Kg	P-3, Reading in MPa
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1950	0.5	134.4	0.671	140.8	0.703	134.4	0.671
1900	1.0	147.2	0.735	153.6	0.767	153.6	0.767
1850	1.5	153.6	0.767	166.4	0.831	172.8	0.863
1800	2.0	166.4	0.831	179.2	0.895	198.4	0.991
1750	2.5	179.2	0.895	185.6	0.927	204.8	1.023
1700	3.0	230.4	1.151	204.8	1.023	230.4	1.151
1600	4.0	300.8	1.502	262.4	1.311	243.2	1.215
1500	5.0	326.4	1.630	320.0	1.598	262.4	1.311
1250	7.5	396.8	1.982	377.6	1.886	300.8	1.502
1000	10.0	454.4	2.269	409.6	2.046	339.2	1.694
750	12.5	537.6	2.685	428.8	2.142	364.8	1.822

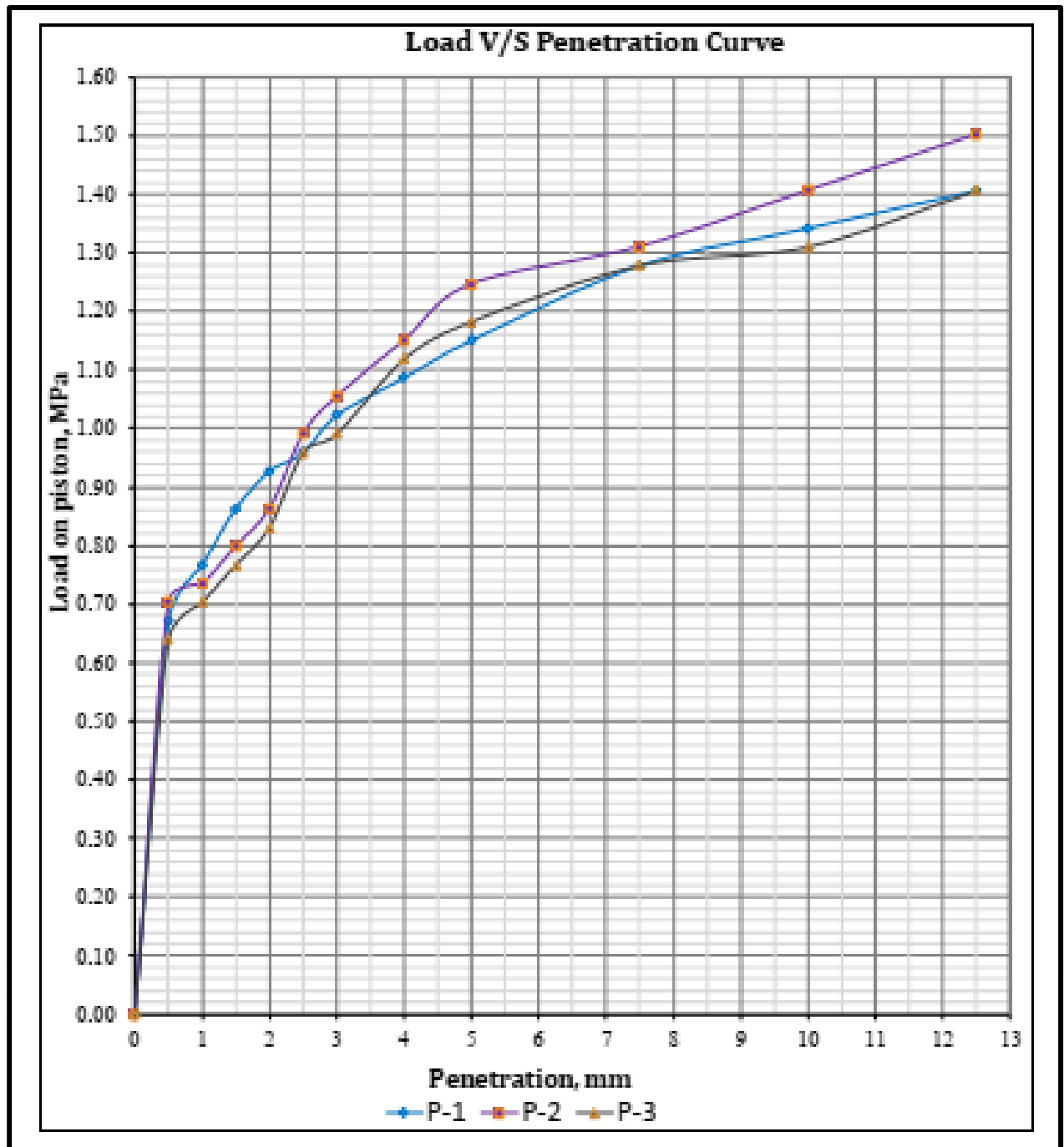


CBR-2: -

Location	: CBR-2	Date: 25-12-2022
Co-ordinate	: N-2554264, E-0617901	
Depth	: 200 mm below from OGL (On Filling Material)	
CBR Value (Unsoaked),%	: 14.17	
Field Dry Density	: 1.929 g/cc, Moisture Content: 5.26 %	

Bearing Ratio	P-1		P-2		P-3	
	Kg	CBR Value, %	Kg	CBR Value, %	Kg	CBR Value, %
Bearing Ratio at 2.5mm Penetration	1370.0	14.01	1370.0	14.48	1370.0	14.01
Bearing Ratio at 5.0mm Penetration	2055.0	11.21	2055.0	12.15	2055.0	11.52

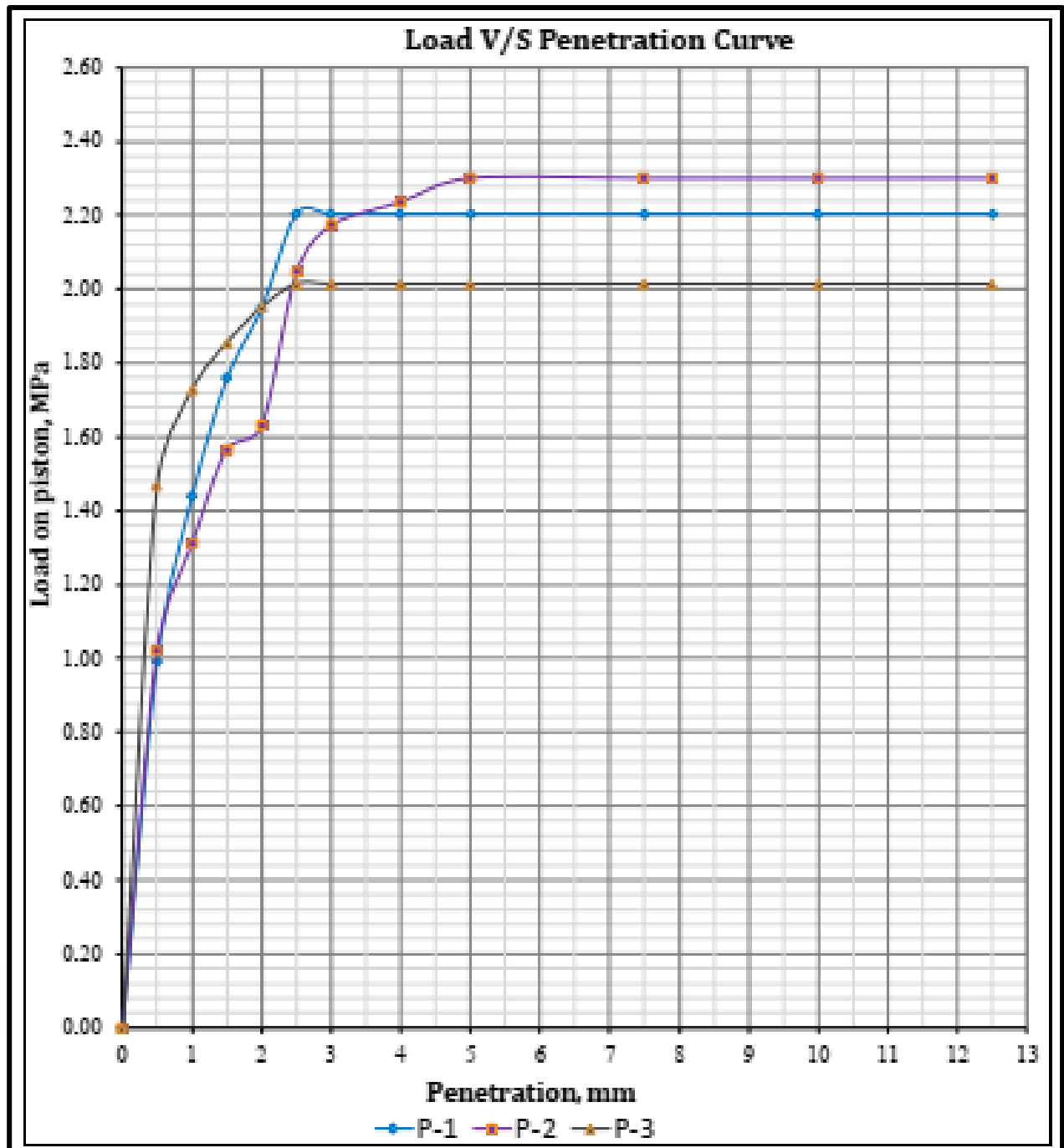
Dial Gauge Reading	Settlement, mm	P-1, Proving ring Reading in Kg	P-1, Reading in MPa	P-2, Proving ring Reading in Kg	P-2, Reading in MPa	P-3, Proving ring Reading in Kg	P-3, Reading in MPa
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1950	0.5	134.4	0.671	140.8	0.703	128.0	0.639
1900	1.0	153.6	0.767	147.2	0.735	140.8	0.703
1850	1.5	172.8	0.863	160.0	0.799	153.6	0.767
1800	2.0	185.6	0.927	172.8	0.863	166.4	0.831
1750	2.5	192.0	0.959	198.4	0.991	192.0	0.959
1700	3.0	204.8	1.023	211.2	1.055	198.4	0.991
1600	4.0	217.6	1.087	230.4	1.151	224.0	1.119
1500	5.0	230.4	1.151	249.6	1.247	236.8	1.183
1250	7.5	256.0	1.279	262.4	1.311	256.0	1.279
1000	10.0	268.8	1.343	281.6	1.406	262.4	1.311
750	12.5	281.6	1.406	300.8	1.502	281.6	1.406



CBR-3: -

Location	: CBR-3	Date: 25-12-2022				
Co-ordinate	: N-2551646, E-0619329					
Depth	: 200 mm below from OGL (On Filling Material)					
CBR Value (Unsoaked),%	: 30.52					
Field Dry Density- 1.806 g/cc , Moisture Content- 4.73 %						
Bearing Ratio	P-1		P-2		P-3	
	Kg	CBR Value, %	Kg	CBR Value, %	Kg	CBR Value, %
Bearing Ratio at 2.5mm Penetration	1370.0	32.23	1370.0	29.90	1370.0	29.43
Bearing Ratio at 5.0mm Penetration	2055.0	21.49	2055.0	22.42	2055.0	19.62

Dial Gauge Reading	Settlement, mm	P-1, Proving ring Reading in Kg	P-1, Reading in MPa	P-2, Proving ring Reading in Kg	P-2, Reading in MPa	P-3, Proving ring Reading in Kg	P-3, Reading in MPa
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1950	0.5	198.4	0.991	204.8	1.023	294.4	1.470
1900	1.0	288.0	1.438	262.4	1.311	345.6	1.726
1850	1.5	352.0	1.758	313.6	1.566	371.2	1.854
1800	2.0	390.4	1.950	326.4	1.630	390.4	1.950
1750	2.5	441.6	2.206	409.6	2.046	403.2	2.014
1700	3.0	441.6	2.206	435.2	2.174	403.2	2.014
1600	4.0	441.6	2.206	448.0	2.238	403.2	2.014
1500	5.0	441.6	2.206	460.8	2.301	403.2	2.014
1250	7.5	441.6	2.206	460.8	2.301	403.2	2.014
1000	10.0	441.6	2.206	460.8	2.301	403.2	2.014
750	12.5	441.6	2.206	460.8	2.301	403.2	2.014

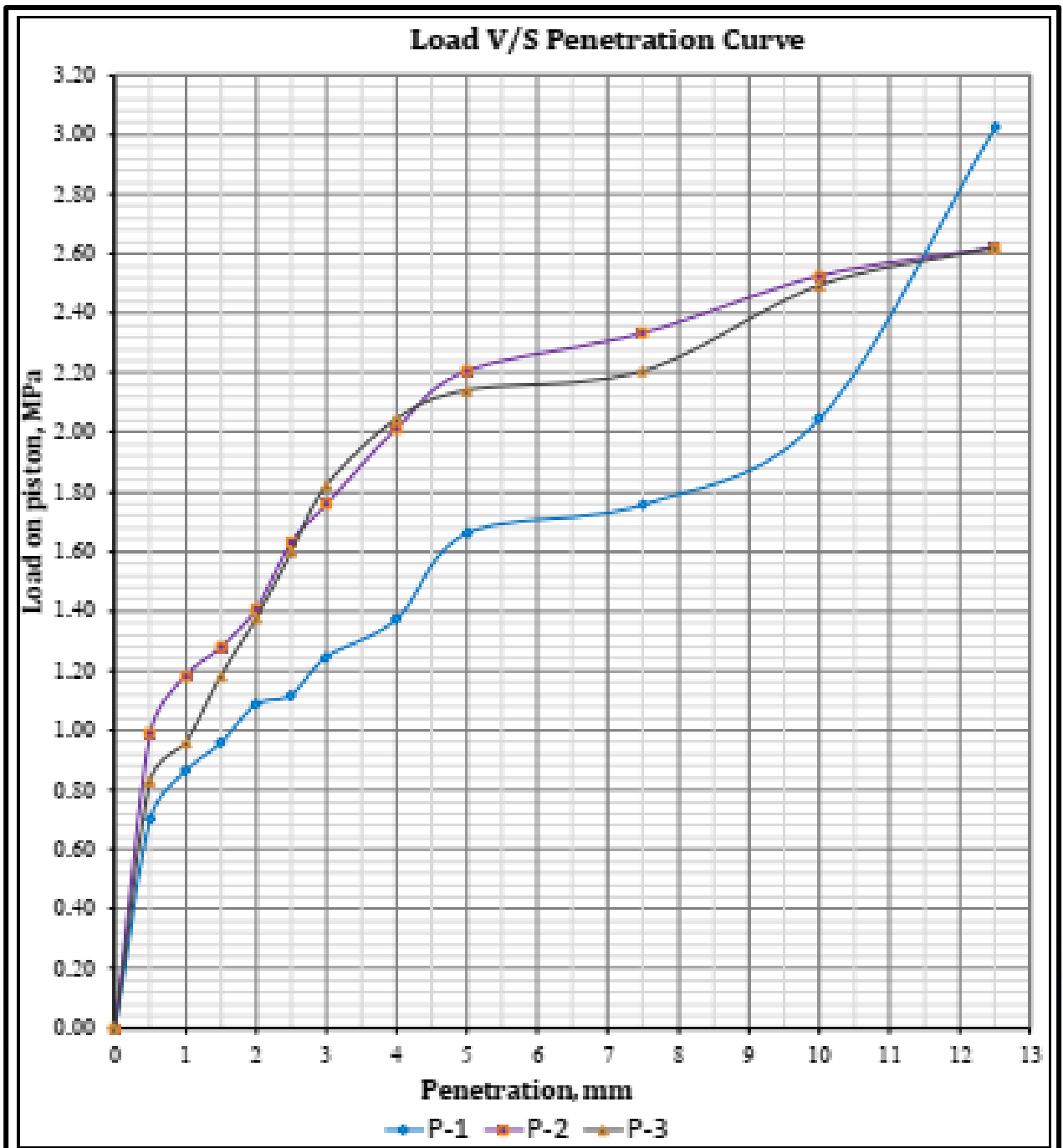


CBR-4: -

Location : CBR-4 Date: 25-12-2022
 Co-ordinate : N-2547819, E-0623548
 Depth : 200 mm below from OGL (On Filling Material)
 CBR Value : 21.18
 (Unsoaked), %
 Field Dry Density- 1.496 g/cc , Moisture Content- 19.76 %

Bearing Ratio	P-1		P-2		P-3	
	Kg	CBR Value, %	Kg	CBR Value, %	Kg	CBR Value, %
Bearing Ratio at 2.5mm Penetration	1370.0	16.35	1370.0	23.82	1370.0	23.36
Bearing Ratio at 5.0mm Penetration	2055.0	16.19	2055.0	21.49	2055.0	20.87

Dial Gauge Reading	Settlement, mm	P-1, Proving ring Reading in Kg	P-1, Reading in MPa	P-2, Proving ring Reading in Kg	P-2, Reading in MPa	P-3, Proving ring Reading in Kg	P-3, Reading in MPa
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1950	0.5	140.8	0.703	198.4	0.991	166.4	0.831
1900	1.0	172.8	0.863	236.8	1.183	192.0	0.959
1850	1.5	192.0	0.959	256.0	1.279	236.8	1.183
1800	2.0	217.6	1.087	281.6	1.406	275.2	1.374
1750	2.5	224.0	1.119	326.4	1.630	320.0	1.598
1700	3.0	249.6	1.247	352.0	1.758	364.8	1.822
1600	4.0	275.2	1.374	403.2	2.014	409.6	2.046
1500	5.0	332.8	1.662	441.6	2.206	428.8	2.142
1250	7.5	352.0	1.758	467.2	2.333	441.6	2.206
1000	10.0	409.6	2.046	505.6	2.525	499.2	2.493
750	12.5	606.1	3.027	524.8	2.621	524.8	2.621

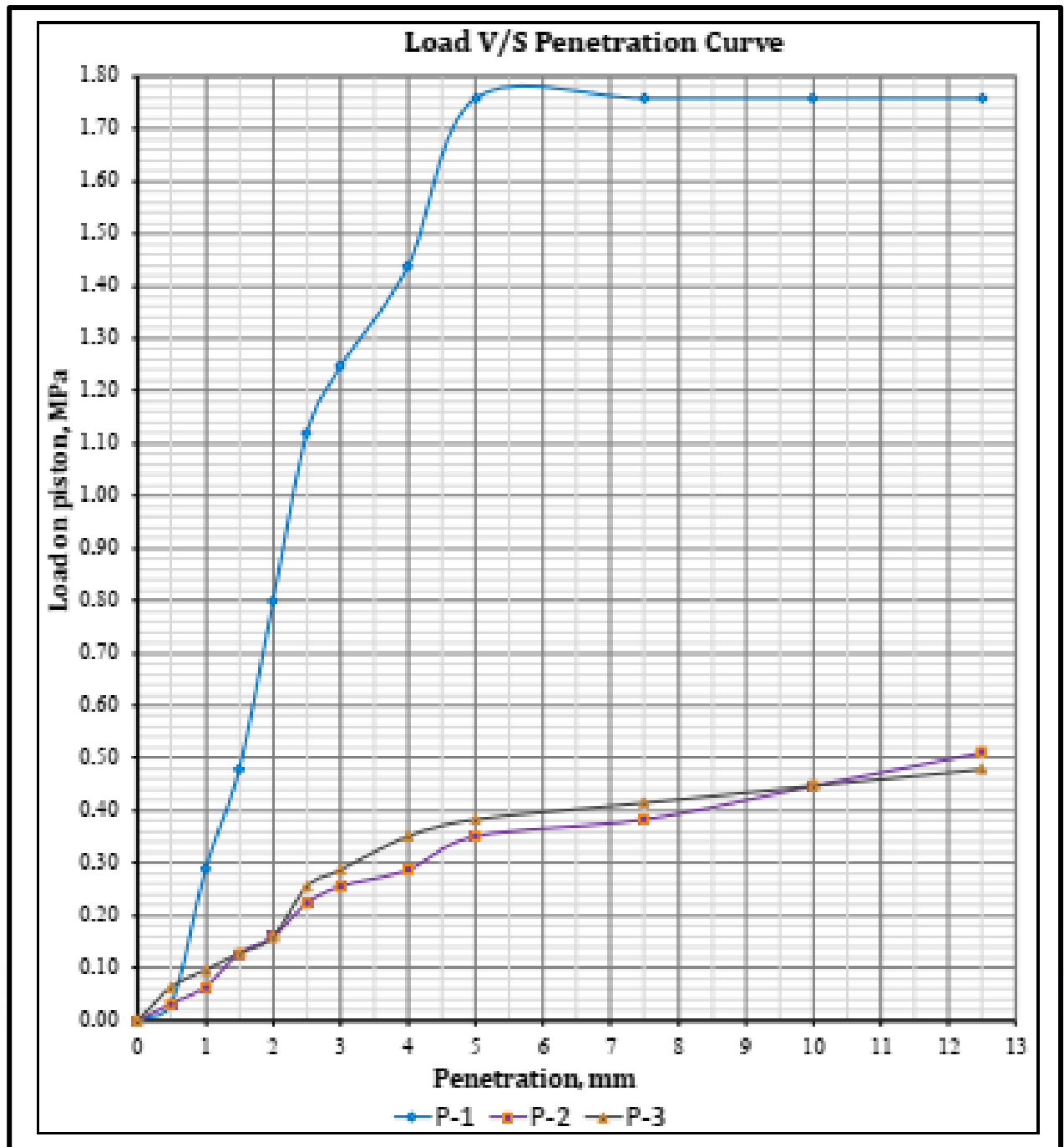


CBR-5: -

Location : CBR-5 Date: 25-12-2022
 Co-ordinate : N-2547819, E-0623548
 Depth : 200 mm below from OGL (On Filling Material)
 CBR Value (Unsoaked),% : 3.58
 Field Dry Density- 1.310 g/cc , Moisture Content- 36.99 %

Bearing Ratio	P-1		P-2		P-3	
	Kg	CBR Value,%	Kg	CBR Value,%	Kg	CBR Value,%
Bearing Ratio at 2.5mm Penetration	1370.0	16.35	1370.0	3.27	1370.0	3.74
Bearing Ratio at 5.0mm Penetration	2055.0	17.13	2055.0	3.43	2055.0	3.74

Dial Gauge Reading	Settlement, mm	P-1, Proving ring Reading in Kg	P-1, Reading in MPa	P-2, Proving ring Reading in Kg	P-2, Reading in MPa	P-3, Proving ring Reading in Kg	P-3, Reading in MPa
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1950	0.5	6.4	0.032	6.4	0.032	12.8	0.064
1900	1.0	57.6	0.288	12.8	0.064	19.2	0.096
1850	1.5	96.0	0.479	25.6	0.128	25.6	0.128
1800	2.0	160.0	0.799	32.0	0.160	32.0	0.160
1750	2.5	224.0	1.119	44.8	0.224	51.2	0.256
1700	3.0	249.6	1.247	51.2	0.256	57.6	0.288
1600	4.0	288.0	1.438	57.6	0.288	70.4	0.352
1500	5.0	352.0	1.758	70.4	0.352	76.8	0.384
1250	7.5	352.0	1.758	76.8	0.384	83.2	0.416
1000	10.0	352.0	1.758	89.6	0.448	89.6	0.448
750	12.5	352.0	1.758	102.4	0.511	96.0	0.479

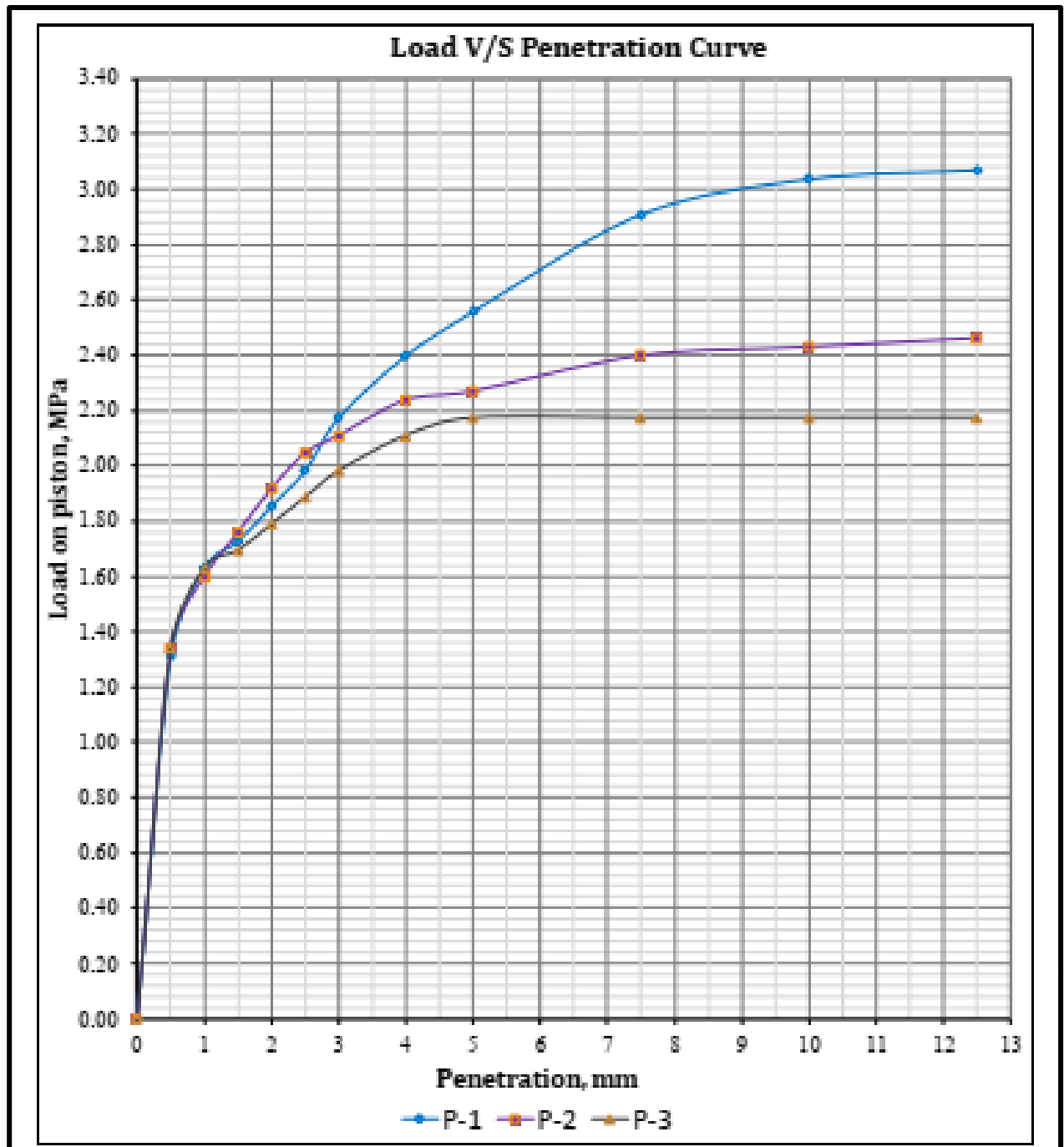


CBR-6: -

Location : CBR-6 Date: 25-12-2022
Co-ordinate : N-2551109, E-0619702
Depth : 200 mm below from OGL (On Filling Material)
CBR Value : 28.8
(Unsoaked), %
Field Dry Density- 1.793 g/cc, Moisture Content- 8.11 %

Bearing Ratio	P-1		P-2		P-3	
	Kg	CBR Value, %	Kg	CBR Value, %	Kg	CBR Value, %
Bearing Ratio at 2.5mm Penetration	1370.0	28.96	1370.0	29.90	1370.0	27.56
Bearing Ratio at 5.0mm Penetration	2055.0	24.91	2055.0	22.11	2055.0	21.18

Dial Gauge Reading	Settlement, mm	P-1, Proving ring Reading in Kg	P-1, Reading in MPa	P-2, Proving ring Reading in Kg	P-2, Reading in MPa	P-3, Proving ring Reading in Kg	P-3, Reading in MPa
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1950	0.5	262.4	1.311	268.8	1.343	268.8	1.343
1900	1.0	326.4	1.630	320.0	1.598	326.4	1.630
1850	1.5	345.6	1.726	352.0	1.758	339.2	1.694
1800	2.0	371.2	1.854	384.0	1.918	358.4	1.790
1750	2.5	396.8	1.982	409.6	2.046	377.6	1.886
1700	3.0	435.2	2.174	422.4	2.110	396.8	1.982
1600	4.0	480.0	2.397	448.0	2.238	422.4	2.110
1500	5.0	512.0	2.557	454.4	2.269	435.2	2.174
1250	7.5	582.4	2.909	480.0	2.397	435.2	2.174
1000	10.0	608.0	3.037	486.4	2.429	435.2	2.174
750	12.5	614.4	3.069	492.8	2.461	435.2	2.174



ANNEXURE 5: SAMPLE CALCULATION SHEETS

Liquefaction Analysis

Evaluation of Liquefaction Potential (IS 1893 - Part 1 : 2016, RA-2021) for KANDLA - BH 1																													
Project Name: Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)														Actual Water Table Depth : 6.00 m				Zone Factor : 0.36											
Borehole No.: 1														Water Table Considered : 0.00 m				Location : Bhuj											
Hammer Fall: 0.75 m														Hammer Weight: 63.5 kg				Earthquake Magnitude (M _w) : 7.5				CONCLUSIONS							
INPUT PARAMETERS						COHESIONLESS SOILS																							
Depth below EGL, m	Type of soil	Observed SPT Value (N)	Saturated Density (t/m ³)	Submerged Density (t/m ³)	Fine Content (%)	Field Moisture Content, FMC (%)	Particles less than 5 micron size (%)	Liquid Limit, LL (%)	Stress Reduction Coefficient (r _d)	Total overburden pressure (σ _v), t/m ²	Effective overburden (σ' _v), t/m ²	Cyclic Stress ratio (CSR)	C _n = sqrt(Pa/σ' _v)	C _{HT}	C _{HW}	C _{BD}	C _{RL}	C _{SS}	(N) ₆₀ = C ₆₀ X N	(N ₁) ₆₀ = C _N X N ₆₀	α	β	(N ₁) _{60CS} = α + β (N ₁) ₆₀	CRR _{7.5}	Magnitude Scaling Factor, MSF = (10) ^{2.24 / (M_w - 2.56)}	CRR = CRR _{7.5} (MSF) K _σ K _α	FOS = CRR / CSR	for Cohesive Soils	for Cohesionless Soils
0.50	SM	4	1.63	0.63	18				1.00	0.81	0.31	0.60	1.70	0.75	0.984	1.05	0.75	1.10	2.56	4.35	3.23	1.07	7.87	0.09	1.000	0.09	0.16		Liquefiable
3.00	SC	30	1.63	0.63	18				0.98	4.88	1.88	0.59	1.70	0.75	0.984	1.05	0.80	1.10	20.46	34.79	3.23	1.07	40.33	NA	1.000	NA	>1		Non Liquefiable
4.50	SW-SM	32	1.91	0.91	9				0.97	7.74	3.24	0.54	1.70	0.75	0.984	1.05	0.85	1.10	23.19	39.42	0.56	1.02	40.65	NA	1.000	NA	>1		Non Liquefiable
6.00	SW-SM	41	1.91	0.91	11				0.95	10.60	4.60	0.51	1.49	0.75	0.984	1.05	0.95	1.10	33.21	49.44	1.21	1.03	51.96	NA	1.000	NA	>1		Non Liquefiable
7.50	SW-SM	58	1.91	0.91	9				0.94	13.46	5.96	0.50	1.31	0.75	0.984	1.05	0.95	1.10	46.98	61.45	0.56	1.02	63.05	NA	1.000	NA	>1		Non Liquefiable
9.00	SW-SM	63	1.91	0.91	6				0.93	16.32	7.32	0.49	1.18	0.75	0.984	1.05	0.95	1.10	51.03	60.22	0.03	1.00	60.54	NA	1.000	NA	>1		Non Liquefiable
10.50	SW-SM	100	1.91	0.91	9				0.89	19.18	8.68	0.46	1.08	0.75	0.984	1.05	1	1.10	85.26	92.41	0.56	1.02	94.53	NA	1.000	NA	>1		Non Liquefiable
12.00	SW-SM	51	1.91	0.91	6				0.85	22.04	10.04	0.44	1.01	0.75	0.984	1.05	1	1.10	43.48	43.82	0.03	1.00	44.05	NA	1.000	NA	>1		Non Liquefiable
13.50	SW-SM	58	1.91	0.91	11				0.81	24.90	11.40	0.42	0.95	0.75	0.984	1.05	1	1.10	49.45	46.77	1.21	1.03	49.21	NA	1.000	NA	>1		Non Liquefiable
15.00	SW-SM	51	1.91	0.91	10				0.77	27.77	12.77	0.39	0.89	0.75	0.984	1.05	1	1.10	43.48	38.87	0.87	1.02	40.58	NA	1.000	NA	>1		Non Liquefiable
18.00	CH	100	1.94	0.94	59	21.40	20.00	53.60	0.69	33.60	15.60	0.35	0.81	0.75	0.984	1.05	1	1.10	85.26	68.95	5.00	1.20	87.74	NA	1.000	NA	>1	Non-Liquefiable	
REMARK																													
The project site falls in Zone - V. A maximum earthquake intensity of 7.5 has been considered in the analysis.																													
1) C _{HT} & C _{HW} = Correction for hammer energy ratio, C _{HT} = 0.75, Energy Ratio for Rope and Pulley System = 80 %, C _{HW} = Height x Weight / 48387																													
2) Borehole diameter = 150 mm , Hence C _{BD} = 1.05																													
3) C _{SS} = Correction for Standard sampler = 1.1																													
4) C ₆₀ = C _{HT} C _{HW} C _{BD} C _{RL} C _{SS}																													
5) The FOS belongs to only COHESIONLESS soils because the liquefaction potential for COHESIVE soil is based on Seed & Idriss Criteria																													
Ref. for Clays: Seed, H. Bolton; Idriss, I. M.; Arango, Ignacio (1983). "Evaluation of Liquefaction Potential Using Field Performance Data", Journal of Geotechnical Engineering, 109(3), 458-482.																													

Evaluation of Liquefaction Potential (IS 1893 - Part 1 : 2016, RA-2021) for KANDLA - BH 2																													
Project Name: Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)													Actual Water Table Depth : 6.00 m				Zone Factor : 0.36												
Borehole No.: 2													Water Table Considered : 0.00 m				Location : Bhuj												
Hammer Fall: 0.75 m													Hammer Weight: 63.5 kg				Earthquake Magnitude (M _w) : 7.5												
INPUT PARAMETERS						COHESIONLESS SOILS															CONCLUSIONS								
Depth below EGL, m	Type of soil	Observed SPT Value (N)	Saturated Density (t/m ³)	Submerged Density (t/m ³)	Fine Content (%)	Field Moisture Content, FMC (%)	Particles less than 5 micron size (%)	Liquid Limit, LL (%)	Stress Reduction Coefficient (r _d)	Total overburden pressure (σ _o), t/m ²	Effective overburden (σ' _o), t/m ²	Cyclic Stress ratio (CSR)	C _n = sqrt(Pa/σ' _o)	C _{HT}	C _{HW}	C _{BD}	C _{RL}	C _{SS}	(N) ₆₀ = C ₆₀ X N	α	β	(N ₁) _{60CS} = α + β (N ₁) ₆₀	CRR _{7.5}	Magnitude Scaling Factor, MSF = (10) ^{2.24 / (MW)^{2.56}}	CRR = CRR _{7.5} (MSF) K _σ K _α	FOS = CRR / CSR	for Cohesive Soils	for Cohesionless Soils	
0.50	SM	6	1.88	0.88	15				1.00	0.94	0.44	0.50	1.70	0.75	0.984	1.05	0.75	1.10	3.84	6.52	2.50	1.05	9.33	0.11	1.000	0.11	0.22		Liquefiable
3.00	SC	31	1.88	0.88	32				0.98	5.64	2.64	0.49	1.70	0.75	0.984	1.05	0.80	1.10	21.14	35.95	4.83	1.17	46.92	NA	1.000	NA	>1		Non Liquefiable
4.50	SW-SM	42	1.91	0.91	7				0.97	8.51	4.01	0.48	1.59	0.75	0.984	1.05	0.85	1.10	30.44	48.55	0.12	1.01	49.08	NA	1.000	NA	>1		Non Liquefiable
6.00	SW-SM	50	1.91	0.91	10				0.95	11.38	5.38	0.47	1.38	0.75	0.984	1.05	0.95	1.10	40.50	55.78	0.87	1.02	57.86	NA	1.000	NA	>1		Non Liquefiable
7.50	SW-SM	53	1.91	0.91	8				0.94	14.24	6.74	0.47	1.23	0.75	0.984	1.05	0.95	1.10	42.93	52.80	0.30	1.01	53.77	NA	1.000	NA	>1		Non Liquefiable
9.00	CH	54	2.03	1.03	64	23.00	20.00	61.40	0.93	17.29	8.29	0.45	1.11	0.75	0.984	1.05	0.95	1.10	43.74	48.52	5.00	1.20	63.22	NA	1.000	NA	>1	Non-Liquefiable	
12.00	SC	71	2.05	1.05	23				0.85	23.45	11.45	0.41	0.94	0.75	0.984	1.05	1	1.10	60.54	57.13	4.06	1.10	66.92	NA	1.000	NA	>1		Non Liquefiable
15.00	CH	100	2.12	1.12	53	25.10	20.00	56.60	0.77	29.82	14.82	0.36	0.83	0.75	0.984	1.05	1	1.10	85.26	70.72	5.00	1.20	89.87	NA	1.000	NA	>1	Non-Liquefiable	
1) The project site falls in Zone - V. A maximum earthquake intensity of 7.5 has been considered in the analysis.																													
2) C _{HT} & C _{HW} = Correction for hammer energy ratio, C _{HT} = 0.75, Energy Ratio for Rope and Pulley System = 80 %, C _{HW} = Height x Weight / 48387																													
3) Borehole diameter = 150 mm , Hence C _{BD} = 1.05																													
4) C _{SS} = Correction for Standard sampler = 1.1																													
5) C ₆₀ = C _{HT} C _{HW} C _{BD} C _{RL} C _{SS}																													
REMARK																													
The FOS belongs to only COHESIONLESS soils because the liquefaction potential for COHESIVE soil is based on Seed & Idriss Criteria																													
Ref. for Clays: Seed, H. Bolton; Idriss, I. M.; Arango, Ignacio (1983). "Evaluation of Liquefaction Potential Using Field Performance Data", Journal of Geotechnical Engineering, 109(3), 458-482.																													

Evaluation of Liquefaction Potential (IS 1893 - Part 1 : 2016, RA-2021) for KANDLA - BH 3																													
Project Name: Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID-262)										Actual Water Table Depth : 4.50 m		Zone Factor : 0.36																	
Borehole No.: 3										Water Table Considered : 0.00 m		Location : Bhuj																	
Hammer Fall: 0.75 m										Hammer Weight: 63.5 kg		Earthquake Magnitude (M _w) : 7.5																	
INPUT PARAMETERS					COHESIONLESS SOILS										CONCLUSIONS														
Depth below EGL, m	Type of soil	Observed SPT Value (N)	Saturated Density (γ _m ³)	Submerged Density (γ _m ³)	Fine Content (%)	COHESIVE SOILS			COHESIONLESS SOILS										for Cohesive Soils	for Cohesionless Soils									
						Field Moisture Content, FMC (%)	Particles less than 5 micron size (%)	Liquid Limit, LL (%)	Stress Reduction Coefficient (r _d)	Total overburden pressure (σ _v), γ _m ²	Effective overburden (σ' _v), γ _m ²	Cyclic Stress ratio (CSR)	C _n = sqrt(Pa/σ' _v)	C _{HT}	C _{HW}	C _{BD}	C _{RL}	C _{SS}			(N) ₆₀ = C ₆₀ X N	α	β	(N ₁) _{60CS} = α + β (N) ₆₀	CRR _{7.5}	Magnitude Scaling Factor, MSF = (10) ^{2.24/(MW)_{2.56}}	CRR = CRR _{7.5} (MSF) Kα	FOS = CRR / CSR	
0.50	SP	11	1.80	0.80	2				1.00	0.90	0.40	0.52	1.70	0.75	0.984	1.05	0.75	1.10	7.03	11.96	0.00	1.00	11.96	0.13	1.000	0.13	0.25		Liquefiable
1.50	SP	15	1.80	0.80	3				0.99	2.70	1.20	0.52	1.70	0.75	0.984	1.05	0.75	1.10	9.59	16.31	0.00	1.00	16.31	0.17	1.000	0.17	0.33		Liquefiable
3.00	SW-SM	84	2.04	1.04	9				0.98	5.77	2.77	0.48	1.70	0.75	0.984	1.05	0.80	1.10	57.30	97.40	0.56	1.02	99.61	NA	1.000	NA	>1		Non Liquefiable
4.50	SW-SM	84	2.04	1.04	8				0.97	8.83	4.33	0.46	1.53	0.75	0.984	1.05	0.85	1.10	60.88	93.43	0.30	1.01	94.91	NA	1.000	NA	>1		Non Liquefiable
6.00	SW-SM	74	2.04	1.04	5				0.95	11.90	5.90	0.45	1.32	0.75	0.984	1.05	0.95	1.10	59.94	78.84	0.00	1.00	78.84	NA	1.000	NA	>1		Non Liquefiable
7.50	SW-SM	86	2.04	1.04	9				0.94	14.96	7.46	0.44	1.17	0.75	0.984	1.05	0.95	1.10	69.66	81.45	0.56	1.02	83.40	NA	1.000	NA	>1		Non Liquefiable
9.00	SC	75	2.04	1.04	39				0.93	18.02	9.02	0.44	1.06	0.75	0.984	1.05	0.95	1.10	60.75	64.59	5.00	1.20	82.50	NA	1.000	NA	>1		Non Liquefiable
12.00	GP	100	2.04	1.04	0				0.85	24.15	12.15	0.40	0.92	0.75	0.984	1.05	1	1.10	85.26	78.11	0.00	1.00	78.11	NA	1.000	NA	>1		Non Liquefiable
1) The project site falls in Zone - V. A maximum earthquake intensity of 7.5 has been considered in the analysis.																		REMARK											
2) C _{HT} & C _{HW} = Correction for hammer energy ratio, C _{HT} = 0.75, Energy Ratio for Rope and Pulley System = 80 %, C _{HW} = Height x Weight / 48387																		The FOS belongs to only COHESIONLESS soils											
3) Borehole diameter = 150 mm , Hence C _{BD} = 1.05																		because the liquefaction											
4) C _{SS} = Correction for Standard sampler = 1.1																		potential for COHESIVE soil is											
5) C ₆₀ = C _{HT} C _{HW} C _{BD} C _{RL} C _{SS}																		based on Seed & Idriss Criteria											
Ref. for Clays: Seed, H. Bolton; Idriss, I. M.; Arango, Ignacio (1983). "Evaluation of Liquefaction Potential Using Field Performance Data". Journal of Geotechnical Engineering. 109(3): 458–482.																													

Ref. for Clays: Seed, H. Bolton; Idriss, I. M.; Arango, Ignacio (1983). "Evaluation of Liquefaction Potential Using Field Performance Data", Journal of Geotechnical Engineering, 109(3), 458-482.

Evaluation of Liquefaction Potential (IS 1893 - Part 1 : 2016, RA-2021) for KANDLA - BH 4																														
Project Name: Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)													Actual Water Table Depth : 7.00 m				Zone Factor : 0.36													
Borehole No.: 4													Water Table Considered : 0.00 m				Location : Bhuj													
Hammer Fall: 0.75 m													Hammer Weight: 63.5 kg				Earthquake Magnitude (M _w) : 7.5													
INPUT PARAMETERS					COHESIONLESS SOILS															CONCLUSIONS										
Depth below EGL, m	Type of soil	Observed SPT Value (N)	Saturated Density (γ _m ³)	Submerged Density (γ _m ³)	Fine Content (%)	Field Moisture Content, FMC (%)	Particles less than 5 micron size (%)	Liquid Limit, LL (%)	Stress Reduction Coefficient (r _d)	Total overburden pressure (σ _o), γ _m ²	Effective overburden (σ' _o), γ _m ²	Cyclic Stress ratio (CSR)	C _n = sqrt(Pa/σ' _o)	C _{HT}	C _{HW}	C _{BD}	C _{RL}	C _{SS}	(N) ₆₀ = C ₆₀ X N	(N) ₁₆₀ = C _n X N ₆₀	α	β	(N ₁) _{60CS} = α + β (N) ₆₀	CRR _{7.5}	Magnitude Scaling Factor, MSF = (10) ^{2.24/(MW)^{2.56}}	CRR = CRR _{7.5} (MSF) K _α K _σ	FOS = CRR / CSR	for Cohesive Soils	for Cohesionless Soils	
0.50	CL	4	1.67	0.67	97	28.20	14	34.20	1.00	0.84	0.34	0.58	1.70	0.75	0.984	1.05	0.75	0.75	1.10	2.56	4.35	5.00	1.20	10.22	0.12	1.000	0.12	0.20	Non-Liquefiable	
3.00	CL	7	1.67	0.67	95	28.20	14	33.80	0.98	5.02	2.02	0.57	1.70	0.75	0.984	1.05	0.80	0.80	1.10	4.77	8.12	5.00	1.20	14.74	0.16	1.000	0.16	0.28	Non-Liquefiable	
6.00	CH	8	1.91	0.91	94	25.10	22.00	71.60	0.95	10.75	4.75	0.51	1.47	0.75	0.984	1.05	0.95	0.95	1.10	6.48	9.50	5.00	1.20	16.40	0.17	1.000	0.17	0.34	Non-Liquefiable	
9.00	SC	36	1.99	0.99	45				0.93	16.72	7.72	0.47	1.15	0.75	0.984	1.05	0.95	0.95	1.10	29.16	33.52	5.00	1.20	45.22	NA	1.000	NA	>1	Non Liquefiable	
10.50	SC	92	1.99	0.99	43				0.89	19.70	9.20	0.45	1.05	0.75	0.984	1.05	1	1	1.10	78.44	82.58	5.00	1.20	####	NA	1.000	NA	>1	Non Liquefiable	
12.00	SC	100	1.99	0.99	42				0.85	22.69	10.69	0.42	0.98	0.75	0.984	1.05	1	1	1.10	85.26	83.29	5.00	1.20	####	NA	1.000	NA	>1	Non Liquefiable	
13.50	SC	100	1.99	0.99	39				0.81	25.67	12.17	0.40	0.92	0.75	0.984	1.05	1	1	1.10	85.26	78.04	5.00	1.20	98.65	NA	1.000	NA	>1	Non Liquefiable	
15.00	SC	100	1.99	0.99	48				0.77	28.66	13.66	0.38	0.86	0.75	0.984	1.05	1	1	1.10	85.26	73.68	5.00	1.20	93.41	NA	1.000	NA	>1	Non Liquefiable	
1) The project site falls in Zone - V. A maximum earthquake intensity of 7.5 has been considered in the analysis.																														
2) C _{HT} & C _{HW} = Correction for hammer energy ratio, C _{HT} = 0.75, Energy Ratio for Rope and Pully System = 80 %, C _{HW} = Height x Weight / 48387																														
3) Borehole diameter = 150 mm , Hence C _{BD} = 1.05																														
4) C _{SS} = Correction for Standard sampler = 1.1																														
5) C ₆₀ = C _{HT} C _{HW} C _{BD} C _{RL} C _{SS}																														
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													REMARK																	
													The FOS belongs to only COHESIONLESS soils because the liquefaction potential for COHESIVE soil is based on Seed & Idriss Criteria																	

Evaluation of Liquefaction Potential (IS 1893 - Part 1 : 2016, RA-2021) for KANDLA - BH 5																														
Project Name: Geotechnical Investigation for the project of widening and improvement of K.K Road (2 to 4 lanes) & constructing 4 lane link road to Kandla Bypass (Project ID:262)													Actual Water Table Depth : 7.00 m				Zone Factor : 0.36													
Borehole No.: 5													Water Table Considered : 0.00 m				Location : Bhuj													
Hammer Fall: 0.75 m													Hammer Weight: 63.5 kg				Earthquake Magnitude (M _w) : 7.5													
INPUT PARAMETERS						COHESIONLESS SOILS															CONCLUSIONS									
Depth below EGL, m	Type of soil	Observed SPT Value (N)	Saturated Density (γ _m ³)	Submerged Density (γ _m ³)	Fine Content (%)	Field Moisture Content, FMC (%)	Particles less than 5 micron size (%)	Liquid Limit, LL (%)	Stress Reduction Coefficient (r _d)	Total overburden pressure (σ _o), γ _m ²	Effective overburden (σ' _o), γ _m ²	Cyclic Stress ratio (CSR)	C _n = sqrt(Pa/σ' _o)	C _{HT}	C _{HW}	C _{BD}	C _{RL}	C _{SS}	(N) ₆₀ = C ₆₀ X N	α	β	(N ₁) _{60CS} = α + β (N ₁) ₆₀	CRR _{7.5}	Magnitude Scaling Factor, MSF = (10) ^{2.24 / (MW)^{2.56}}	CRR = CRR _{7.5} (MSF) K _α	FOS = CRR / CSR	for Cohesive Soils	for Cohesionless Soils		
0.50	CH	2	1.59	0.59	98	29.60	22.00	56.10	1.00	0.80	0.30	0.63	1.70	0.75	0.984	1.05	0.75	1.10	1.10	1.28	2.17	5.00	1.20	7.61	0.09	1.000	0.09	0.15	Non-Liquefiable	
3.00	CH	2	1.59	0.59	97	29.60	22.00	58.20	0.98	4.78	1.78	0.61	1.70	0.75	0.984	1.05	0.80	1.10	1.36	2.32	5.00	1.20	7.78	0.09	1.000	0.09	0.15	Non-Liquefiable		
4.50	ML	5	1.59	0.59	60				0.97	7.17	2.67	0.61	1.70	0.75	0.984	1.05	0.85	1.10	3.62	6.16	5.00	1.20	12.39	0.13	1.000	0.13	0.22	Liquefiable		
6.00	ML	7	1.59	0.59	76				0.95	9.55	3.55	0.60	1.69	0.75	0.984	1.05	0.95	1.10	5.67	9.61	5.00	1.20	16.53	0.18	1.000	0.18	0.29	Liquefiable		
9.00	CL	9	1.75	0.75	77	24.80	14.00	34.20	0.93	14.80	5.80	0.56	1.33	0.75	0.984	1.05	0.95	1.10	7.29	9.67	5.00	1.20	16.60	0.18	1.000	0.18	0.32	Non-Liquefiable		
12.00	CL	14	1.79	0.79	57	24.80	14.00	31.20	0.85	20.16	8.16	0.49	1.12	0.75	0.984	1.05	1	1.10	11.94	13.34	5.00	1.20	21.01	0.23	1.000	0.23	0.46	Non-Liquefiable		
13.50	SC	66	1.79	0.79	45				0.81	22.84	9.34	0.47	1.04	0.75	0.984	1.05	1	1.10	56.27	58.79	5.00	1.20	75.55	NA	1.000	NA	>1	Non Liquefiable		
15.00	SC	100	1.79	0.79	38				0.77	25.52	10.52	0.44	0.98	0.75	0.984	1.05	1	1.10	85.26	83.94	5.00	1.20	###	NA	1.000	NA	>1	Non Liquefiable		
1) The project site falls in Zone - V. A maximum earthquake intensity of 7.5 has been considered in the analysis.																														
2) C _{HT} & C _{HW} = Correction for hammer energy ratio, C _{HT} = 0.75, Energy Ratio for Rope and Pully System = 80 %, C _{HW} = Height x Weight / 48387																														
3) Borehole diameter = 150 mm , Hence C _{BD} = 1.05																														
4) C _{SS} = Correction for Standard sampler = 1.1																														
5) C ₆₀ = C _{HT} C _{HW} C _{BD} C _{RL} C _{SS}																														
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With Liquefaction

SINGLE PILE CAPACITY COMPUTATION - Bored Cast in-situ Piles (IS 2911 Part I / Sec 2)															
Sample Calculation of 18m Deep Pile with 1m Diameter for BH-1															
DESIGN PARAMETERS															
1	Diameter	D	m	1.00	6	Critical Depth	D _c	m	15.00						
2	Length with CUTOFF below EGL, m - 0.00	L	m	18.00	7	Water Table below EGL	GWT	m	0.00						
3	Angle of Internal Friction at Toe	φ	degree	15.0	8	Cross Sectional Area of Pile tip	A _p	m ²	0.786						
4	Cohesion at Toe	C	kN/m ²	61.0	9	Factor of Safety for Uplift Capacity	F _{au}	IS 2911 P1 S2	3.0						
5	L/D Ratio	L/D	---	15.00	10	Factor of Safety for Vertical Capacity	F _{sv}	Ci: 6.3.2	2.5						
PILE CAPACITY COMPUTATION															
Layer below EGL	Depth, m	Type of Soil	Bulk Density	Effective Unit Weight of soil at pile tip	Average Cohesion at pile tip	Angle of Internal Friction	Shear Strength (Cu)	Angle of Wall Friction between Pile and Soil	Bearing Capacity Factors			Adhesion Factor	Coefficient of Earth Pressure	-ve Skin Friction Factor	
									N _c	N _q	N _γ				
	L		γ _b	γ	C	φ	= C + σ tanφ	δ	--	--	α	K	β	--	
1	0.00	SM	16.27	6.27	0.0	0.0	0.0	0.0	0.0	9.0	1.00	0.00	0.00	1.50	0.30
2	0.50	SM	16.27	6.27	0.0	0.0	0.0	0.0	0.0	9.0	1.00	0.00	0.00	1.50	0.30
3	2.10	SM	16.27	6.27	0.0	0.0	0.0	0.0	0.0	9.0	1.00	0.00	0.00	1.50	0.30
4	3.45	SC	19.07	9.07	0.0	28.0	13.5	28.0	28.0	9.0	12.68	16.72	0.00	1.50	0.00
5	15.45	SW-SM	19.07	9.07	0.0	28.0	69.2	28.0	28.0	9.0	12.68	16.72	0.00	1.50	0.00
6	18.00	CH	19.44	9.44	61.0	15.0	95.9	15.0	15.0	9.0	3.94	2.65	0.74	1.00	0.00
7	20.00	CH	19.44	9.44	61.0	15.0	95.9	15.0	15.0	9.0	3.94	2.65	0.74	1.00	0.00
Effective Overburden Pressure at Tip	σ	Effective Overburden Pressure at CG	Skin Friction, P _{su}		End Bearing, P _{pu}				Self Weight of Pile (P _{self})		Negative Skin Friction (P _{sd})	Ultimate Vertical Downward Capacity (Q _u)	Safe Vertical Downward Capacity (Q _{us})	Uplift Capacity (Q _p)	
			α * C * A _s	K * P _d * Tanδ * A _s	P _{su}	N _c * C	q * N _q	0.5 * D * γ * N _γ	P _{pu}	γ _c = 24 kN/m ³					
	P _d		kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
	kN/m ²		kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.14	1.57	1.57	0.00	0.00	0.00	0.00	3.14	0.00	2.46	9.43	1.48	0.00	0.00	0.00	0.00
13.17	8.15	5.02	0.00	0.00	0.00	0.00	13.17	0.00	10.35	27.03	21.31	10.35	0.00	0.00	0.00
25.41	19.29	4.24	0.00	65.23	65.23	0.00	322.22	75.83	312.86	41.88	21.31	378.09	129.93	63.62	63.62
130.17	77.79	37.69	0.00	2338.40	2403.63	0.00	1650.56	75.83	1356.94	173.83	21.31	3760.57	1482.92	975.04	975.04
130.17	130.17	8.01	360.26	279.38	3043.28	549.00	512.87	12.51	844.46	201.87	21.31	3887.74	1533.79	1216.30	1216.30
130.17	130.17	6.28	282.45	219.04	3544.77	549.00	512.87	12.51	844.46	223.87	21.31	4389.23	1734.38	1405.46	1405.46

Sample Calculation of 18m Deep Pile with 1m Diameter for BH-1

DESIGN PARAMETERS :

Diameter of Pile	D	=	1.00	m	
Length of Pile	L	=	18.00	m	CUTOFF below EGL, m - 0.00
Angle of Internal Friction at Toe	Ø	=	15	degree	
Cohesion at Toe	C	=	61	kN/m ²	
L/D Ratio	L/D	=	15.00	---	
Critical Depth	Dc	=	15.00	m	
Water Table below EGL	GWT	=	0.00	m	
Cross Sectional Area of Pile-tip	Ap	=	0.786	m ²	
Factor of Safety (Uplift Capacity)	Fsu	=	3.00	(Ref.: IS 2911 Part 1 Sec 2 CL.: 6.3.2)	
Factor of Safety (Vertical Capacity)	Fsv	=	2.50	(Ref.: IS 2911 Part 1 Sec 2 CL.: 6.8.2)	

Vertical Capacity, $Q_u = \text{End Bearing (Ppu)} + \text{Skin Friction (Psu)}$

$$\begin{aligned} P_{pu} &= A_p \times ((0.5 \times D \times \gamma \times N_\gamma + q \times N_q) + (N_c \times C_p)) \\ &= 0.786 \times (((0.5 \times 1 \times 9.44 \times 2.65) + (130.17 \times 3.94)) + (9 \times 61)) \\ &= 844.47 \quad \text{kN} \end{aligned}$$

$P_{su} = (\text{Skin friction for 15.45m to 18m Depth}) + \text{Total skin friction upto 15.45m Depth}$

$$\begin{aligned} P_{su} &= ((K \times P_d \times \tan(\alpha_i) \times A_{si}) + (a_i \times c_i \times A_{si})) + 2403.635 \\ &= ((1 \times 130.17 \times \tan 15^\circ \times 8.01) + (0.738 \times 61 \times 8.01)) + 2403.635 \\ &= 3043.61 \quad \text{kN} \end{aligned}$$

Vertical Capacity, $Q_u = P_{pu} + P_{su}$

$$= 844.47 + 3043.61$$

$$Q_u = 3888.08 \quad \text{kN}$$

Safe Vertical Capacity, $Q_{us} = (Q_u / F_{sv}) - (\text{'-ve' skin friction})$

$$= (3888.08 / 2.5) - 21.31$$

$$Q_{us} = 1533.922 \quad \text{kN}$$

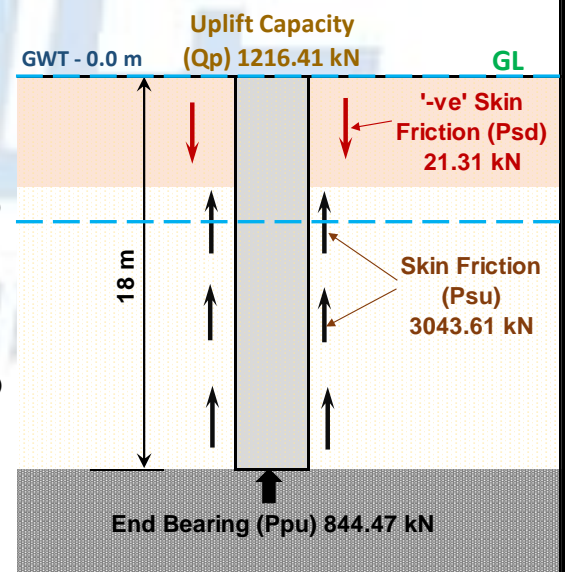
$$Q_{us} = 153.39 \quad \text{MT}$$

Uplift Capacity, $Q_p = (P_{su} / \text{FoS}) + \text{Self Weight of Pile (Pself)}$

$$= (3043.61 / 3) + 201.87$$

$$Q_p = 1216.41 \quad \text{kN}$$

$$Q_p = 121.64 \quad \text{MT}$$



Note: The above figure is just for illustration purpose, so it is not to scale and not as per actual borelog.

PILE LATERAL CAPACITY FOR BH-1				
PILE DESIGN - Bored Cast <i>in-situ</i> Piles - (IS 2911 Part I/Sec2)				
* Diameter, D (cm)	100	120	150	
LATERAL CAPACITY OF PILE FOR SAND & NORMALLY LOADED CLAYS				
1 Permissible Deflection of top, Y (mm)	5.0	5.0	5.0	
2 Grade of Concrete M	35			
3 Young's Modulus of Concrete, E (kN/m ²)	29580399			
= $5000 \times 35 \times 10^3$ = 29580399				
4 Moment Inertia of Pile, I (m ⁴)	0.049088	0.101788	0.248505	
= $(\pi / 64) \times (D/100)^4$ = $(\pi / 64) \times (100/100)^4$ = 0.049088				
5 Free Length, e (m)	2.1			
FIXED HEAD CONDITION - LATERAL CAPACITY (H _{fx})				
6 Modulus of Subgrade reaction, ηh (kN/m ³)	4280	(For N - 30 from IS 2911 Part 1 Sec 2)		
7 Stiffness Factor, T (m)	3.2	3.7	4.4	
= $((E \times I) / \eta h)^{0.2}$ = $((29580399 \times 0.049088) / 4280)^{0.2}$ = 3.2				
8 Ratio Lf / T	2.2			
9 Cantilever Length, Zf (m)	7.1	8.2	9.8	
= $(Lf / T) \times T$ = 2.2×3.21 = 7.1				
	(Depth of Fixity)			
10 Lateral Capacity, H _{fx} (kN)	113.3	167.1	264.5	
= $(12 \times E I Y) / ((e + Zf)^3 \times 1000)$ = $(12 \times 29580399 \times 0.049088 \times 5) / ((2.1 + 7.062)^3 \times 1000)$ = 113.3				
Lateral Capacity, H _{fx} (MT)	11.3	16.7	26.4	
11 Reduction Factor, RF	0.83			
12 Maximum Moment in Pile, M (kN-m)	430.7	566.1	1071.0	
= $((Hfx (e + Zf))/2) \times RF$ = $((113.29 \times (2.1 + 7.062))/2) \times 0.83$ = 430.7				
FREE HEAD CONDITION - LATERAL CAPACITY (H _{fr})				
13 Ratio Lf / R	1.9			
14 Cantilever Length, Lf, m	6.1	7.1	8.4	
= $(Lf / R) \times T$ = 1.9×3.21 = 6.1				
	(Depth of Fixity)			
15 Lateral Capacity, H _{fr} (kN)	39.5	59.0	94.5	
= $(3 \times E I Y) / ((e + Lf)^3 \times 1000)$ = $(3 \times 29580399 \times 0.049088 \times 5) / ((2.1 + 6.099)^3 \times 1000)$ = 39.5				
Lateral Capacity, H _{fr} (MT)	4.0	5.9	9.4	
16 Reduction Factor, RF	0.40			
17 Maximum Moment in Pile, M (kN-m)	129.60	166.25	318.54	
= $((Hfr (e + Lf)) \times RF$ = $(39.52 \times (2.1 + 6.099)) \times 0.4$ = 129.6				

Without Liquefaction

SINGLE PILE CAPACITY COMPUTATION - Bored Cast in-situ Piles (IS 2911 Part I / Sec 2)														
Sample Calculation of 18m Deep Pile with 1m Diameter for BH-1														
DESIGN PARAMETERS														
	Diameter	D	m	1.00	6	Critical Depth	D _c	m	15.00					
1	Length with CUTOFF below EGL, m - 0.00	L	m	18.00	7	Water Table below EGL	GWT	m	0.00					
2	Angle of Internal Friction at Toe	φ	degree	15.0	8	Cross Sectional Area of Pile tip	A _p	m ²	0.786					
3	Cohesion at Toe	C	kN/m ²	61.0	9	Factor of Safety for Uplift Capacity	F _{su}	IS 2911 Pt S2	3.0					
4	L/D Ratio	L/D	---	15.00	10	Factor of Safety for Vertical Capacity	F _{sv}	CI: 6.3.2	2.5					
PILE CAPACITY COMPUTATION														
Layer below EGL	Depth, m	Type of Soil	Bulk Density	Effective Unit Weight of soil at pile tip	Average Cohesion at pile tip	Angle of Internal Friction	Shear Strength (Cu)	Angle of Wall Friction between Pile and Soil	Bearing Capacity Factors			Adhesion Factor	Coefficient of Earth Pressure	Skin Friction Factor
									N _c	N _q	N _γ			
	L		γ _b	γ	C	φ	= C + σ tanφ	δ	--	--	--	α	K	β
	m		kN/m ³	kN/m ³	kN/m ²	degree	kN/m ²	degree				--	--	--
1	0.00	SM	16.27	6.27	0.0	0.0	0.0	0.0	9.0	1.00	0.00	0.00	1.50	0.00
2	0.50	SM	16.27	6.27	0.0	0.0	0.0	0.0	9.0	1.00	0.00	0.00	1.50	0.00
3	2.10	SM	16.27	6.27	0.0	0.0	0.0	0.0	9.0	1.00	0.00	0.00	1.50	0.00
4	3.45	SC	19.07	9.07	0.0	28.0	13.5	28.0	9.0	12.68	16.72	0.00	1.50	0.00
5	15.45	SW-SM	19.07	9.07	0.0	28.0	69.2	28.0	9.0	12.68	16.72	0.00	1.50	0.00
6	18.00	CH	19.44	9.44	61.0	15.0	95.9	15.0	9.0	3.94	2.65	0.74	1.00	0.00
7	20.00	CH	19.44	9.44	61.0	15.0	95.9	15.0	9.0	3.94	2.65	0.74	1.00	0.00
Effective Overburden Pressure at Tip	Effective Overburden Pressure at CG	Surface Area of Pile Shaft	Skin Friction, P _{su}		End Bearing, P _{pu}			Self Weight of Pile (P _{self})	Negative Skin Friction (P _{sd})	Ultimate Vertical Downward Capacity (Q _u)	Safe Vertical Downward Capacity (Q _{us})	Uplift Capacity (Q _p)		
			α * C * A _s	K * P _d * Tanδ * A _s	P _{su}	N _c * C	0.5 * D * γ * N _γ						P _{pu}	
σ	P _d	A _s	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	
kN/m ²	kN/m ²	m ²	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3.14	1.57	1.57	0.00	0.00	0.00	0.00	3.14	0.00	2.46	9.43	2.46	0.99	9.43	
13.17	8.15	5.02	0.00	0.00	0.00	0.00	13.17	0.00	10.35	27.03	10.35	4.14	27.03	
25.41	19.29	4.24	0.00	65.23	65.23	0.00	322.22	75.83	312.86	41.88	378.09	151.24	63.62	
130.17	77.79	37.69	0.00	2338.40	2403.63	0.00	1650.56	75.83	1356.94	173.83	3760.57	1504.23	975.04	
130.17	130.17	8.01	360.26	279.38	3043.28	549.00	512.87	12.51	844.46	201.87	3887.74	1555.10	1216.30	
130.17	130.17	6.28	282.45	219.04	3544.77	549.00	512.87	12.51	844.46	223.87	4389.23	1755.69	1405.46	

Sample Calculation of 18m Deep Pile with 1m Diameter for BH-1

DESIGN PARAMETERS :

Diameter of Pile	D	=	1.00	m	
Length of Pile	L	=	18.00	m	CUTOFF below EGL, m - 0.00
Angle of Internal Friction at Toe	Ø	=	15	degree	
Cohesion at Toe	C	=	61	kN/m ²	
L/D Ratio	L/D	=	15.00	---	
Critical Depth	Dc	=	15.00	m	
Water Table below EGL	GWT	=	0.00	m	
Cross Sectional Area of Pile-tip	Ap	=	0.786	m ²	
Factor of Safety (Uplift Capacity)	Fsu	=	3.00	(Ref.: IS 2911 Part 1 Sec 2 CL.: 6.3.2)	
Factor of Safety (Vertical Capacity)	Fsv	=	2.50	(Ref.: IS 2911 Part 1 Sec 2 CL.: 6.8.2)	

Vertical Capacity, $Q_u = \text{End Bearing (Ppu)} + \text{Skin Friction (Psu)}$

$$\begin{aligned} P_{pu} &= A_p \times ((0.5 \times D \times \gamma \times N_\gamma + q \times N_q) + (N_c \times C_p)) \\ &= 0.786 \times (((0.5 \times 1 \times 9.44 \times 2.65) + (130.17 \times 3.94)) + (9 \times 61)) \\ &= 844.47 \quad \text{kN} \end{aligned}$$

$P_{su} = (\text{Skin friction for 15.45m to 18m Depth}) + \text{Total skin friction upto 15.45m Depth}$

$$\begin{aligned} P_{su} &= ((K \times P_d \times \tan(\phi_i) \times A_{si}) + (a_i \times c_i \times A_{si})) + 2403.635 \\ &= ((1 \times 130.17 \times \tan 15^\circ \times 8.01) + (0.738 \times 61 \times 8.01)) + 2403.635 \\ &= 3043.61 \quad \text{kN} \end{aligned}$$

Vertical Capacity, $Q_u = P_{pu} + P_{su}$

$$= 844.47 + 3043.61$$

$$Q_u = 3888.08 \quad \text{kN}$$

Safe Vertical Capacity, $Q_{us} = (Q_u / F_{sv}) - (\text{'-ve' skin friction})$

$$= (3888.08 / 2.5) - 0$$

$$Q_{us} = 1555.232 \quad \text{kN}$$

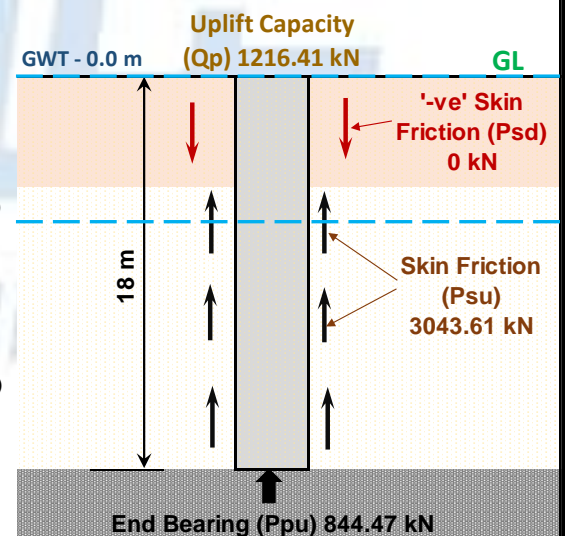
$$Q_{us} = 155.52 \quad \text{MT}$$

Uplift Capacity, $Q_p = (P_{su} / \text{FoS}) + \text{Self Weight of Pile (Pself)}$

$$= (3043.61 / 3) + 201.87$$

$$Q_p = 1216.41 \quad \text{kN}$$

$$Q_p = 121.64 \quad \text{MT}$$



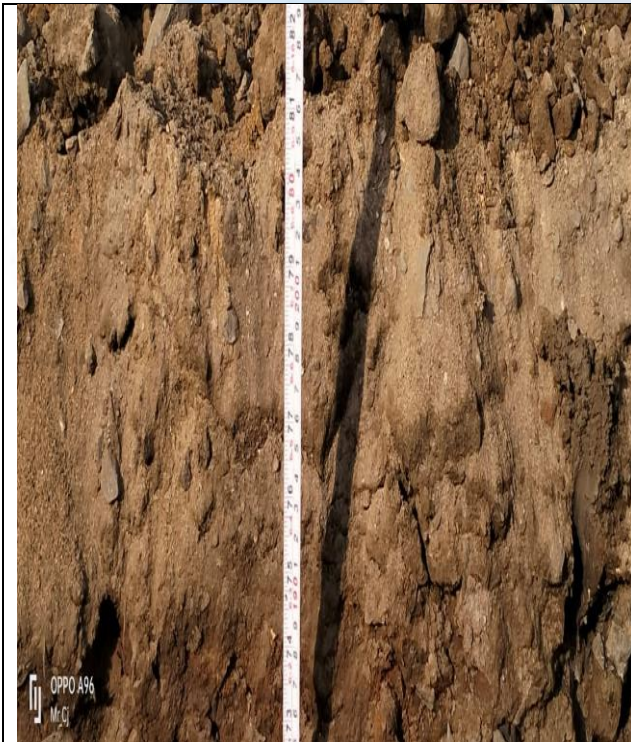
Note: The above figure is just for illustration purpose, so it is not to scale and not as per actual borelog.

PILE LATERAL CAPACITY FOR BH-1				
PILE DESIGN - Bored Cast <i>in-situ</i> Piles - (IS 2911 Part I/Sec2)				
* Diameter, D (cm)	↔	100	120	150
LATERAL CAPACITY OF PILE FOR SAND & NORMALLY LOADED CLAYS				
1 Permissible Deflection of top, Y (mm)		5.0	5.0	5.0
2 Grade of Concrete M		35		
3 Young's Modulus of Concrete, E (kN/m ²)		29580399		
$= 5000 \times 35 \times 10^3 = 29580399$				
4 Moment Inertia of Pile, I (m ⁴)		0.049088	0.101788	0.248505
$= (\pi / 64) \times (D/100)^4 = (\pi / 64) \times (100/100)^4 = 0.049088$				
5 Free Length, e (m)		0		
FIXED HEAD CONDITION - LATERAL CAPACITY (H _{fx})				
6 Modulus of Subgrade reaction, ηh (kN/m ³)		3848	(For N - 27 from IS 2911 Part 1 Sec 2)	
7 Stiffness Factor, T (m)		3.3	3.8	4.5
$= ((E \times I) / \eta h)^{0.2} = ((29580399 \times 0.049088) / 3848)^{0.2} = 3.3$				
8 Ratio Lf / T		2.2		
9 Cantilever Length, Zf (m)		7.2	8.3	10.0
$= (Lf / T) \times T = 2.2 \times 3.28 = 7.2$ (Depth of Fixity)				
10 Lateral Capacity, H _{fx} (kN)		231.9	311.5	445.2
$= (12 \times E I Y) / ((e + Zf)^3 \times 1000) = (12 \times 29580399 \times 0.049088 \times 5) / ((0 + 7.216)^3 \times 1000) = 231.9$				
Lateral Capacity, H _{fx} (MT)		23.2	31.2	44.5
11 Reduction Factor, RF		0.83		
12 Maximum Moment in Pile, M (kN-m)		694.4	1078.1	1841.8
$= ((Hfx (e + Zf))/2) \times RF = ((231.87 \times (0 + 7.216))/2) \times 0.83 = 694.4$				
FREE HEAD CONDITION - LATERAL CAPACITY (H _{fr})				
13 Ratio Lf / R		1.9		
14 Cantilever Length, Lf, m		6.2	7.2	8.6
$= (Lf / R) \times T = 1.9 \times 3.28 = 6.2$ (Depth of Fixity)				
15 Lateral Capacity, H _{fr} (kN)		90.0	120.9	172.8
$= (3 \times E I Y) / ((e + Lf)^3 \times 1000) = (3 \times 29580399 \times 0.049088 \times 5) / ((0 + 6.232)^3 \times 1000) = 90.0$				
Lateral Capacity, H _{fr} (MT)		9.0	12.1	17.3
16 Reduction Factor, RF		0.40		
17 Maximum Moment in Pile, M (kN-m)		224.32	348.30	595.03
$= ((Hfr (e + Lf)) \times RF = (89.99 \times (0 + 6.232)) \times 0.4 = 224.3$				

ANNEXURE – 6 SITE PHOTOGRAPHS

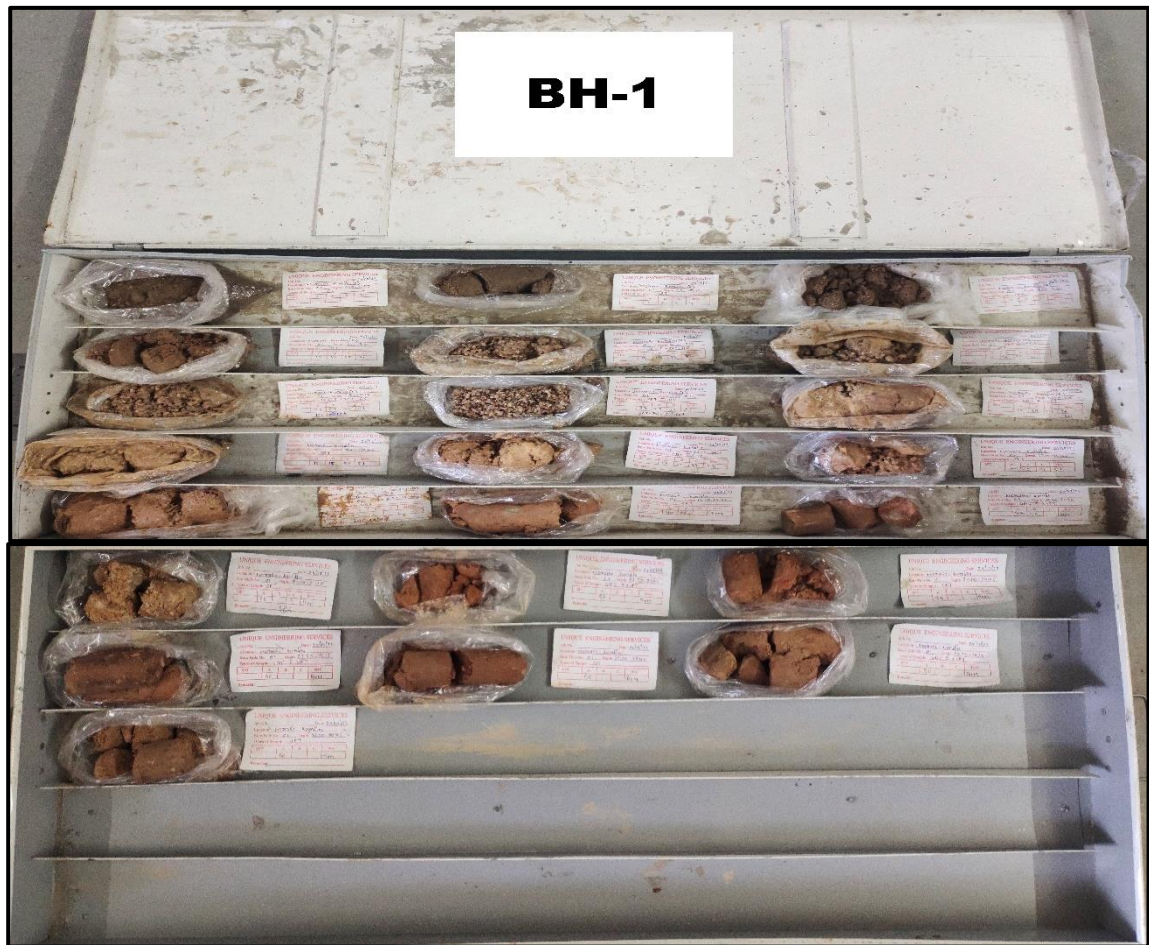


BORE DRILLING

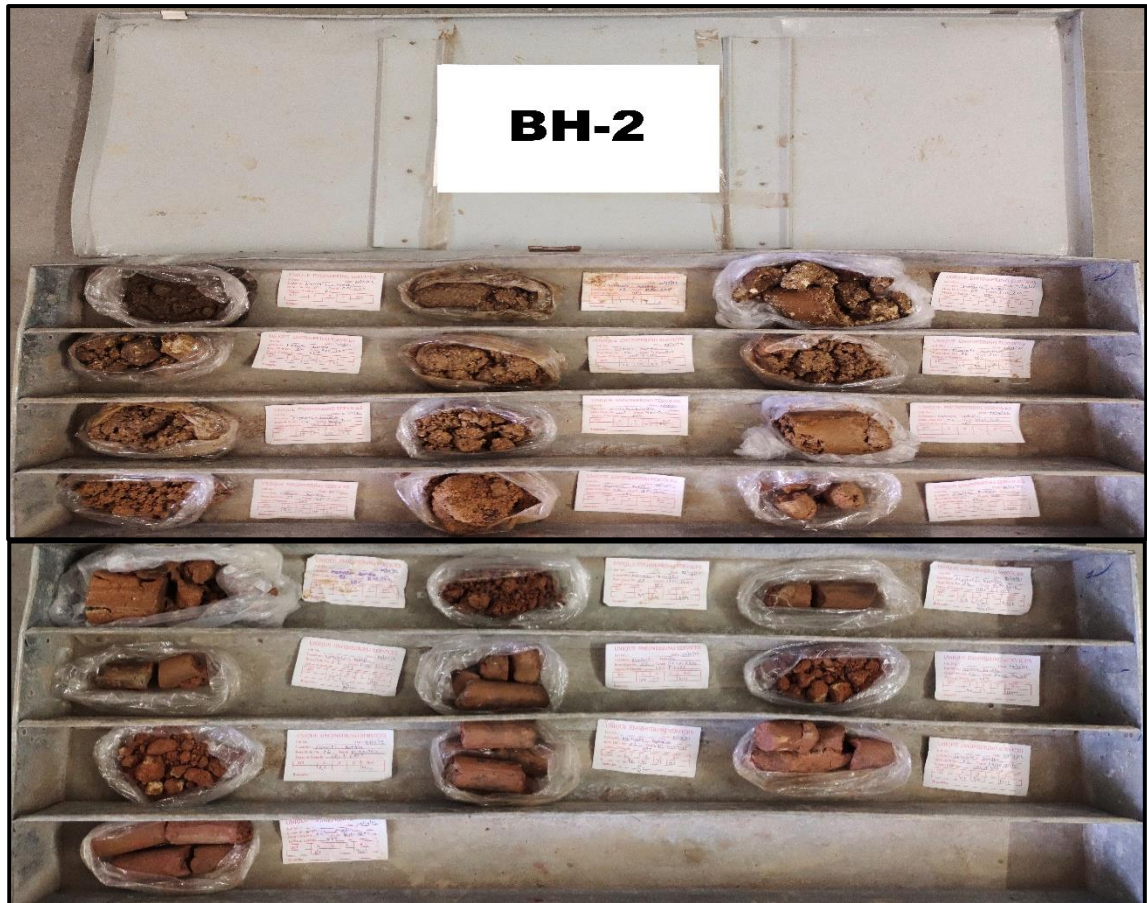


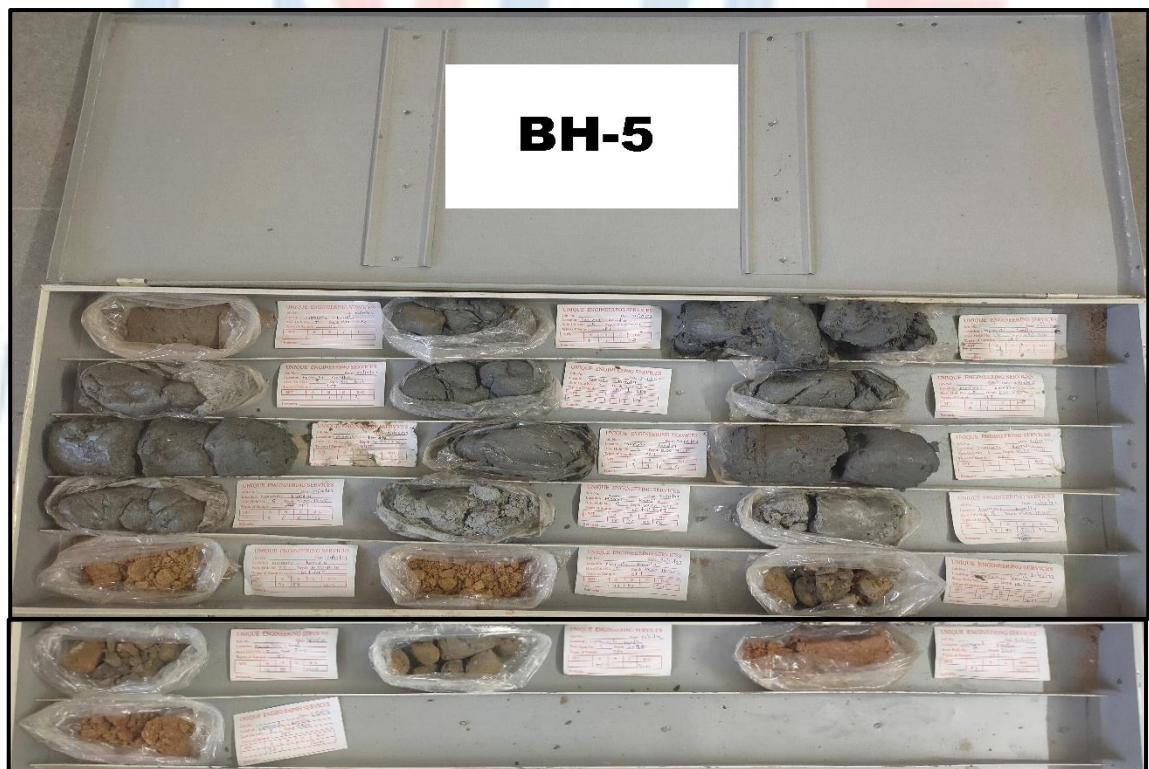
Trial Pit

ANNEXURE – 7 SAMPLE PHOTOGRAPHS



UNIQUE ENGINEERING SERVICES





ANNEXURE 8: LABORATORY TESTING PHOTOGRAPHS



WET SIEVE ANALYSIS



**LIQUID LIMIT TEST BY CONE
PENETROMETER METHOD**



SPECIFIC GRAVITY TEST



FREE SWELL INDEX

**DIRECT SHEAR TEST****TRIAXIAL TEST****HYDROMETER TEST**

ABBREVIATIONS

G	Gravel
S	Sand
M	Silt
C	Clay
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
NP	Non-Plastic
FDD	Field Dry Density
FMC	Field Moisture Content
C	Unit Cohesion
Ø	Angle of Internal Friction
Cc	Compression Index
Pc	Pre-Consolidation Pressure
UCS	Unconfined Compressive Strength
CH	Clay of High Plasticity
CI	Clay of Intermediate Plasticity
CL	Clay of Low Plasticity
MH	Silt of High Plasticity
MI	Silt of Intermediate Plasticity
ML	Silt of Low Plasticity
SP	Poorly Graded Sand
SM	Silty Sand
DS	Disturbed Sample
UDS	Undisturbed Sample
WR	Weathered Rock
HWR	Highly Weathered Rock
EGL	Existing ground Level

APPENDIX

Table 4 Requirements for Concrete Exposed to Sulphate Attack
(Clauses 8.2.2.4 and 9.1.2)

Sl No.	Class	Concentration of Sulphates, Expressed as SO ₃			Type of Cement	Dense, Fully Compacted Concrete. Made with 20 mm Nominal Maximum Size Aggregates Complying with IS 383	
		In Soil		In Ground Water		Minimum Cement Content kg/m ³	Maximum Face Water-Cement Ratio
		Total SO ₃	SO ₃ in 2:1 Water: Soil Extract				
(1)	(2)	Percent	g/l	g/l	(6)	(7)	(8)
i)	1	Traces (< 0.2)	Less than 1.0	Less than 0.3	Ordinary Portland cement or Portland slag cement or Portland pozzolana cement	280	0.55
ii)	2	0.2 to 0.5	1.0 to 1.9	0.3 to 1.2	Ordinary Portland cement or Portland slag cement or Portland pozzolana cement Supersulphated cement or sulphate resisting Portland cement	330 310	0.50 0.50
iii)	3	0.5 to 1.0	1.9 to 3.1	1.2 to 2.5	Supersulphated cement or sulphate resisting Portland cement Portland pozzolana cement or Portland slag cement	330 350	0.50 0.45
iv)	4	1.0 to 2.0	3.2 to 5.0	2.5 to 5.0	Supersulphated or sulphate resisting Portland cement	370	0.45
v)	5	More than 2.0	More than 5.0	More than 5.0	Sulphate resisting Portland cement or supersulphated cement with protective coatings	400	0.40

NOTES

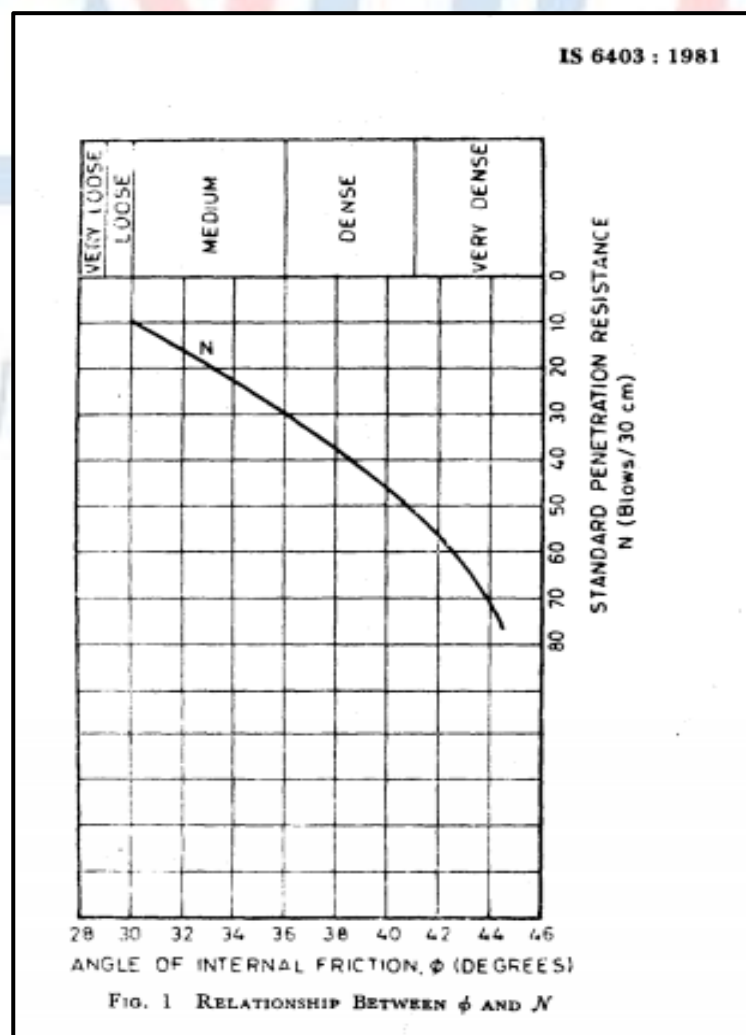
- Cement content given in this table is irrespective of grades of cement.
- Use of supersulphated cement is generally restricted where the prevailing temperature is above 40 °C.
- Supersulphated cement gives an acceptable life provided that the concrete is dense and prepared with a water-cement ratio of 0.4 or less, in mineral acids, down to pH 3.5.
- The cement contents given in col 6 of this table are the minimum recommended. For SO₃ contents near the upper limit of any class, cement contents above these minimum are advised.
- For severe conditions, such as thin sections under hydrostatic pressure on one side only and sections partly immersed, considerations should be given to a further reduction of water-cement ratio.
- Portland slag cement conforming to IS 455 with slag content more than 50 percent exhibits better sulphate resisting properties.
- Where chloride is encountered along with sulphates in soil or ground water, ordinary Portland cement with C_A content from 5 to 8 percent shall be desirable to be used in concrete, instead of sulphate resisting cement. Alternatively, Portland slag cement conforming to IS 455 having more than 50 percent slag or a blend of ordinary Portland cement and slag may be used provided sufficient information is available on performance of such blended cements in these conditions.

TABLE 3-4

Empirical values for ϕ , D_r , and unit weight of granular soils based on the SPT at about 6 m depth and normally consolidated [approximately, $\phi = 28^\circ + 15^\circ D_r (\pm 2^\circ)$]

Description	Very loose	Loose	Medium	Dense	Very dense
Relative density D_r	0	0.15	0.35	0.65	0.85
SPT N'_{70} : fine	1-2	3-6	7-15	16-30	?
medium	2-3	4-7	8-20	21-40	> 40
coarse	3-6	5-9	10-25	26-45	> 45
ϕ : fine	26-28	28-30	30-34	33-38	
medium	27-28	30-32	32-36	36-42	< 50
coarse	28-30	30-34	33-40	40-50	
γ_{wet} , kN/m ³	11-16*	14-18	17-20	17-22	20-23

* Excavated soil or material dumped from a truck has a unit weight of 11 to 14 kN/m³ and must be quite dense to weigh much over 21 kN/m³. No existing soil has a $D_r = 0.00$ nor a value of 1.00. Common ranges are from 0.3 to 0.7.





DEENDAYAL PORT AUTHORITY
ISO 9001:2008 | ISO 14001 | ISPS compliant port

Consultancy Service for Preparation of Details Project Report for widening & Improvement of Existing 2/4-lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)



FINAL DETAILED PROJECT REPORT

DESIGN REPORT

[VOLUME – II]



MONARCH

SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.

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Consultancy Service for Preparation of Details Project Report (DPR) for widening & Improvement of Existing 2/4 –lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)

**Detailed Project
Report**

DESIGN OF HIGHWAYS

MONARCH Surveyors & Engineering

Deendayal Port Authority

A

Chapter-1: DESIGN OF HIGHWAYS

1.1. Methodology

The project involves a series of inter related activities, both in the field and in the design office. Methodology for carrying out these activities is described in the following paragraphs.

1.2. Site Investigations and Surveys

a) Road Inventory

Inventory of the existing road shall cover all existing physical features such as terrain, land-use, roadway, carriageway, type of cross section (cut or fill), utility lines passing along or crossing the highway, roadside facilities and all other features that may have influence on the project preparation.

b) Road Condition Survey

Inventory of the existing road shall cover all existing physical features such as terrain, land use, roadway, carriageway, type of cross section (cut or fill), utility lines passing along or crossing the highway, roadside facilities and all other features that may have influence on the project preparation.

Detailed field study shall be carried out for road and pavement surface conditions covering the following:

- i. pavement condition (surface distress type and extent);
- ii. shoulder condition;
- iii. embankment condition; and

iv. drainage condition

The process ensures that complete information on condition of existing pavement and shoulder is collected so that design parameters related to pavement can be established.

The information collected shall consist of the details of cracking (narrow and wide), rut depth, raveling, potholing, patching in the form of percentage area as well as edge break in terms of length and rut depth in mm. affected of the existing pavement; and paved shoulder material loss, rut depth, corrugation, edge etc. in the case of unpaved shoulders.

The study shall identify defects and road section with similar characteristics i.e. homogeneous sections.

1.3. Topographic, Drainage and Utility Survey

According to the TOR, detailed topographic survey is required to be carried out for capturing the essential ground features along the alignment and for working out improvements, rehabilitation and upgrading costs.

Hence, the Consultants propose to carry out detailed topographic survey for the project road. Briefly the survey work would include:

- Topographic survey true to ground realities using precision instruments like Total Stations and Auto Levels, and bringing out data in digital form (X,Y,Z format) for developing digital terrain model (DTM)
- Capturing all existing physical features, including utility poles, trees of girth greater than 0.3 m, oil and gas lines, hills, valley etc. within the survey corridor which should be compatible with the widening requirements subject to a minimum of 25 m on either side of the centre line of the road or road land boundary, whichever is more.
- Additional surveys at bridge sites for hydraulic calculations and for all arms of crossing

roads at intersections.

- Where existing road crosses the alignments, the survey will extend a minimum of 100m on either side of the road centre line to allow improvements, including at-grade intersections.
- Longitudinal sections shall be taken at 25 m interval and at the locations of curve points, small streams, and intersections and at change in elevation. Cross-sections, in general covering the full width of survey corridor at 50 m interval shall be taken and should show levels at every 2-5 m intervals also at all breaks in the profile. Cross sections shall be taken at closer interval (15-25 m depending on radius of curve) on curves.

Fixing horizontal and vertical control points with concrete pillars. The Reference Pillars/BMs with levels drawn from GTS bench marks shall be of size 15cmX15cmX45cm, cast in RCC grade M15 with a nail fixed in the centre of the top surface. The reference pillar shall be embedded in concrete up to a depth of 30 cm with CC M 10 (5 CM wide all around). The balance 15 cm above ground shall be painted yellow. The spacing shall be 250m apart.

1.4. Study of Alternatives for Realignments/Poor Geometrics

Alignment, realignment design was done on satellite images and its validity was studied at site. The poor geometrics were corrected by increasing the radii of sharp curves

The revised design was then incorporated on topographic survey finalize to report.

1.5. Junctions/Intersections at Grade

Though there is 1 nos. major junction and most of the minor junctions were T/Y shaped, but they were studied at site for the purpose of improving them.

1.6. Pavement Studies

1.6.1. Sub-grade Characteristics and Strength

Project length is divided into homogeneous sections with respect to pavement condition and structural strength. The delineation of segments homogeneous with respect to roughness and strength should be done using the cumulative difference approach (AASHTO, 1993). For the widening of existing road within the ROW, sampling and testing of at least 3 sub-grade soil samples for each homogeneous road sections or 3 samples for each soil type encountered, whichever is higher. In case of new alignments, the test pits for sub-grade soil shall be @ 5 km interval or for each soil type, whichever is more. A minimum of three samples should be tested corresponding to each homogeneous segment. The testing for sub-grade soils shall include the following:

- i) In situ density and moisture content at each test pit
- ii) Field CBR using DCP at each test pit.
- iii) Characterization (Grain size and Atterberg Limit test) for each test pit sample.
- iv) Laboratory moisture density characteristics (modified AASHTO compaction).
- v) Laboratory CBR (un-soak and 4-day soak compacted at three energy levels) and swell.
- vi) Apart from the above, permeability and consolidation test shall be carried out for problematic soils along project corridor.

1.6.2. Material Investigation

The activities included:

- i) Identification of potential sources (including use of fly-ash/slag), quarry sites and borrow areas.
- ii) Collection of samples and conducting relevant laboratory tests.
- iii) Evaluation of test results and assesses the suitability thereof for incorporation in various works and making recommendation on the use of the materials from different sources based on techno-economic principles.
- iv) Assess adequacy of quality and quantities of various construction materials available

- v) No material shall be used from the ROW except by way of leveling the ground as required from construction point of view or for landscaping and planting of trees. Environmental restrictions, if any and feasibility of availability of these sites to perspective civil works contractors should be duly taken into account.
- vi) Preparation of mass haul diagram and quarry charts indicating the location of selected borrow areas, quarries and the respective estimated quantities.
- vii) Recommend on how to make good this borrow and quarry areas after the exploitation of materials for construction of works.
- viii) Preparation and testing of bituminous mixes for various layers and concrete mixes of different grades using suitable materials (binders, aggregates, sand fillers etc.) as identified during material investigation to conform to latest MORT&H specifications.

1.7. Traffic Studies

Traffic survey stations have been selected by the Consultant on the basis of understanding of the road network as well as consideration of the following aspects:

- to represent homogeneous traffic section
- to be outside urban and local influence area
- to be located at a level with good visibility

1.7.1. Schedule of primary surveys

To capture the traffic flow characteristics and the travel pattern of the users passing through the project road and other characteristics related to miscellaneous requirements as per ToR following primary surveys were conducted.

- 7-days classified traffic volume count surveys at two locations on the project road
- 1 Day (12 hours) OD Survey at two locations on the project road
- 1 Day (24 hours) Axle Load Survey at two locations on the project road (Details included under different section)

- 1 Day (12 hours) Turning Movement Surveys at three major intersections on the project road
- 1 Day (12Hours) Pedestrian Count Surveys at six major town locations
- Speed & Delay Survey - 2 trip of project road

1.8. Design Of Road Features

1.8.1. General

The salient proposals for up gradation and improvement of the project road are classified into the following engineering aspects.

- Widening of the project road based on traffic capacity.
- Improving the horizontal and vertical geometry of the existing road based on the design standards.
- and the subsequent extra widening are presented
- Design of new pavement for widening and strengthening of the existing road.
- Improvement of all major and minor intersections.
- Rehabilitation and widening of the existing structures including bridges, culverts etc. and design of new ones.
- Provision of comprehensive road furniture for complete road safety.

1.8.2. Design Basis, Standards and Specifications:

The design criteria / method applied for important components of the project are as follows:

Geometric Design:	IRC SP 87-2019 Manual of Standards & Specifications for six lan- ing highways with paved shoulder IRC SP:48-1998 Hill Road Manual IRC 73 : Geometric design standards for rural highways
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IRC-SP 23 – Design of Vertical Alignment

Pavement Design: Overlay

IRC-81-1997 for designing and strengthening requirements of existing pavement.

New Pavement

IRC 37-2012 for design of flexible pavement

IRC 58-2015 for design of rigid pavement.

Road Furniture &

Roadside facilities: Related standards of IRC manual of specifications & MoRT&H publications.

The basis of preliminary design of various components of the project road is provided in following table.

Table-1: 1 Design Basis, Standards and Specifications

SI No.	Project Component	Basis	Outcome
1	Road alignment and profile	<ul style="list-style-type: none"> Geometric design standards Road Inventory Type of area, rural or urban including available ROW and road-side developments Suitability of location for new bridges 	<ul style="list-style-type: none"> Location of widening carriageway Improvement to sub-standard curves and steep grade sections
2	Intersections/ Junctions	<ul style="list-style-type: none"> Peak-hour traffic intensities and turning movement data 	<ul style="list-style-type: none"> Design of at-grade intersections Installation of traffic control measures

Sl No.	Project Component	Basis	Outcome
3	Pavement design strengthening of existing pavement	<ul style="list-style-type: none"> • Traffic loading in terms of cumulative standard axles for design lane • Benkelman Beam deflection data • CBR of existing sub-grade • Laboratory soaked CBR of sub-grade material • Thickness and composition of existing pavement layers 	Strengthening overlays for applicable stretches
4	Pavement design new pavement	<ul style="list-style-type: none"> • Traffic loading in terms of cumulative standard axles for design lane • Soaked laboratory CBR of soil samples from prospective borrow areas • Initial design life and stage development strategy 	<ul style="list-style-type: none"> • Thickness and composition of various pavement courses • Design life determination
5	Road furniture and safety measures	<ul style="list-style-type: none"> • Road inventory • Alignment plans • Locations of intersections on urban areas 	<ul style="list-style-type: none"> • Identification of different types of signs on linear plans • Identification of locations for installation of crash barriers and pedestrian guard rails • Pavement marking details
6	Roadside Drains	Results from drainage study	Location, type and size of roadside drains to be provided

Sl No.	Project Component	Basis	Outcome
7	Wayside Amenities	Inventory of existing wayside amenities by location, type and quality grade	<ul style="list-style-type: none"> • Evaluation of need and additional amenities • Locations and laybye design for bus stops

1.8.3. Geometric Design Standards

This project is existed as Single lane and intermediate lane of having fair to poor condition of existing pavement. The geometric of this road will be proposed according to Six lane with paved shoulder. The geometric designs are formulated as per the recommendations of IRC: SP: 87-2019.

1.8.4. Design of horizontal and vertical alignment

The existing designs of both horizontal and vertical alignments are not sound with lots of sharp curves and improper gradients. The proposed design is emphasized in adhering to the IRC codes and manual. The design methodology is also supported by various directives received from Project coordinating consultants and as well as at various occasions. The design proposed is mostly eccentric widening with overlay or reconstruction depending on the condition of the existing road. Efforts have been made to follow the existing road in most of the places in order to minimizing the land acquisition and project cost. Realignment has been proposed for minor built-up areas and areas with poor geometrics and all major built-up areas are proposed with Bypasses where found feasible.

1.8.5. Typical Cross Sections

Selection of cross-section has been governed by the widening scheme adopted and by other considerations like land-use, drainage condition, traffic characteristics etc. The following typical cross sections are proposed for the widening/new construction of project highway. These depict

generalized or critical/important main features only within the related stretches.

Following are the Typical cross sections adopted for development of the project highway: -

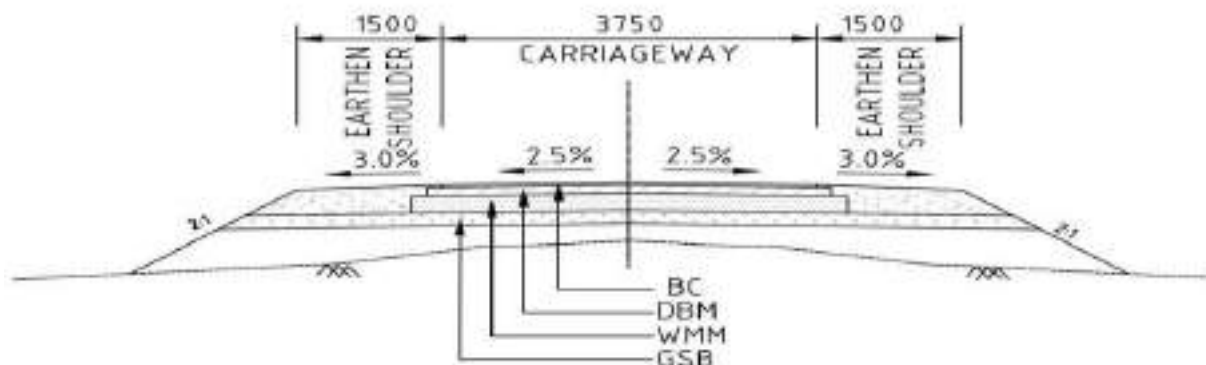


Fig-1: 1 Type-I: Single lane road

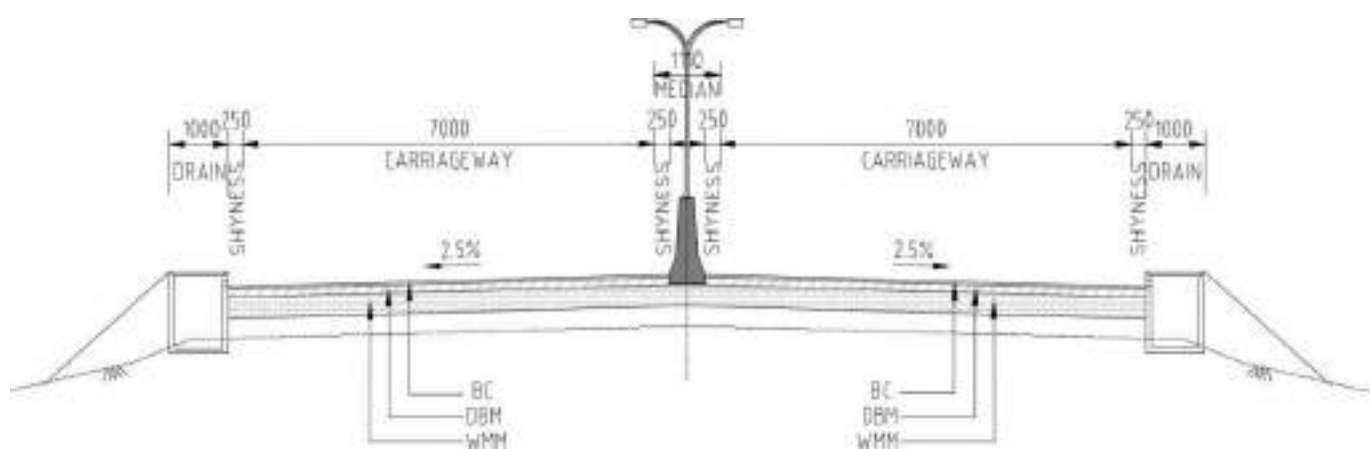


Fig-1: 2 Type-II: Four lane road at Built-up Area

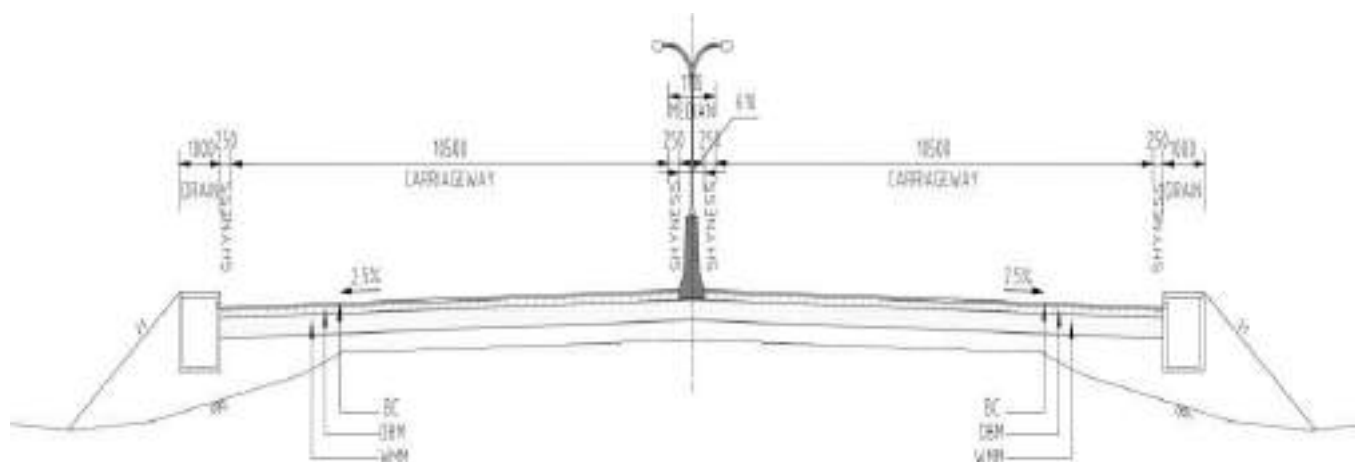


Fig-1: 3 Type-III: Six lane road at Built-up Area

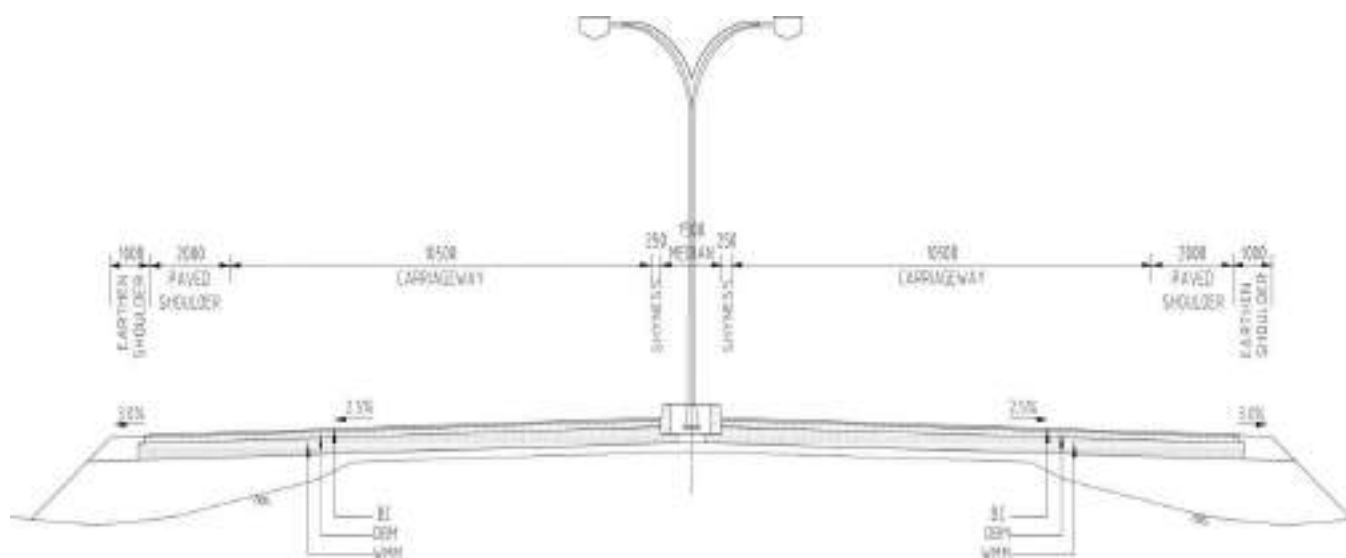


Fig-1: 4 Type-IV: Six lane road at Open Area

1.8.6. Widening and Strengthening of Carriageway

In all the cases the shoulders have to be rebuilt and all sections are required to be widened to four/six lane carriageway.

1.8.7. Proposals for Realignments

Four types of typical cross sections have been prepared for up-gradation of the highway, which conform to the Manual of Specification & Standards 6-laning (IRC: SP 87-2019 for the entire project corridor.

For Phase-I:

- (i) Type-I: Single lane road (km 0+000 to 0+080)
- (ii) Type-II: Four lane road at Built-up Area (km 0+080 to 0+560)
- (iii) Type-III: Six lane road at Built-up Area (km 0+560 to 2+500)
- (iv) Type-IV: Six lane road at Open Area (km 2+500 to 9+000)

1.8.8. Road Side Drains

Due consideration has been given to drainage while preparing the design. The cross-sections incorporating roadside drains have been proposed at various stretches of the highway taking into account the existing and natural conditions as well as anticipated situation. In general, unlined trapezoidal drains have been considered at Hill side of road. Covered drains have been proposed in urban stretches. Details of drains are provided as in following table.

Table-1: 2 Details of Road Side Drains

S.No	Chainage (km)		Design Length	Type of Drains
	From	To	(m)	
1	0+100	2+500	2400	Rectangular Both Side

1.8.9. Major and Minor Junctions

The project highway meets/crosses different category of road like NH, SH, MDR and other roads. The major junctions along the project highway are as below:

Table-1: 3 Major Intersection

S. No.	Chainage (km)	Type	Side (LHS,RHS)
1	03+600	Roundabout	4-leg

These are the intersections with category of roads like ODR, VR and have black top, brick soled or earthen surface. Details of intersections with secondary importance (Minor Junction) are presented as below:

Table-1: 4 Minor Intersection

Sl	Ch	Type	Side	To
1	00+310	T	LHS	Port
2	00+360	T	RHS	IFFCO Gate
3	00+700	T	LHS	Port
4	01+390	T	LHS	
5	01+950	T	LHS	Port
6	03+050	T	LHS	Port
7	06+400	T	RHS	Jetty/Port
8	07+620	+	4-leg	Port
9	08+900	T	LHS	

1.8.10. ROB/RUB

No ROB/RUB has been proposed.

1.8.11. Other road features and facilities

1.8.11.1. Bus Bays

No bus bay has been proposed in this road section.

1.8.11.2. Vehicle Parking Area

Vehicle Parking Area has been proposed in this road section.

1.8.11.3. Passing Places

No passing Places has been proposed.

1.8.11.4. Cattle Crossing

There is no significant cattle movement across the road and hence there is no proposal of separate cattle crossing.

1.8.12. Traffic Safety and Other Appurtenances

Following road furniture and miscellaneous items have been designed keeping safety aspect in mind.

- Road markings
- Road Signs & Delineators
- Crash Barriers
- Parapet Wall
- Noise Barriers
- Hard Topping

1.8.13. Road Markings

Road Markings on the carriageway and on the objects within and adjacent to the roadway are used as a means of guiding and controlling the traffic. They promote road safety and ensure smooth flow of traffic in the required paths of travel.

The location and type of marking lines, material and colour is followed using IRC: 35-2015 – “Code of Practice for Road Markings”.

The road markings were carefully planned on carriageways, intersections, toll plazas and bridge locations.

1.8.14. Road Signs & Delineators

Road signs were planned to supply information, to regulate traffic by imparting messages to the drivers. The type, locations, sizes were planned using IRC: 67-2012 “Code of Practice for Road Sign”.

The role of delineators is to provide visual assistance to driver about alignment of the road ahead, especially at night. Reflectors are used on the delineators for better night visibility. IRC: 79-1981 “Recommended Practice for Road Delineators” was followed to plan locations details. Two types of road delineators were planned i.e. hazard markers and object markers. Hazard markers are to define obstructions like guardrails, and abutments adjacent to the carriageway, for instance at culverts and bridges. Object markers are used to indicate hazards and obstructions within the vehicle flow path, at channeling islands close to intersections.

1.8.15. Crash Barrier

Metal crash barriers are proposed/ provided for safety of the traffic on the stretches on approaches of bridges. It is also proposed on the curves for safety of traffic irrespective of embankment height as per NHAI Circular (NHAI/PH-II/NHDP/ADB/GM (NS)-I dated May 19, 2004).

1.8.16. Parapet Wall

Parapet walls are provided along the edge of the shoulders at the valley side throughout the project stretch excluding the settlement areas. These are provided to prevent the vehicles from toppling over.

ANNEXURES

Annex-I: DESIGN CENTRE LINE REPORT

Easting	Northing	Elevation (m)	Chainage (km)
625024.290	2547225.878	4.280	00+000
625028.933	2547245.331	4.398	00+020
625015.982	2547256.878	4.515	00+040
624996.576	2547261.715	4.633	00+060
624977.565	2547267.856	4.742	00+080
624960.197	2547277.699	4.834	00+100
624944.192	2547289.690	4.908	00+120
624928.280	2547301.807	4.965	00+140
624912.343	2547313.889	5.004	00+160
624895.379	2547324.428	5.027	00+180
624876.592	2547331.181	5.032	00+200
624857.086	2547335.595	5.021	00+220
624837.550	2547339.877	5.009	00+240
624818.014	2547344.159	4.997	00+260
624798.478	2547348.442	4.984	00+280
624778.942	2547352.724	4.972	00+300
624759.416	2547357.053	4.960	00+320
624740.695	2547363.893	4.947	00+340
624726.948	2547377.997	4.935	00+360
624723.973	2547397.511	4.922	00+380
624728.763	2547416.883	4.910	00+400
624735.309	2547435.782	4.898	00+420
624741.861	2547454.678	4.885	00+440
624748.178	2547473.651	4.873	00+460
624750.476	2547493.403	4.861	00+480
624742.692	2547511.445	4.848	00+500
624726.054	2547522.212	4.836	00+520
624706.822	2547527.642	4.824	00+540
624687.372	2547532.298	4.811	00+560
624667.921	2547536.955	4.799	00+580
624648.471	2547541.611	4.786	00+600
624629.021	2547546.267	4.774	00+620
624609.570	2547550.924	4.762	00+640
624590.120	2547555.580	4.749	00+660
624570.669	2547560.236	4.737	00+680
624551.219	2547564.893	4.725	00+700
624531.769	2547569.549	4.712	00+720
624512.318	2547574.205	4.700	00+740
624492.868	2547578.862	4.687	00+760

Easting	Northing	Elevation (m)	Chainage (km)
624473.417	2547583.518	4.675	00+780
624453.967	2547588.175	4.663	00+800
624434.517	2547592.831	4.650	00+820
624415.066	2547597.487	4.638	00+840
624395.616	2547602.144	4.626	00+860
624376.165	2547606.800	4.613	00+880
624356.715	2547611.456	4.601	00+900
624337.265	2547616.113	4.588	00+920
624317.814	2547620.769	4.576	00+940
624298.362	2547625.417	4.564	00+960
624278.900	2547630.027	4.551	00+980
624259.430	2547634.599	4.539	01+000
624239.950	2547639.132	4.527	01+020
624220.468	2547643.652	4.514	01+040
624200.985	2547648.173	4.503	01+060
624181.503	2547652.693	4.493	01+080
624162.020	2547657.213	4.484	01+100
624142.538	2547661.734	4.477	01+120
624123.056	2547666.254	4.471	01+140
624103.573	2547670.774	4.465	01+160
624084.091	2547675.295	4.462	01+180
624064.608	2547679.815	4.459	01+200
624045.126	2547684.335	4.458	01+220
624025.643	2547688.856	4.457	01+240
624006.161	2547693.376	4.458	01+260
623986.678	2547697.896	4.461	01+280
623967.196	2547702.417	4.464	01+300
623947.713	2547706.937	4.469	01+320
623928.231	2547711.457	4.475	01+340
623908.748	2547715.978	4.481	01+360
623889.266	2547720.498	4.487	01+380
623869.783	2547725.018	4.493	01+400
623850.301	2547729.539	4.499	01+420
623830.819	2547734.059	4.505	01+440
623811.336	2547738.579	4.511	01+460
623791.854	2547743.100	4.517	01+480
623772.371	2547747.620	4.523	01+500
623752.889	2547752.140	4.529	01+520
623733.406	2547756.661	4.535	01+540
623713.924	2547761.181	4.541	01+560
623694.441	2547765.701	4.547	01+580
623674.959	2547770.222	4.553	01+600
623655.476	2547774.742	4.559	01+620
623635.994	2547779.262	4.565	01+640

Easting	Northing	Elevation (m)	Chainage (km)
623616.511	2547783.783	4.571	01+660
623597.029	2547788.303	4.577	01+680
623577.546	2547792.823	4.583	01+700
623558.064	2547797.344	4.589	01+720
623538.581	2547801.864	4.595	01+740
623519.099	2547806.384	4.600	01+760
623499.617	2547810.905	4.606	01+780
623480.134	2547815.425	4.612	01+800
623460.652	2547819.945	4.618	01+820
623441.169	2547824.466	4.624	01+840
623421.687	2547828.986	4.630	01+860
623402.204	2547833.506	4.636	01+880
623382.722	2547838.027	4.642	01+900
623363.239	2547842.547	4.648	01+920
623343.757	2547847.067	4.654	01+940
623324.274	2547851.588	4.660	01+960
623304.792	2547856.108	4.666	01+980
623285.309	2547860.628	4.672	02+000
623265.827	2547865.148	4.678	02+020
623246.344	2547869.669	4.684	02+040
623226.862	2547874.189	4.690	02+060
623207.379	2547878.709	4.696	02+080
623187.897	2547883.230	4.702	02+100
623168.415	2547887.750	4.708	02+120
623148.932	2547892.270	4.714	02+140
623129.450	2547896.791	4.720	02+160
623109.967	2547901.311	4.726	02+180
623090.485	2547905.831	4.732	02+200
623071.002	2547910.352	4.738	02+220
623051.520	2547914.872	4.744	02+240
623032.037	2547919.392	4.750	02+260
623012.555	2547923.913	4.756	02+280
622993.072	2547928.433	4.762	02+300
622973.590	2547932.953	4.768	02+320
622954.107	2547937.474	4.774	02+340
622934.625	2547941.994	4.780	02+360
622915.142	2547946.514	4.786	02+380
622895.660	2547951.035	4.792	02+400
622876.177	2547955.555	4.798	02+420
622856.695	2547960.075	4.804	02+440
622837.213	2547964.596	4.810	02+460
622817.730	2547969.116	4.816	02+480
622798.248	2547973.636	4.822	02+500
622778.765	2547978.157	4.828	02+520

Easting	Northing	Elevation (m)	Chainage (km)
622759.283	2547982.677	4.834	02+540
622739.800	2547987.197	4.840	02+560
622720.318	2547991.718	4.846	02+580
622700.835	2547996.238	4.852	02+600
622681.353	2548000.758	4.858	02+620
622661.870	2548005.279	4.864	02+640
622642.388	2548009.799	4.870	02+660
622622.905	2548014.319	4.876	02+680
622603.423	2548018.840	4.882	02+700
622583.940	2548023.360	4.888	02+720
622564.458	2548027.880	4.894	02+740
622544.975	2548032.401	4.900	02+760
622525.493	2548036.921	4.906	02+780
622506.011	2548041.441	4.912	02+800
622486.528	2548045.962	4.918	02+820
622467.046	2548050.482	4.924	02+840
622447.563	2548055.002	4.930	02+860
622428.081	2548059.523	4.936	02+880
622408.598	2548064.043	4.942	02+900
622389.116	2548068.563	4.948	02+920
622369.633	2548073.084	4.954	02+940
622350.151	2548077.604	4.960	02+960
622330.668	2548082.124	4.966	02+980
622311.186	2548086.645	4.972	03+000
622291.703	2548091.165	4.978	03+020
622272.221	2548095.685	4.984	03+040
622252.738	2548100.206	4.990	03+060
622233.256	2548104.726	4.996	03+080
622213.774	2548109.246	5.002	03+100
622194.291	2548113.767	5.008	03+120
622174.809	2548118.287	5.014	03+140
622155.326	2548122.807	5.020	03+160
622135.844	2548127.328	5.026	03+180
622116.361	2548131.848	5.032	03+200
622096.879	2548136.368	5.038	03+220
622077.396	2548140.889	5.044	03+240
622057.914	2548145.409	5.050	03+260
622038.431	2548149.929	5.056	03+280
622018.949	2548154.450	5.062	03+300
621999.466	2548158.970	5.068	03+320
621979.984	2548163.490	5.074	03+340
621960.501	2548168.010	5.080	03+360
621941.019	2548172.531	5.086	03+380
621921.536	2548177.051	5.092	03+400

Easting	Northing	Elevation (m)	Chainage (km)
621902.054	2548181.571	5.098	03+420
621882.572	2548186.094	5.104	03+440
621863.120	2548190.744	5.110	03+460
621843.784	2548195.850	5.116	03+480
621824.665	2548201.716	5.122	03+500
621805.826	2548208.426	5.128	03+520
621787.304	2548215.966	5.134	03+540
621769.135	2548224.322	5.140	03+560
621751.355	2548233.476	5.146	03+580
621733.999	2548243.412	5.152	03+600
621717.102	2548254.109	5.158	03+620
621700.697	2548265.546	5.164	03+640
621684.816	2548277.700	5.170	03+660
621669.491	2548290.549	5.176	03+680
621654.752	2548304.065	5.182	03+700
621640.628	2548318.223	5.188	03+720
621627.147	2548332.994	5.194	03+740
621614.335	2548348.350	5.200	03+760
621602.195	2548364.242	5.206	03+780
621590.541	2548380.496	5.212	03+800
621579.094	2548396.895	5.218	03+820
621567.663	2548413.307	5.224	03+840
621556.232	2548429.719	5.230	03+860
621544.802	2548446.130	5.236	03+880
621533.371	2548462.542	5.242	03+900
621521.941	2548478.954	5.248	03+920
621510.510	2548495.365	5.254	03+940
621499.079	2548511.777	5.260	03+960
621487.649	2548528.188	5.266	03+980
621476.218	2548544.600	5.272	04+000
621464.788	2548561.012	5.278	04+020
621453.357	2548577.423	5.284	04+040
621441.926	2548593.835	5.290	04+060
621430.496	2548610.247	5.296	04+080
621419.065	2548626.658	5.302	04+100
621407.635	2548643.070	5.308	04+120
621396.204	2548659.481	5.314	04+140
621384.773	2548675.893	5.320	04+160
621373.343	2548692.305	5.326	04+180
621361.912	2548708.716	5.332	04+200
621350.482	2548725.128	5.338	04+220
621339.051	2548741.540	5.344	04+240
621327.620	2548757.951	5.350	04+260
621316.190	2548774.363	5.356	04+280

Easting	Northing	Elevation (m)	Chainage (km)
621304.759	2548790.774	5.362	04+300
621293.328	2548807.186	5.368	04+320
621281.898	2548823.598	5.374	04+340
621270.467	2548840.009	5.380	04+360
621259.037	2548856.421	5.386	04+380
621247.606	2548872.832	5.392	04+400
621236.175	2548889.244	5.398	04+420
621224.745	2548905.656	5.404	04+440
621213.314	2548922.067	5.410	04+460
621201.884	2548938.479	5.416	04+480
621190.453	2548954.891	5.422	04+500
621179.022	2548971.302	5.428	04+520
621167.592	2548987.714	5.434	04+540
621156.161	2549004.125	5.440	04+560
621144.731	2549020.537	5.446	04+580
621133.300	2549036.949	5.452	04+600
621121.869	2549053.360	5.458	04+620
621110.439	2549069.772	5.464	04+640
621099.008	2549086.184	5.470	04+660
621087.578	2549102.595	5.476	04+680
621076.147	2549119.007	5.482	04+700
621064.716	2549135.418	5.488	04+720
621053.286	2549151.830	5.494	04+740
621041.855	2549168.242	5.500	04+760
621030.425	2549184.653	5.506	04+780
621018.994	2549201.065	5.512	04+800
621007.563	2549217.476	5.518	04+820
620996.133	2549233.888	5.524	04+840
620984.702	2549250.300	5.530	04+860
620973.272	2549266.711	5.536	04+880
620961.841	2549283.123	5.542	04+900
620950.410	2549299.535	5.547	04+920
620938.980	2549315.946	5.553	04+940
620927.549	2549332.358	5.559	04+960
620916.118	2549348.769	5.565	04+980
620904.688	2549365.181	5.571	05+000
620893.257	2549381.593	5.577	05+020
620881.827	2549398.004	5.583	05+040
620870.396	2549414.416	5.589	05+060
620858.965	2549430.828	5.595	05+080
620847.535	2549447.239	5.601	05+100
620836.104	2549463.651	5.607	05+120
620824.674	2549480.062	5.613	05+140
620813.243	2549496.474	5.619	05+160

Easting	Northing	Elevation (m)	Chainage (km)
620801.812	2549512.886	5.625	05+180
620790.382	2549529.297	5.631	05+200
620778.951	2549545.709	5.637	05+220
620767.521	2549562.120	5.643	05+240
620756.090	2549578.532	5.649	05+260
620744.659	2549594.944	5.655	05+280
620733.229	2549611.355	5.661	05+300
620721.798	2549627.767	5.667	05+320
620710.368	2549644.179	5.673	05+340
620698.937	2549660.590	5.679	05+360
620687.506	2549677.002	5.685	05+380
620676.076	2549693.413	5.691	05+400
620664.645	2549709.825	5.697	05+420
620653.215	2549726.237	5.703	05+440
620641.783	2549742.648	5.709	05+460
620630.307	2549759.028	5.715	05+480
620618.829	2549775.406	5.721	05+500
620607.350	2549791.784	5.727	05+520
620595.872	2549808.162	5.733	05+540
620584.394	2549824.541	5.739	05+560
620572.915	2549840.919	5.745	05+580
620561.437	2549857.297	5.751	05+600
620549.958	2549873.675	5.757	05+620
620538.480	2549890.053	5.763	05+640
620527.001	2549906.431	5.769	05+660
620515.523	2549922.810	5.775	05+680
620504.044	2549939.188	5.781	05+700
620492.566	2549955.566	5.788	05+720
620481.087	2549971.944	5.798	05+740
620469.609	2549988.322	5.811	05+760
620458.130	2550004.701	5.828	05+780
620446.652	2550021.079	5.848	05+800
620435.174	2550037.457	5.871	05+820
620423.695	2550053.835	5.897	05+840
620412.217	2550070.213	5.927	05+860
620400.738	2550086.591	5.960	05+880
620389.260	2550102.970	5.996	05+900
620377.781	2550119.348	6.035	05+920
620366.303	2550135.726	6.078	05+940
620354.824	2550152.104	6.124	05+960
620343.346	2550168.482	6.174	05+980
620331.867	2550184.861	6.226	06+000
620320.389	2550201.239	6.281	06+020
620308.910	2550217.617	6.337	06+040

Easting	Northing	Elevation (m)	Chainage (km)
620297.432	2550233.995	6.392	06+060
620285.954	2550250.373	6.447	06+080
620274.475	2550266.752	6.503	06+100
620262.997	2550283.130	6.558	06+120
620251.518	2550299.508	6.613	06+140
620240.040	2550315.886	6.669	06+160
620228.561	2550332.264	6.724	06+180
620217.083	2550348.642	6.779	06+200
620205.604	2550365.021	6.834	06+220
620194.126	2550381.399	6.890	06+240
620182.647	2550397.777	6.945	06+260
620171.169	2550414.155	7.000	06+280
620159.691	2550430.533	7.056	06+300
620148.212	2550446.912	7.110	06+320
620136.734	2550463.290	7.158	06+340
620125.255	2550479.668	7.199	06+360
620113.777	2550496.046	7.234	06+380
620102.298	2550512.424	7.261	06+400
620090.820	2550528.803	7.282	06+420
620079.341	2550545.181	7.295	06+440
620067.863	2550561.559	7.302	06+460
620056.384	2550577.937	7.302	06+480
620044.906	2550594.315	7.295	06+500
620033.427	2550610.693	7.281	06+520
620021.949	2550627.072	7.261	06+540
620010.474	2550643.452	7.233	06+560
619999.109	2550659.909	7.199	06+580
619987.795	2550676.401	7.157	06+600
619976.480	2550692.893	7.110	06+620
619965.166	2550709.385	7.062	06+640
619953.852	2550725.877	7.014	06+660
619942.537	2550742.369	6.967	06+680
619931.223	2550758.861	6.919	06+700
619919.909	2550775.353	6.871	06+720
619908.594	2550791.845	6.823	06+740
619897.280	2550808.337	6.775	06+760
619885.966	2550824.829	6.727	06+780
619874.651	2550841.321	6.680	06+800
619863.337	2550857.813	6.632	06+820
619852.022	2550874.305	6.584	06+840
619840.708	2550890.797	6.536	06+860
619829.394	2550907.289	6.488	06+880
619818.079	2550923.781	6.440	06+900
619806.765	2550940.273	6.392	06+920

Easting	Northing	Elevation (m)	Chainage (km)
619795.451	2550956.765	6.345	06+940
619784.136	2550973.257	6.297	06+960
619772.822	2550989.749	6.249	06+980
619761.508	2551006.241	6.201	07+000
619750.193	2551022.732	6.153	07+020
619738.794	2551039.167	6.105	07+040
619727.364	2551055.578	6.058	07+060
619715.933	2551071.990	6.010	07+080
619704.502	2551088.401	5.962	07+100
619693.071	2551104.813	5.921	07+120
619681.641	2551121.224	5.887	07+140
619670.210	2551137.636	5.860	07+160
619658.779	2551154.047	5.841	07+180
619647.348	2551170.459	5.830	07+200
619635.918	2551186.870	5.826	07+220
619624.487	2551203.282	5.829	07+240
619613.056	2551219.693	5.840	07+260
619601.625	2551236.105	5.859	07+280
619590.194	2551252.516	5.885	07+300
619578.764	2551268.928	5.919	07+320
619567.333	2551285.339	5.960	07+340
619555.902	2551301.751	6.008	07+360
619544.471	2551318.162	6.065	07+380
619533.041	2551334.574	6.128	07+400
619521.610	2551350.985	6.193	07+420
619510.179	2551367.397	6.258	07+440
619498.748	2551383.808	6.323	07+460
619487.318	2551400.220	6.388	07+480
619475.887	2551416.631	6.453	07+500
619464.456	2551433.043	6.518	07+520
619453.025	2551449.454	6.583	07+540
619441.594	2551465.866	6.648	07+560
619430.164	2551482.277	6.713	07+580
619418.733	2551498.689	6.778	07+600
619407.302	2551515.100	6.843	07+620
619395.871	2551531.512	6.908	07+640
619384.441	2551547.923	6.974	07+660
619373.010	2551564.335	7.039	07+680
619361.579	2551580.746	7.104	07+700
619350.148	2551597.158	7.169	07+720
619338.718	2551613.569	7.234	07+740
619327.287	2551629.981	7.297	07+760
619315.856	2551646.392	7.357	07+780
619304.425	2551662.804	7.415	07+800

Easting	Northing	Elevation (m)	Chainage (km)
619292.994	2551679.215	7.469	07+820
619281.564	2551695.627	7.521	07+840
619270.133	2551712.038	7.569	07+860
619258.702	2551728.450	7.615	07+880
619247.271	2551744.861	7.657	07+900
619235.841	2551761.273	7.697	07+920
619224.410	2551777.684	7.733	07+940
619212.979	2551794.096	7.767	07+960
619201.543	2551810.503	7.798	07+980
619189.960	2551826.808	7.826	08+000
619177.997	2551842.835	7.850	08+020
619165.611	2551858.537	7.872	08+040
619152.811	2551873.903	7.893	08+060
619139.605	2551888.923	7.913	08+080
619126.004	2551903.585	7.934	08+100
619112.016	2551917.880	7.954	08+120
619097.657	2551931.800	7.975	08+140
619083.046	2551945.457	7.996	08+160
619068.388	2551959.064	8.016	08+180
619053.730	2551972.671	8.037	08+200
619039.073	2551986.278	8.057	08+220
619024.415	2551999.885	8.078	08+240
619009.757	2552013.492	8.098	08+260
618995.100	2552027.099	8.119	08+280
618980.442	2552040.707	8.140	08+300
618965.784	2552054.314	8.160	08+320
618951.126	2552067.921	8.181	08+340
618936.469	2552081.528	8.201	08+360
618921.811	2552095.135	8.222	08+380
618907.153	2552108.742	8.247	08+400
618892.496	2552122.349	8.276	08+420
618877.838	2552135.956	8.311	08+440
618863.180	2552149.563	8.351	08+460
618848.523	2552163.170	8.396	08+480
618833.865	2552176.777	8.446	08+500
618819.207	2552190.384	8.501	08+520
618804.549	2552203.991	8.561	08+540
618789.892	2552217.598	8.627	08+560
618775.234	2552231.205	8.697	08+580
618760.576	2552244.812	8.769	08+600
618745.919	2552258.419	8.841	08+620
618731.261	2552272.026	8.913	08+640
618716.603	2552285.633	8.985	08+660
618701.946	2552299.240	9.057	08+680

Easting	Northing	Elevation (m)	Chainage (km)
618687.288	2552312.847	9.129	08+700
618672.630	2552326.455	9.201	08+720
618657.972	2552340.062	9.273	08+740
618643.315	2552353.669	9.345	08+760
618628.657	2552367.276	9.416	08+780
618613.999	2552380.883	9.488	08+800
618599.342	2552394.490	9.560	08+820
618584.684	2552408.097	9.632	08+840
618570.026	2552421.704	9.704	08+860
618555.368	2552435.311	9.776	08+880
618540.711	2552448.918	9.849	08+900
618526.053	2552462.525	9.922	08+920
618511.395	2552476.132	9.996	08+940
618496.738	2552489.739	10.071	08+960
618482.080	2552503.346	10.147	08+980
618468.224	2552517.741	10.223	09+000

Annex-II: HORIZONTAL DESIGN REPORT

	Horizontal Alignment Details																				
Sl. No.	CIRCULAR CURVES								SPIRAL CURVES				Horizontal Intersection Point (HIP)						Design Speed	Super e	Extra Widen
	Curve No.	Start Chainage (km)	End Chainage (km)	Start Easting (x)	Start Northing (y)	End Easting (x)	End Northing (y)	Radius (m)	Direction	Start Chainage (km)	Start Ls (m)	End Ls (m)	End Chainage (km)	Chainage (km)	Easting (x)	Northing (y)	Deflection				
Deg																	Min	Sec			
1	00+020.156	00+032.646	625028.969	2547245.483	625023.118	2547255.103	8	Left	-	-	-	-	00+028.080	625030.808	2547253.191	89	27	18.00	25	3.10	1.5
2	00+075.318	00+091.953	624981.911	2547266.116	624966.934	2547273.301	90	Right	00+055.318	20	20	00+111.953	00+083.659	624974.090	2547269.014	10	35	24.00	20	5.90	0.9
3	00+172.212	00+191.369	624902.224	2547320.719	624884.871	2547328.747	90	Left	00+152.212	20	20	00+211.369	00+181.827	624893.977	2547325.660	12	11	42.00	20	5.90	0.9
4	00+352.979	00+363.644	624730.735	2547372.105	624725.551	2547381.36	30	Right	00+312.979	40	40	00+403.644	00+358.368	624727.312	2547376.267	20	22	1.20	80	NC	1.5
5	00+487.866	00+497.954	624748.837	2547501.078	624744.014	2547509.884	30	Left	00+447.866	40	40	00+537.954	00+492.958	624747.173	2547505.890	19	16	1.20	80	6.30	1.5
6	00+946.470	01+016.347	624311.522	2547622.275	624243.509	2547638.306	10000	Left	-	-	-	-	00+981.409	624277.543	2547630.410	0	24	0.00	80	NC	NR
7	03+483.625	03+764.124	621840.299	2548196.85	621611.78	2548351.586	450	Right	03+433.625	50	50	03+814.124	03+628.599	621701.114	2548237.408	35	42	50.40	80	NC	NR
8	05+457.850	05+463.687	620643.013	2549740.884	620639.67	2549745.669	2000	Left	-	-	-	-	05+460.769	620641.345	2549743.279	0	10	1.20	80	NC	NR
9	06+555.740	06+575.709	620012.916	2550639.961	620001.537	2550656.371	2000	Right	-	-	-	-	06+565.724	620007.185	2550648.138	0	34	19.20	80	3.80	NR
10	07+018.433	07+032.584	619751.08	2551021.44	619743.033	2551033.081	2000	Left	-	-	-	-	07+025.509	619747.077	2551027.275	0	24	18.00	50	7.00	NR
11	08+000.376	08+131.006	619189.739	2551827.112	619104.158	2551925.585	750	Left	07+970.376	30	30	08+161.006	08+065.856	619151.248	2551880.084	9	58	44.40	50	5.80	NR
12	08+983.573	09+022.284	618479.461	2552505.777	618455.792	2552536.196	120	Right	-	-	-	-	09+003.098	618465.152	2552519.061	18	28	58.80	50	5.60	0.6
13	09+087.861	09+172.025	618424.354	2552593.747	618401.407	2552674.008	190	Right	-	-	-	-	09+130.645	618403.844	2552631.294	25	22	48.00	50	5.60	0.6
14	09+320.956	09+356.371	618392.923	2552822.697	618394.039	2552858.049	200	Right	-	-	-	-	09+338.710	618391.912	2552840.422	10	8	45.60	35	7.00	0.6
15	09+404.693	09+425.749	618399.827	2552906.022	618401.246	2552927.022	200	Left	-	-	-	-	09+415.231	618401.090	2552916.485	6	1	55.20	35	5.40	0.6

Annex-III: VERTICAL DESIGN REPORT

Vertical Alignment Details

Vertical Curve No.	Vertical Intersection Points (VIP) Details			Vertical Curve Details				Gradient Details			Curve Type	Curve Length (m)	K Value
	Chainage (Km)	Lavel, Z (m)	M Value	Start Ch. (Km)	Start Z. (m)	End Ch. (Km)	End Z (m)	In (%)	Out (%)	Algebric Diff. (%)			
1	0+135.000	5.074	-0.325	0+035.000	4.486	0+235.000	5.012	0.588	-0.062	-0.65	Hog	200	308
2	1+181.070	4.427	1.281	1+081.070	4.489	1+281.070	6.927	-0.062	2.5	2.562	Sag	200	78
3	1+516.000	12.8	-1.25	1+416.000	10.3	1+616.000	12.8	2.5	0	-2.5	Hog	200	80
4	1+784.000	12.8	-1.25	1+684.000	12.8	1+884.000	10.3	0	-2.5	-2.5	Hog	200	80
5	2+109.180	4.67	1.265	2+009.180	7.17	2+209.180	4.701	-2.5	0.031	2.531	Sag	200	79
6	5+856.000	5.828	0.193	5+706.000	5.782	6+006.000	6.743	0.031	0.61	0.579	Sag	300	518
7	6+462.000	9.526	-0.37	6+312.000	8.611	6+612.000	8.776	0.61	-0.5	-1.11	Hog	300	270
8	7+243.444	5.619	0.275	7+093.444	6.369	7+393.444	6.107	-0.5	0.325	0.825	Sag	300	364
9	7+888.333	7.716	-0.074	7+738.333	7.228	8+038.333	7.87	0.325	0.103	-0.222	Hog	300	1349
10	8+474.886	8.32	0.165	8+374.886	8.217	8+574.886	8.752	0.103	0.433	0.33	Sag	200	607
11	9+701.202	13.624	-0.263	9+551.202	12.975	9+851.202	13.087	0.433	-0.358	-0.79	Hog	300	380

Consultancy Service for Preparation of Details Project Report (DPR) for widening & Improvement of Existing 2/4 –lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)

**Detailed Project
Report**

DESIGN OF PAVEMENTS

MONARCH Surveyors & Engineering

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Chapter-2: DESIGN OF PAVEMENT

2.1. Introduction

Pavement design aims at determining the total thickness of the pavement structure as well as the thickness of the individual structural components for carrying the estimated traffic loading under the prevailing environmental conditions. Many design methods, from purely empirical to rigorous analytical ones are available and these are practiced in different parts of the world. The design methods adopted in other countries may not be applicable to Indian climatic conditions. In India the generally adopted method of design of flexible pavement is based on IRC-37-2018.

2.2. Review of Design Methods for New Construction

The AASHTO and IRC methods of pavement design have been reviewed before recommending the pavement composition. However, in the perspective of such review, it is important to note that no method in practice can be considered better than the other as each method has its own inherent limitations, owing to the characteristics of materials used in construction and their complex interaction, climatic and traffic conditions.

2.3. Guidelines for the Design of Flexible Pavements

The pavement designs given in this guide are based on the results of pavement research work done in India and experience gained over the years on the performance of the designs given therein. Flexible pavement has been modeled as a three-layer structure with stresses and strains at critical locations computed using the linear elastic model FPAVE developed under the Ministry of Road Transport & Highways Research Scheme, R -56 and further updated it with IITPAVE recently. The pavement designs are given for sub-grade CBR values ranging from 2% to 15% for different pavement type options like Cement Treated base and Sub base, use of RAP in asphalt layer with foamed bitumen or emulsion. The pavement compositions given in the design catalogue are relevant to Indian conditions, materials and specifications. Where changes to layer thickness and speci-

fications are considered desirable from practical considerations, the guidelines recommend modifications using an analytical approach. Hence, the design has been carried out based on the procedure given in IRC.

2.4. Design Methodology

The design shall be based on various design parameters as evaluated from various field and laboratory investigations, design procedures with the objective to ascertain optimal pavement structure meeting the structural requirements for the traffic and complying with the provisions of the relevant codes and guidelines. The structural requirements are:

- (i) The total thickness of the pavement and the thickness of individual layers should be designed in such a way that they are not subjected to stresses or strains exceeding those admissible in view of the material characteristics and performance factors,
- (ii) The pavement layers should be able to with stand repeated applications of wheelloads of different magnitudes under the actual conditions of sub grade, climate, drainage, and other environmental factors during the design life without causing
 - ✓ excessive permanent deformation in the form of rutting and undulations;
 - ✓ cracking of bituminous layers; and
 - ✓ other structural and functional deficiencies such as potholes
- (iii) Ensure structural and functional performance under varied conditions and factors affecting the performance of the road i.e. soil type, traffic, environment, etc.

Pavement design guidelines given in IRC:37-2012 adopts are based on the Analytical method which is believed to have been developed based on performance of existing designs and using analytical approach (to limit the vertical compressive strain at the top of sub grade and horizontal tensile strain at bottom of bituminous layer adopting linear elastic model). Flow chart showing the various steps involved in the design process is given in below.

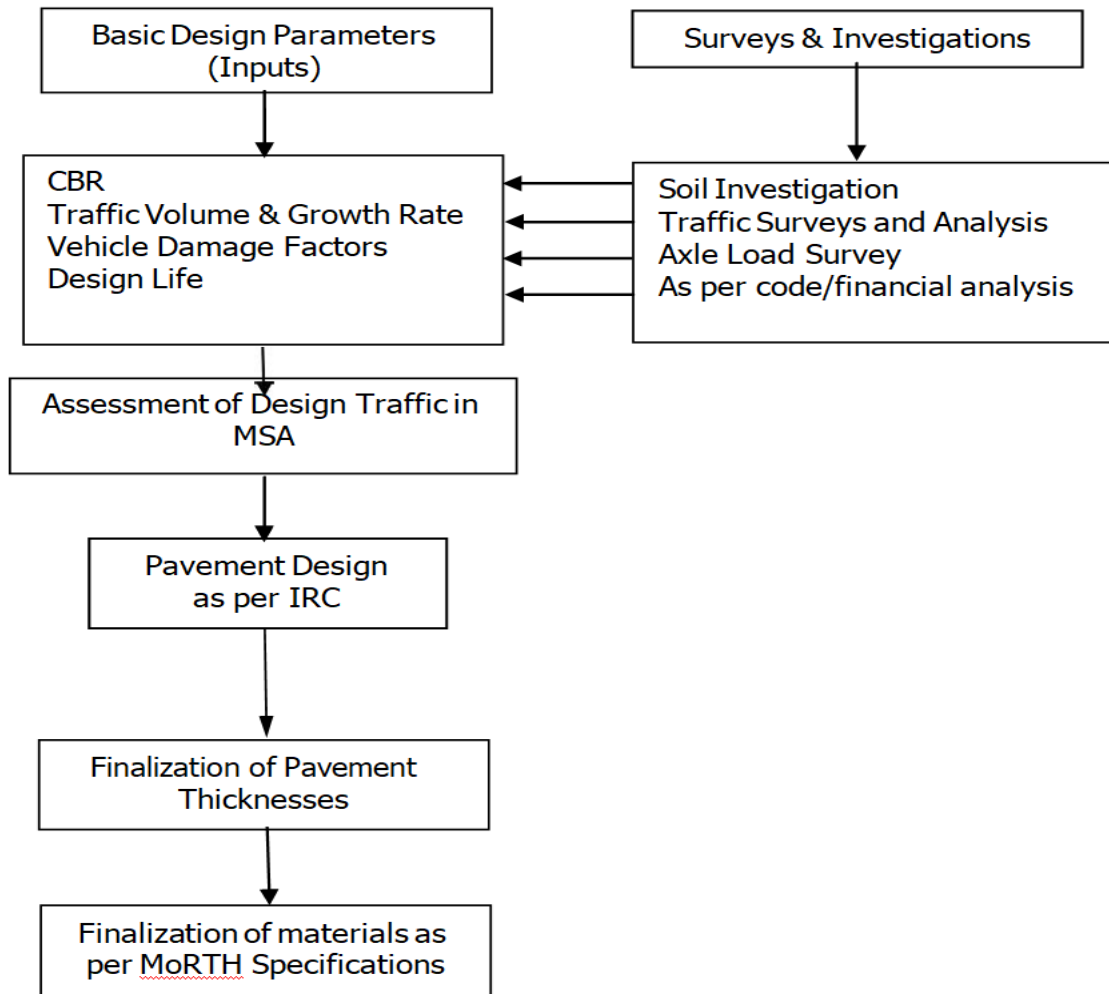


Fig-2: 1 Flow Chart of Pavement Design

2.5. Flexible Pavement Design

Indian Road Congress published Guidelines for the design of Flexible Pavements, IRC: 37. The design of flexible pavements involves the interplay of several variables, such as, the wheel load, traffic, climate, terrain and sub-grade conditions. The IIT-PAVE Software provided by IRC, issued for the design.

2.1.1. Fatigue Criteria for Bituminous Surfacing

The bituminous surfacing of the pavement, displays a flexural fatigue cracking, if tensile strain at bottom of the bituminous layer is beyond certain limit. Based on large amount of field performance data of pavements of south, north, east & west zones in India collected under the research schemes of Ministry of Surface transport, Govt. of India, the relation between the fatigue life of the pavement layers was developed by Indian Road Congress:

$$N_f = 2.21 \times 10^{-4} \times \left(\frac{1}{\epsilon_t} \right)^{3.89} \times \left(\frac{1}{E} \right)^{0.854}$$

2.1.2. Rutting Equation for Sub grade

As large number of data for rutting failure of pavements were obtained from the R search Scheme of MORT&H and other research investigations. Indian Road Congress set the allowable rut depth as 20 mm; the rutting equation was obtained as:

$$N_r = 4.1656 \times 10^{-8} \times \left(\frac{1}{\epsilon_z} \right)^{4.5337}$$

2.1.3. Evaluation of Pavement Design Parameters

i. Design Life (n)

Design life is the time from original construction to a terminal condition for a pavement structure. Structural design is carried to withstand the pavement for a traffic loading encountered over the design life. IRC: 37-2012 suggests design life of 15 years for the flexible pavements and accordingly, design period of 15 years has been considered for the design of pavement.

ii. Design Traffic

A detailed traffic surveys and analysis for the project roads have been conducted in the base year. Design life and growth rates obtained for different types of vehicles are discussed in traffic chapter. For the purpose of pavement design, commercial vehicles of gross vehicle weight more than 3 tonne have been considered. Such vehicles consisted of buses, LCVs, 2 axle trucks, 3 axle trucks and multi axle trucks. From total projected base year AADT and estimated traffic growth rates, vehicle category-wise traffic volume projections have been made for various design periods. Table gives the total base year (2022) traffic volumes in terms of commer-

cial vehicles per day (CVPD) for each of the identified traffic homogeneous section and has been used for the estimation of design traffic in terms of MSA for pavement design.

Table-2: 1 Base Year Traffic Volumes in CVPD

Location		Car	Bus	Truck	Total
A1	FSWAI MAIN TERMINAL	286	14	2062	2361
A2	HPCL Main Terminal	188	16	1844	2047
A3	IOCL Main Terminal	501	16	2025	2542
A4	NH141 near LC236	1679	318	11106	13103

The total projected traffic on to the project road is presented in Main Report. The same is reproduced for cardinal years in the below:

Table-2: 2 Traffic Volumes Forecasting in CVPD

Design Traffic (MSA) Estimation									
Base Year CVPD, Two-Way CV Wise as per Last Classified Traffic Volume Count, P (Important Note ! If Any of the CV Wise CVPD is Zero, Enter 0 there)			LCV (CVP D)	M.BU S	BUS (CVP D)	2AT (CVP D)	3AT (CVP D)	MAV (CVPD)	Total CVPD
				(CVP D)					
			258	1	14	19	574	1333	2199
Initial CVPD, Two-Way (CV Wise) at the Start when the Road is			263	1	14	20	614	1490	2401
Opened, A									
Annual Growth Rate of Commercial Vehicles.			LCV	M.BU S	BUS	2AT	3AT	MAV	Average Growth %
(Important Note ! If Any of the CV Wise CVPD is Zero, Enter Corresponding Growth Rate % as Any Non-Zero Value. Don't Put 0			(Gro wth	(Gro wth	(Gro wth	(Gro wth	(Gro wth	(Growth	(If Growth Rate Assumed Uniform for all CV)
or Don't Leave it Blank)			%)	%)	%)	%)	%)	%)	
Growth Rate (%) During the Period		Period in Years →							
1.5 Years for Design, Project Pre- parat ion & Construc		1		1.20%	0.00%	0.00%	1.90%	4.60%	7.70%

Design Traffic (MSA) Estimation												
tion	Period in Years →				0	1.20%	0.00%	0.00%	1.90%	4.60%	7.70%	
					5							
Growth Rate % for the First 'Time	Year	0	T	Ye ar	5	1.10%	0.00%	0.00%	1.80%	5.30%	8.90%	
Horizon',			o									
Growth Rate % for the Second 'Time	Year	5	T	Ye ar	1	0.90%	0.00%	0.00%	1.50%	4.60%	7.80%	
Horizon',			o		0							
Growth Rate % for the Third 'Time	Year	1	T	Ye ar	1	0.70%	0.00%	0.00%	1.20%	3.90%	6.70%	
Horizon',		0	o		5							
Growth Rate % for the Fourth 'Time	Year	1	T	Ye ar	2	0.60%	0.00%	0.00%	1.00%	3.20%	5.80%	
Horizon',		5	o		0							
Growth Rate % for the Fifth 'Time	Year	2	T	Ye ar	2	0.50%	0.00%	0.00%	0.90%	2.70%	5.10%	
Horizon',		0	o		5							

Design Traffic (MSA) Estimation													
Growth Rate % for the Sixth 'Time	Year	2	T	Ye ar	5	0.50%	0.00%	0.00%	0.80%	2.40%	4.90%		
Horizon',		5	o		0								
Design Two-Way Cumulative Number of Commercial Vehicles (CV) for the Entire Design Period, C						CLCV	CM.BUS	CBUS	C2AT	C3AT	CMAV	C = (CLCV+CM.BUS+CBUS+C2AT+C3A	
												T+CMAV)	
						15397			1200	48094	2E+06	21481696	
						42			64	90	0		
Whether like to Use Design VDF as CV Wise or Average or by User Input (CV Wise / Average / User Input)											Mandat ory Input for VDF	User Input	
Design VDF (To be determined from Axle Load Survey, if not, then Enter Value as Per Cl. 4.4.6 of IRC:37-2012), F						LCV (VDF)	M.BU	BUS (VDF)	2AT (VDF)	3AT (VDF)	MAV (VDF)	Average VDF	
							S (VDF)					(If VDF Assumed Uniform for all CV)	
		0	0	0	0.25	6.27	→		6.6				
Directional Distribution Factor (For Undivided Road 100%, For Divided Road 50%)											B	50%	
Lane Distribution Factor (Refer Clause 4.5.1 of IRC:37-2012)											D	0.6	
Design MSA											msa	39	

iii. Vehicle Damage Factors (F)

Vehicle damage factor as listed in the table. Axle load surveys were conducted to estimate the loading behavior of commercial vehicles plying on the project road. The detailed analysis and information of axle loads collected from site from axle load surveys is provided in, Surveys & Investigations of Main Report. The summary of VDFs is presented in the following table.

Table-2: 3 Summary of VDF

VEHICLE TYPE	FROM KANDLA	FROM GANDHIDHAM	AVERAGE
LCV	0	0	0
Bus	0	0	0
2 Axle	0.24	0.26	0.25
3 Axle	3.07	9.47	6.27
MAV	8.84	4.36	6.6

For small projects, in the absence of weigh pad, the axle loads of typical commercial vehicles plying on the road may be estimated approximately from the type of goods carried. Where information on the axle loads is not available and the proportion of heavy vehicles using the road is small, the indicative values of Vehicle Damage Factor given in Table below can be used. These indicative VDF values have been worked out based on typical axle load spectrums and taking into consideration the legal axle load limits notified in the Gazette of India dated 16th July, 2018

Table-2: 4 Indicative VDF values

Initial (Two-Way) Traffic Volume in Terms of Commercial Vehicles Per Day	Terrain	
	Rolling/Plain	Hilly
0-150	1.7	0.6
150-1500	3.9	1.7
More than 1500	5	2.8

iv. Traffic Growth Rate (r)

For estimating the cumulative traffic expected to use the pavement over the design period, it is necessary to estimate the rate(s) at which the commercial traffic will grow over the design period. The growth rates may be estimated as per IRC: 108[16]. Typical data required for estimation of the growth rates(r) are:

- (i) Past trends of traffic growth and
- (ii) Demand elasticity of traffic with respect to macro-economic parameters (like the gross domestic product and state domestic product) and the demand expected due to specific developments and land use changes likely to take place during the design life period.

Traffic growth rates shall be established for each category of commercial vehicles. In the absence of data for estimation of the annual growth rate of commercial vehicles or when the estimated growth rate is less than 5 per cent, a minimum annual growth rate of 5 per cent should be used for commercial vehicles for estimating the design traffic.

Table-2: 5 Traffic Growth Rates

Time Period	Cars	Bus	LCV	2-axle Truck	3-axle Truck	MAV
2021-2023	5.92	0	1.21	1.93	4.63	7.72
2023-2028	4.76	0	1.07	1.77	5.32	8.87
2028-2033	3.85	0	0.87	1.48	4.64	7.75
2033-2038	3.13	0	0.7	1.23	3.85	6.74
2038-2043	3.13	0	0.58	1.01	3.18	5.82
2043-2048	2.99	0	0.5	0.85	2.66	5.1
2048-2053	2.99	0	0.46	0.77	2.42	4.85

v. Lane distribution factor (D)

A Lane distribution factor of 0.5 has been considered Clause 4.5 of IRC: 37-2012. Lateral distribution of commercial traffic on the carriageway is required for estimating the design traffic (equivalent standard axle load applications) to be considered for the structural design of pavement. The following lateral distribution factors may be considered for roads with different types of the carriageway:

Two-lane two-way roads

The design should be based on 50 per cent of the total number of commercial vehicles in both the directions.

Four-lane single carriageway roads

40 per cent of the total number (sum) of commercial vehicles in both directions should be considered for design.

Dual carriageway roads

The design of dual two-lane carriageway roads should be based on 75 per cent of the number of commercial vehicles in each direction. For dual three-lane carriageway and dual four-lane carriageway, the distribution factors shall be 60 per cent and 45 per cent respectively.

2.1.4. Evaluation of Design Traffic (MSA) for Pavement Design

Base year traffic (vehicle category-wise & in terms of AADT), traffic growth rates, design life (in terms of number of years) and vehicle damage factors are required to estimate the design traffic in terms of equivalent standard axles. The following data have been considered to arrive at the design traffic (MSA). With the base year traffic in terms of CVPD, annual growth rate of each of commercial vehicle over the design period, design traffic in terms of MSA over the design life can be estimated using the following formula.

$$N = \frac{365 \times ((1+r)^n - 1)}{r} \times A \times D \times F$$

Where,

N = Cumulative number of standard axles to be catered

A = Initial number commercial vehicles per day in the year when the road is operational

n = Design period in years,

r = Annual rate of growth of commercial traffic, D= Lane distribution factor

F= Vehicle Damage Factors

The traffic in the year of completion of construction may be estimated using equation below

$$A = P (1+r)^n$$

Where,

P = number of commercial vehicles per day as per last count.

x = number of years between the last count and the year of completion of construction

Table-2: 6 Design Traffic (MSA) Estimation

Design Traffic (MSA) Estimation									
Base Year CVPD, Two-Way CV Wise as per Last Classified Traffic Volume Count, P (Important Note ! If Any of the CV Wise CVPD is Zero, Enter 0 there)			LCV (CVP D)	M.BU S	BUS (CVP D)	2AT (CVP D)	3AT (CVP D)	MAV (CVPD)	Total CVPD
				(CVP D)					
			258	1	14	19	574	1333	2199
Initial CVPD, Two-Way (CV Wise) at the Start when the Road is			263	1	14	20	614	1490	2401
Opened, A									
Annual Growth Rate of Commercial Vehicles.			LCV	M.BU S	BUS	2AT	3AT	MAV	Average Growth %
(Important Note ! If Any of the CV Wise CVPD is Zero, Enter Corresponding Growth Rate % as Any Non-Zero Value. Don't Put 0			(Gro wth	(Gro wth	(Gro wth	(Gro wth	(Gro wth	(Growth	(If Growth Rate Assumed Uniform for all CV)
or Don't Leave it Blank)			%)	%)	%)	%)	%)	%)	
Growth Rate (%) During the Pe- riod	Period in Years →		1	1.20%	0.00%	0.00%	1.90%	4.60%	7.70%

Design Traffic (MSA) Estimation											
1.5 Years for Design, Project Preparation & Construction											
tion	Period in Years →				0	1.20%	0.00%	0.00%	1.90%	4.60%	7.70%
					5						
Growth Rate % for the First 'Time Horizon',	Ye ar	0	T o	Ye ar	5	1.10%	0.00%	0.00%	1.80%	5.30%	8.90%
Growth Rate % for the Second 'Time Horizon',	Ye ar	5	T o	Ye ar	1 0	0.90%	0.00%	0.00%	1.50%	4.60%	7.80%
Growth Rate % for the Third 'Time Horizon',	Ye ar	1 0	T o	Ye ar	1 5	0.70%	0.00%	0.00%	1.20%	3.90%	6.70%

Design Traffic (MSA) Estimation												
Growth Rate % for the Fourth 'Time Horizon',	Ye ar	1	T	Ye ar	2	0.60%	0.00%	0.00%	1.00%	3.20%	5.80%	
		5	o		0							
Growth Rate % for the Fifth 'Time Horizon',	Ye ar	2	T	Ye ar	2	0.50%	0.00%	0.00%	0.90%	2.70%	5.10%	
		0	o		5							
Growth Rate % for the Sixth 'Time Horizon',	Ye ar	2	T	Ye ar	5	0.50%	0.00%	0.00%	0.80%	2.40%	4.90%	
		5	o		0							
Design Two-Way Cumulative Number of Commercial Vehicles (CV) for the Entire Design Period, C						CLCV	CM.BUS	CBUS	C2AT	C3AT	CMAV	C = (CLCV+CM.BUS+CBUS+C2AT+C3A T+CMAV)
						15397			1200	48094	2E+06	21481696
						42			64	90	0	
Whether like to Use Design VDF as CV Wise or Average or by User Input (CV Wise / Average / User Input)											Mandatory Input for VDF	User Input

Design Traffic (MSA) Estimation							
Design VDF (To be determined from Axle Load Survey, if not, then Enter Value as Per Cl. 4.4.6 of IRC:37-2012), F	LCV (VDF)	M.BU	BUS (VDF)	2AT (VDF)	3AT (VDF)	MAV (VDF)	Average VDF
		S (VDF)					(If VDF Assumed Uniform for all CV)
	0	0	0	0.25	6.27	→ 6.6	
Directional Distribution Factor (For Undivided Road 100%, For Divided Road 50%)						B	50%
Lane Distribution Factor (Refer Clause 4.5.1 of IRC:37-2012)						D	0.6
Design MSA						msa	39

2.1.5. Design of Pavement Structure for new Construction

Design of new flexible pavement applies to the widened portions of existing carriagewaylanes including paved shoulders. Paved shoulders are proposed to be constructed to the same standard as the main carriageway and thus forming an integral part of the paved carriageway. With the design traffic loading in MSA and the sub grade strength in terms of CBR, the pavement composition has been worked out by IRC design procedure to account for the design period of 15 years. The pavement structure has been worked out for the project road and is given below.

Table-2: 7 Proposed Pavement Composition and Thickness

Design Layer No.	Crust Layers (with individual thickness)				Thickness (mm)
1	BC =	40	DBM =	110	150
2	Base (B) =				300
3	Sub-Base (SB) =				200
4	Subgrade =				-
					500

2.1.6. Design Check with IITPAVE Software

Proposed strengthening Design for reconstruction has been checked with IITPAVE Software, using following input parameters:

Table-2: 8 Proposed Strengthening Design Input Parameters

Layer Designation	Design MSA = 40 MSA
	Thickness(mm)
BC	40
DBM	110
WMM	300
GSB	200
Existing Sub-Grade Soil CBR (8%)	

The output sheet of software and the strain comparison is given below:

Table-2: 9 The output sheet of software

No. of layers									
5									
E values (MPa)									
3000.00 3000.00 218.15 218.15 66.60									
Mu values									
0.350.350.350.350.35									
thicknesses (mm)									
40.00 110.00 300.00 200.00									
single wheel load (N)									
20000.00									
tyre pressure (MPa)									
0.56									
Dual Wheel									
Z	R	SigmaZ	SigmaT	SigmaR	TecRZ	DispZ	epZ	epT	epR
150.00	0.00	-0.1056E+00	0.6505E+00	0.5429E+00	-0.1470E-01	0.3752E+00	-0.1779E-03	0.1758E-03	0.1139E-03
150.00L	0.00	-0.1056E+00	-0.3249E-02	-0.1326E-01	-0.1470E-01	0.3752E+00	-0.4676E-03	0.1758E-03	0.1139E-03
150.00	155.00	-0.9542E-01	0.6020E+00	0.2987E+00	-0.4619E-01	0.3853E+00	-0.1369E-03	0.1770E-03	0.4047E-04
150.00L	155.00	-0.9547E-01	-0.3888E-02	-0.2595E-01	-0.4619E-01	0.3853E+00	-0.3857E-03	0.1770E-03	0.4047E-04
650.00	0.00	-0.1603E-01	0.2461E-01	0.2200E-01	-0.2390E-02	0.2633E+00	-0.1483E-03	0.1032E-03	0.8706E-04
650.00L	0.00	-0.1603E-01	0.1518E-02	0.7120E-03	-0.2390E-02	0.2633E+00	-0.2525E-03	0.1033E-03	0.8698E-04
650.00	0.00	-0.1603E-01	0.2461E-01	0.2200E-01	-0.2390E-02	0.2633E+00	-0.1483E-03	0.1032E-03	0.8706E-04
650.00L	0.00	-0.1603E-01	0.1518E-02	0.7120E-03	-0.2390E-02	0.2633E+00	-0.2525E-03	0.1033E-03	0.8698E-04

Table-2: 10 Strain Comparison

S. No.	Layer	Location of Strain	Permissible Strain as per fatigue equations	Actual Micro- strain Values Obtained	Remarks
1	Bituminous Layer	Bottom of Layer	1.81E-04	1.77E-04	Safe
2	Subgrade	Top of Subgrade	3.90E-04	2.52E-04	Safe

From the above results the proposed strengthening design is safe for CBR 8%.

Consultancy Service for Preparation of Details Project Report (DPR) for widening & Improvement of Existing 2/4 –lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)

**Detailed Project
Report**

DESIGN OF STRUCTURES

MONARCH Surveyors & Engineering

Deendayal Port Authority

A

Chapter-3: DESIGN OF STRUCTURES

Design of RCC BOX Culvert

In this section, detailed design calculations of RCC Box structure are presented.

3.1. Units

Design is presented consistently in SI units; the following apply unless mentioned specifically otherwise:

Table-3: 1Units of measurement

Length	m
Force	kN
Stress	MPa
Bearing Pressure	kN/m ²
Hog Mom/Com Str.	-ve
Sag Mom/Ten Str.	+ve

3.2. Assumptions

The following assumptions have been taken while designing the Box.

- ✓ Structure is designed for per meter width.
- ✓ Deck width taken-24.5 m
- ✓ Carriageway width-23 m
- ✓ Modulus of subgrade reaction - 10000 KN/m³ (Based on the Geotech Report)
- ✓ Shear value is taken at a dist. of deff from the face of the slab.
- ✓ In design sheet under summary of moments, only magnitude of force has been considered.
- ✓ In case of earth pressure and LL surcharge governing case out of Normal earth pressure and Fluid ressure is taken.

- ✓ Structure is designed for standard earth pressure with weep holes.

3.3. Loads

The different types of loads used as per IRC 6 : 2017 are.

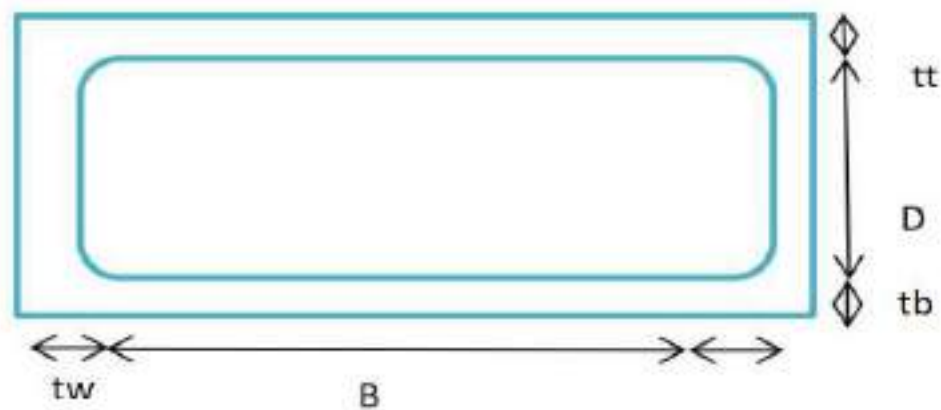
- ✓ Dead load.
- ✓ In SIDL fill & crash barrier load is considered.
- ✓ Normal Earth pressure with drainage arrangement
- ✓ Live load -Class AA Track, 40 T Boggie, 70R Wheel load in case of top slab.
- ✓ Live load surcharge.
- ✓ Breaking load is taken as 20% of the live load on top slab.
- ✓ Temperature loading for uniform rise and temperature gradient is considered.
- ✓ The Earth pressure coefficient at rest 0.5 is considered.

3.4. Load combinations

Load combinations as per IRC 6: 2017 have been considered in staad load combination

3.5. Material properties

- ✓ Grade of Concrete M30
- ✓ Grade of Steel Fe 500.



BOX Culvert (0.2 Cell 2.4m wide x 2.21m height)

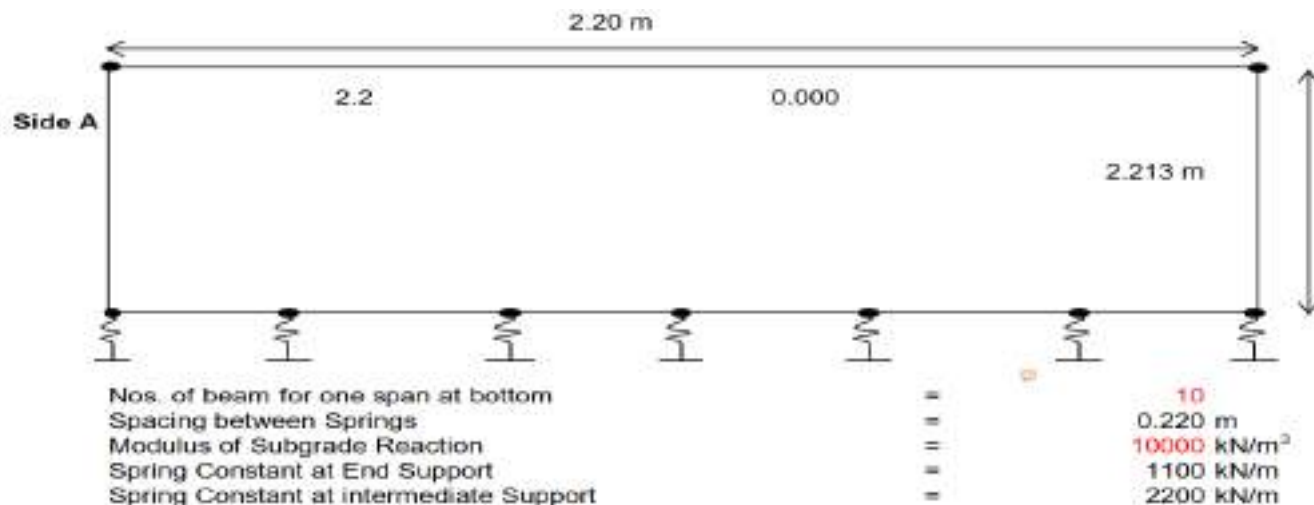
3.6. Structure Dimensions

No. of Cell	=	1	Clear Width of cell	=	2.00 m
Top Slab Thick. (tt)	=	0.200 m	Clear Height of Cell	=	2.00 m
Bot. Slab Thick. (tb)	=	0.225 m	C/C Width of structure	=	2.200 m
Side Wall Thick. (tw)	=	0.200 m	C/C Height of structure	=	2.213 m
			Total length of Structure at top =		2.40 m
Total Deck width	=	24.50 m	Total length of Structure at bottom =		2.40 m
Carriageway Width	=	23.00 m	Total Height of Structure	=	2.43 m
Water above bott. Slab	=	0.500 m	Footpath Dimensions	=	0.00 m
			Parapet/ Crash barrier width	=	0.50 m
Wearing coat for SIDL	=	75mm	Height of fill =		2.00 m
Haunch size	=	150mm			
SIDL (Top Slab)					
Crash barrier	=				
Due to earth fill	=		2 x 20 =	13.00	kN/m ²
Wt of kerb	=			40.00	kN/m ²
				0.00	
				53.00	kN/m ²
Due to wearing coat & PCC	=			2.00	kN/m ²

3.7. Basic Parameters

Earth Pressure at rest $K_0 = (1 - \sin \phi) =$	=	0.5
Dry Density of fill	=	20 kN/m ³
Density of Concrete	=	25 kN/m ³
Live Load Surcharge	=	0 m
Safe Bearing Pressure	=	200 kN/m ²
Fluid Pressure as per cl. 214.1 of IRC 6 2014		4.80 kN/m ²

3.8. Idealized Structure for Staad Analysis (Analysis is done for 1m Strip)



2.1.1. Earth Pressure and Live Load Calculation

1) a Earth Pressure (Normal Condition)

Earth Pressure	Height
21.75 kN/m ²	2.175 m
43.88 kN/m ²	4.388 m

1) b (Fluid Pressure)

Earth Pressure	Height
10.44 kN/m ²	2.175 m
21.06 kN/m ²	4.388 m

1) c Earth Pressure (HFL) Providing Drainage arrangement

Earth Pressure	Height
10.875 kN/m ²	2.175 m
21.9375 kN/m ²	4.388 m

2) a Live Load Surcharge (Normal Condition)

Live Load Surcharge = 0.000 kN/m

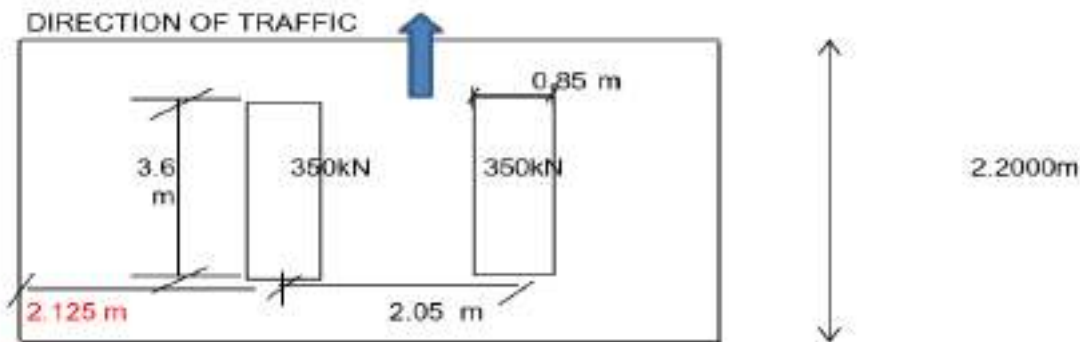
Uniform Load = 5.00 kN/m²

2.1.2. Dead Load

Weight of Top Slab	=	12.00 kN/m	
Weight of earth on Top Slab	=	96.00 kN/m	
Weight of Bottom Slab	=	13.50 kN/m	
Weight of Side wall	=	20.00 kN/m	
Weight of Int. side wall	=	0.00 kN/m	
Weight of the parapet wall	=	0.00 kN	
Weight of the footpath	=	0.00 kN	
Wt of Railing/Crash Barrier	=	24.00 kN	
Weight of wearing coat	=	3.43 kN/m	
Weight of water	=	12 kN/m	
Weight of haunch	=	1.125 kN/m	
<u>Base Pressure Without Live Load</u>			
Base Pressure	=	72.29 kN/m ²	OK
Base Pressure in HFL Case	=	32.01 kN/m ²	OK
<u>Base Pressure With Live Load</u>			
Base Pressure	=	115.34 kN/m ²	OK
Base Pressure in HFL Case	=	75.06 kN/m ²	OK

2.1.3. Live Load on Top Slab

A)



Total Load = 700kN
 194.44 kN/m
 427.8 kN

3.6 2.2000m

Effective width of Loading

a = 1.10 m
 b1 = 5.00 m
 b/lo = 11.14
 a = 2.60
 beff = 6.43 m

2.05 < 6.43

Therefore overlapping due to load dispersion occurs

Effective width = 7.39 m
 Width along span = 2.2 m
 Load Intensity = 26.31 kN/m²
 Impact factor = 1.25
 Increase due to impact = 32.89 kN/m²
 Say 32.90 kN/m²

B) Class AA Track at Support

Effective width of Loading

a = 1.10 m
 b1 = 5.00 m
 b/lo = 11.14
 a = 2.60
 beff = 6.43 m

2.05 < 6.43

Therefore overlapping due to load dispersion occurs

Effective width = 7.39 m
 Width along span = 2.200 m
 Load Intensity = 26.31 kN/m²
 Impact factor = 1.25
 Increase due to impact = 32.89 kN/m²
 Say 32.90 kN/m²

D) 40T Boggie Load at Support

Effective width of Loading

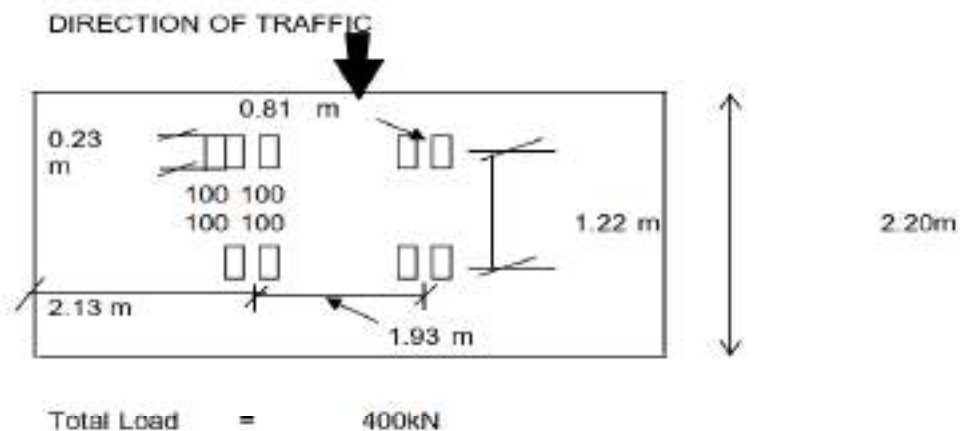
a	=	0.61 m
b1	=	4.96 m
b/lo	=	11.14
a	=	2.60
beff	=	6.11 m

$$1.93 < 6.11$$

Therefore overlapping due to load dispersion occurs

Effective width	=	7.12 m
Width along span	=	2.200 m
Load Intensity	=	25.55 kN/m ²
Impact factor	=	1.25
Increase due to impact	=	31.94 kN/m ²
Say		32.00 kN/m²

C) 40T Boggie Load at Mid Span



Effective width of Loading

a	=	0.49 m
b1	=	4.96 m
b/lo	=	11.14
a	=	2.60
beff	=	5.95 m

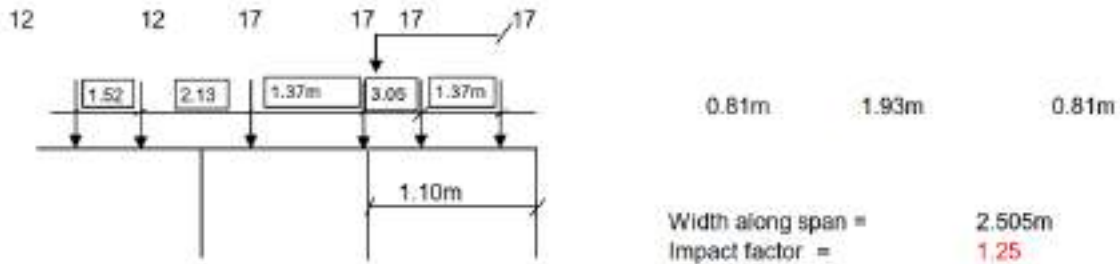
$$1.93 < 5.95$$

Therefore overlapping due to load dispersion occurs

Effective width	=	7.04 m
Width along span	=	2.2 m
Load Intensity	=	25.84 kN/m ²
Impact factor	=	1.25
Increase due to impact	=	32.30 kN/m ²
Say		32.30 kN/m²

E) 70R Wheel Case 1

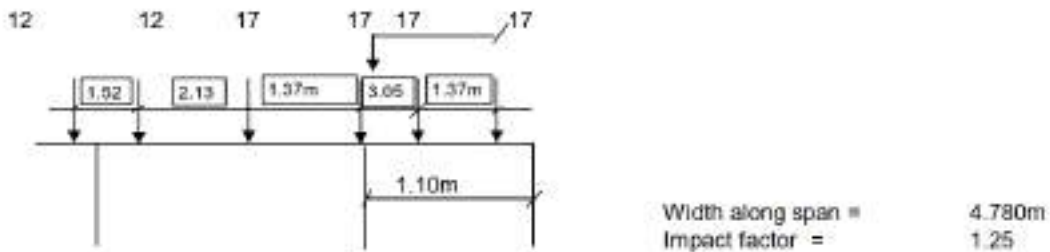
(at support)



S.No.	Load	a	a	b _{eff}	Overlap	Eff. Width	Load Int.	With Imp.
1	170	0.95m	2.60	6.36m	Yes	7.22m	9.4 kN/sqm	12 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm

F) 70R Wheel Case 2

(at mid span)



S.No.	Load	a	a	b _{eff}	Overlap	Eff. Width	Load Int.	With Imp.
1	170	0.000	2.60	4.96m	Yes	6.52m	5.5 kN/sqm	7 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm

G) Braking load		20%	Av. Eff. Width	Load per meter
Load on the span 70R Wheel	0 kN	0 kN	7.22m	0 kN/m
Load on the span 40T Boggie	400 kN	80 kN	7.04m	11 kN/m
Load on the span ClassAA Track	0 kN	0 kN	7.39m	0 kN/m
Max. force	No braking load considered in case of earthfill.			11 kN/m

2.1.4. Collision Load

Nominal Vehicle collision load as per cl. 222.3 table 9 of IRC 6 2010

Point of application above Carriageway level	Direction of load	Load	Av. Eff. Width	Load per meter
At crash barrier due to live load moving on bottom slab				
Main + Residual Load	1.0m Normal to the carriageway	75 kN	1.00m	75 kN/m/m
Main + Residual Load	1.0m Parallel to the carriageway	150 kN	1.00m	150 kN/m/m

2.1.5. Temperature load calculation

Effective Bridge Temperature

Maximum Air Shade temperature	=	47.5	°C (as per Fig 8 of IRC:6-2014)
Minimum Air Shade temperature	=	-2.5	°C (as per Fig 9 of IRC:6-2014)
Mean of max and min temperature	=	22.5	°C (as per clause 215.2 of IRC:6-2014)
Bridge temperature to be assumed	=	32.5	
TEMPERATURE RISE		32.5	
TEMPERATURE FALL		12.5	

Effect of temperature gradient

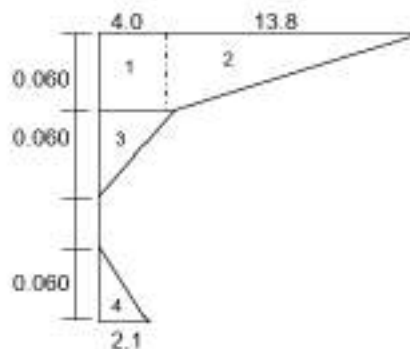
The box has been checked for temperature differential. As per IRC:6 - 2014, for this combination only 50% live load shall be considered.

$$F = E_c a \Delta t A$$

E_c = Modulus of Elasticity of Concrete	=	3.16E+06	
a = Coefficient of Thermal expansion	=	1.20E-05	1/m ²
Δt = Temperature differential			°C (as per IRC:6)
A = X sectional Area of section where temperature differential is Δt			
Average thickness of Deck slab =	200	mm	

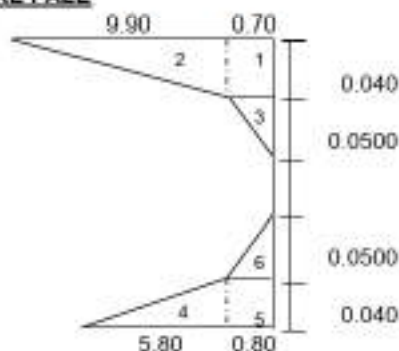
Table-3: 2 Temperature Stresses

EFFECT OF TEMPERATURE RISE



Sr. No.	Dt	b	t	A = b x t	F (force)	Acting at	Eccentricity e*
1	4.0	1.0	0.060	0.060	9.11	0.030 m from top	0.070
2	$\frac{13.8}{2}$	1.0	0.100	0.100	26.18	0.033 m from top	0.067
3	$\frac{4.0}{2}$	1.0	0.060	0.060	4.55	0.080 m from top	0.020
4	$\frac{2.1}{2}$	1.0	0.060	0.060	2.39	0.020 m from bottom	-0.080
					SF = 42.23	M =	2.283

EFFECT OF TEMPERATURE FALL



Sr. No.	Dt	b	t	A = b x t	F (force)	Acting at	Eccentricity e*
1	0.70	1.0	0.040	0.040	1.06	0.020 m from top	0.080
2	$\frac{9.90}{2}$	1.0	0.040	0.040	7.51	0.013 m from top	0.087
3	$\frac{0.70}{2}$	1.0	0.0500	0.0500	0.66	0.057 m from top	0.043
4	$\frac{5.80}{2}$	1.0	0.040	0.040	4.40	0.013 m from bottom	-0.087
5	0.80	1.0	0.040	0.040	1.21	0.020 m from bottom	-0.080
6	$\frac{0.80}{2}$	1.0	0.0500	0.0500	0.76	0.057 m from bottom	-0.043
					SF = 15.61	M =	0.253

2.1.6. Summary of factored moments

Table-3: 3 Summary of factored moments

Grade of Concrete = M30
Grade of Steel = Fe500

Summary of factored moments

Load Case	Top slab			Bottom slab			Outer wall			
	Moment in Mid-Span	Moment at End Support	Top slab shear at deff	Moment in Mid-Span	Moment at End Support	Bottom slab shear at deff	Moment at top	Moment at bottom	Span Moment	Wall shear at deff
	kN-m	kN-m	kN	kN-m	kN-m	kN	kN-m	kN-m	kN-m	
Structural Strength (Basic Combination) LC-100 To	45.836	24.069	114.583	51.297	32.501	136.204	25.173	25.173	5.759	47.478
Serviceability Check(Rare Combination) LC-172 To LC219	37.951	13.546	99.321	44.211	23.391	118.397	20.776	20.776	11.697	34.682
Serviceability Check(Quasi-Permanent Combination) LC-220 To LC223	19.162	12.61	50.783	22.604	18.071	64.174	12.537	12.537	1.205	35.067
Combination for Design of Foundation (Combination 1) LC-148 To	44.768	21.748	114.583	51.308	21.96	103.657	25.173	25.173	5.759	52.066

2.1.7. Partial Safety Factors

Material Parameters

Concrete Refer Table 6.5, IRC:112-2019

Grade

Cube strength of concrete at 28 days f_{ck} = **M30** MPa

Design value of concrete compressive strength f_{cd} = $\alpha f_{ck} / \gamma_m$

Refer cl. 6.4.2.8 of IRC:112-2019

$\alpha =$ 0.67

f_{ctm} = 2.5 MPa

For Basic Combination f_{cd} = 13.40 MPa

For Accidental Combination f_{cd} = 16.75 MPa

For Seismic Combination f_{cd} = 13.40 MPa

Modulus of Elasticity E_c = 31000 MPa

Mean value of axial tensile strength of concrete f_{ctm} = 2.5 MPa

Density = 2.50 t/m³

Reinforcing Steel

Grade

=

Characteristics yield strength f_{yk} = 500 MPa

Design yield strength f_{yd} = f_{yk} / γ_m

For Basic Combination f_{yd} = 434.78 MPa

For Accidental Combination f_{yd} = 500 MPa

For Seismic Combination f_{yd} = 434.78 MPa

Modulus of Elasticity E_s = 2.0E+05 MPa

Density = 7.85 t/m³

Partial Safety Factor for Materials

Material	Partial Safety Factor γ_m		
	Basic Combination	Accidental Combination	Seismic Combination
Concrete	1.5	1.2	1.5
Steel	1.15	1	1.15

Cl 6.4.2.8, IRC:112-2011

Cl 6.2.2, IRC:112-2011

2.1.8. Partial Safety Factor for Loads

Table-3: 4 Partial safety factors

Ultimate Limit State

Partial Safety for Verification of Structural Strength Table 3.1, Annex B, IRC:6-2017

Loads	Partial Safety Factor					
	Basic Combination		Accidental Combination		Seismic Combination	
(1)	(2)	(3)	(4)	(5)	(4)	(3)
	Overtuning or Sliding or Uplift Effect	Restoring or Resisting Effect	Overtuning or Sliding or Uplift Effect	Restoring or Resisting Effect	Overtuning or Sliding or Uplift Effect	Restoring or Resisting Effect
Permanent Loads:	1.10	0.90	1.00	1.00	1.10	0.90
Dead Load, SIDL except surfacing, Backfill Weight, Settlement, Creep and shrinkage effect						
Surfacing	1.35	1.00	1.00	1.00	1.35	1.00
Earth Pressure due to Backfill	1.50	1.00	1.00	0.00	1.00	1.00
Variable Loads:						
Carriageway Live Load and associated loads (braking, tractive and centrifugal forces) and pedestrian live load:						
a) Leading Load	1.50	0.00	0.75	0.00	0.00	0.00
b) Accompanying Load	1.15	0.00	0.20	0.00	0.20	0.00
c) Construction Live Load	1.35	0.00	1.00	0.00	1.00	0.00
Thermal Loads						
a) As Leading Load	1.50	0.00	0.00	0.00	0.00	0.00
b) As Accompanying Load	0.90	0.00	0.50	0.00	0.50	0.00
Wind						
a) As Leading Load	1.50	0.00	0.00	0.00	0.00	0.00
b) As Accompanying Load	0.90	0.00	0.00	0.00	0.00	0.00
Live Load Surcharge (as accompanying load)	1.20	0.00	0.00	0.00	0.00	0.00
Accidental Effects:						
i) Vehicle Collision	0.00	0.00	1.00	0.00	0.00	0.00
ii) Barge Impact	0.00	0.00	1.00	0.00	0.00	0.00
iii) Impact due to floating bodies	0.00	0.00	1.00	0.00	0.00	0.00
Seismic Effect						
a) During Service	0.00	0.00	0.00	0.00	1.50	0.00
b) During Construction	0.00	0.00	0.00	0.00	0.75	0.00
Construction Condition:						
Counter Weights:						
a) When density or self weight is well defined	0.00	0.90	0.00	1.00	0.00	1.00
b) When density or self weight is not well defined	0.00	0.80	0.00	1.00	0.00	1.00
c) Erection effects	1.05	0.95	0.00	0.00	0.00	0.00
Wind						
a) As Leading Load	1.50	0.00	0.00	0.00	0.00	0.00
b) As Accompanying Load	1.20	0.00	0.00	0.00	0.00	0.00
Hydraulic Loads:						
(Accompanying Load):						
Water Current Forces	1.00	0.00	1.00	0.00	1.00	0.00
Wave Pressure	1.00	0.00	1.00	0.00	1.00	0.00
Hydrodynamic Effect	0.00	0.00	0.00	0.00	1.00	0.00
Buoyancy	1.00	0.00	1.00	0.00	1.00	0.00

Partial Safety for Verification of Structural Strength Table 3.2, Annex B, IRC:6-2017

Loads	Partial Safety Factor		
	Basic Combination	Accidental Combination	Seismic Combination
(1)	(2)	(3)	(4)
Permanent Loads:			
Dead Load			
SIDL except surfacing			
a) Adding to the effect of variable loads	1.35	1.00	1.35
b) Relieving the effect of variable loads	1.00	1.00	1.00
Surfacing:			
a) Adding to the effect of variable loads	1.75	1.00	1.75
b) Relieving the effect of variable loads	1.00	1.00	1.00
Backfill Weight	1.50	1.00	1.00
Earth Pressure due to Backfill			
a) Leading Load	1.50	1.00	1.00
b) Accompanying Load	1.00	1.00	1.00
Variable Loads:			
Carriageway Live Load and associated loads (braking, tractive and centrifugal forces) and pedestrian live load:			
a) Leading Load	1.50	0.75	0.00
b) Accompanying Load	1.15	0.20	0.20
c) Construction Live Load	1.35	1.00	1.00
Wind during service and construction			
a) Leading Load	1.50	0.00	0.00
b) Accompanying Load	0.90	0.00	0.00
Live Load Surcharge (as accompanying load)	1.20	0.20	0.20
Erection effects	1.00	1.00	1.35
Accidental Effects:			
i) Vehicle Collision	0.00	1.00	0.00
ii) Barge Impact	0.00	1.00	0.00
iii) Impact due to floating bodies	0.00	1.00	0.00
Seismic Effect			
a) During Service	0.00	0.00	1.50
b) During Construction	0.00	0.00	0.75
Hydraulic Loads (Accompanying Load):			
Water Current Forces	1.00	1.00	1.00
Wave Pressure	1.00	1.00	1.00
Hydrodynamic Effect	0.00	0.00	1.00
Buoyancy	0.15	0.15	1.00

2.1.9. Serviceability Limit State

Partial Safety for Verification of Serviceability Limit S Table 3.3, Annex B, IRC:6-2017

Loads	Partial Safety Factor		
	Rare Combination	Frequent Combination	Quasi-permanent
(1)	(2)	(3)	(4)
Permanent Loads:			
Dead Load	1.00	1.00	1.00
SIDL including surfacing	1.20	1.20	1.20
Backfill Weight	1.00	1.00	1.00
Shrinkage and Creep Effects	1.00	1.00	1.00
Earth Pressure due to Backfill	1.00	1.00	1.00
Settlement Effects			
a) Adding to the permanent loads	1.00	1.00	1.00
b) Opposing the permanent loads	0.00	0.00	0.00
Variable Loads:			
Carriageway Live Load and associated loads (braking, tractive and centrifugal forces) and pedestrian live load:			
a) Leading Load	1.00	0.75	0.00
b) Accompanying Load	0.75	0.20	0.00
Thermal Loads:			
a) Leading Load	1.00	0.60	0.00
b) Accompanying Load	0.60	0.50	0.50
Wind			
a) Leading Load	1.00	0.60	0.00
b) Accompanying Load	0.60	0.50	0.00
Live Load Surcharge (Accompanying load)	0.80	0.00	0.00
Hydraulic Loads (Accompanying Load):			
Water Current Forces	1.00	1.00	0.00
Wave Pressure	1.00	1.00	0.00
Buoyancy	0.15	0.15	0.15

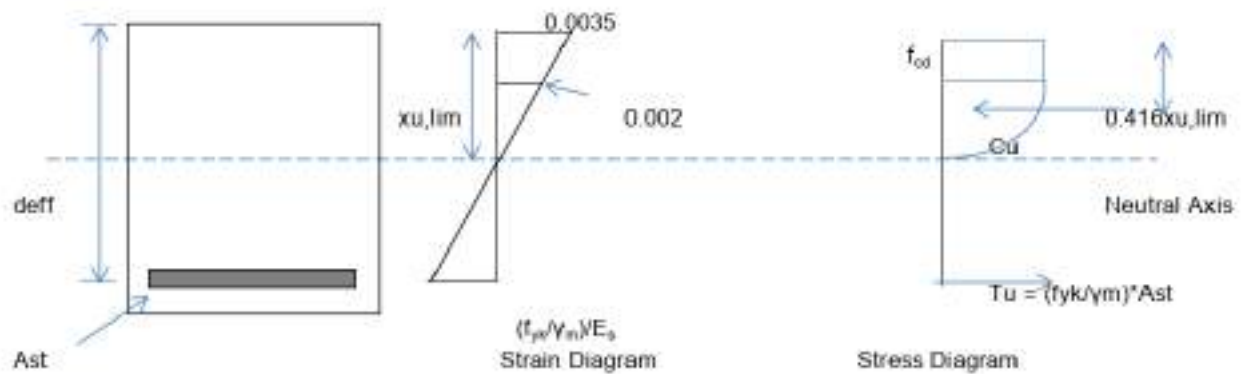
2.1.10. Combination for Base Pressure and Design of Foundation

Table-3: 5 Combination for Base Pressure and Design of Foundation

Table 3.4, Annex B, IRC:6-2014

Loads	Partial Safety Factor			
	Combination (1)	Combination (2)	Seismic Combination	Accidental Combination
(1)	(2)	(3)	(4a)	(4b)
Permanent Loads:				
Dead Load, SIDL except surfacing, Backfill earth filling	1.35	1.00	1.35	1.00
SIDL Surfacing	1.75	1.00	1.75	1.00
Settlement Effect	1.0 or 0	1.0 or 0	1.0 or 0	1.0 or 0
Earth Pressure due to Backfill				
a) Leading Load	1.50	1.30	1.00	1.00
b) Accompanying Load	1.00	0.85	1.00	1.00
Variable Loads:				
Carriageway Live Load and associated loads (braking, tractive and centrifugal forces) and pedestrian live load:				
	1.50	1.30	(0.75 if applicable) or 0	(0.75 if applicable) or 0
a) Leading Load				
b) Accompanying Load	1.15	1.00	0.20	0.20
Thermal Loads as accompanying load	0.90	0.80	0.50	0.50
Wind				
a) Leading Load	1.50	1.30	0.00	0.00
b) Accompanying Load	0.90	0.80	0.00	0.00
Live Load Surcharge (as accompanying load applicable)	1.20	1.00	0.20	0.20
Accidental Effects or Seismic Effect:				
a) During Service	0.00	0.00	1.50	1.00
b) During Construction	0.00	0.00	0.75	0.50
Erection effects	1.35	1.00	1.00	1.00
Hydraulic Loads:				
Water Current	1.0 or 0	1.0 or 0	1.0 or 0	1.0 or 0
Wave Pressure	1.0 or 0	1.0 or 0	1.0 or 0	1.0 or 0
Hydrodynamic Effect	0.00	0.00	1.0 or 0	1.0 or 0
Buoyancy:				
For Base Pressure	1.00	1.00	1.00	1.00
For Structural Design	0.15	0.15	0.15	0.15

2.1.11. Verification of structural strength for top slab



ULTIMATE LIMIT STATE

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 6.4.2.8, IRC:112-2011					
	f_{cd}	=	13.40	N/mm ²	For Basic Combination
	f_{cd}	=	16.75	N/mm ²	For Accidental Combination
	f_{cd}	=	13.40	N/mm ²	For Seismic Combination
	E_c	=	31000	MPa	
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	435	N/mm ²	For Basic Combination
	f_{yd}	=	500	N/mm ²	For Accidental Combination
	f_{yd}	=	435	N/mm ²	For Seismic Combination

Refer Fig. 6.2 of IRC: 112-2011

For steel reinforcement, simplified bilinear diagram is used

Minimum strain in steel reinforcement = $0.87 f_y / E_s$

$E_s = 2.0E+05$ MPa

$C_u = f_{cd} \cdot b \cdot (3/7 x_{u,lim} + 2/3 \cdot 4/7 x_{u,lim})$

$= 17/21 \cdot f_{cd} \cdot b \cdot x_u$

$= 0.8095 \cdot f_{cd} \cdot b \cdot x_u$

cg of compression block from top = $0.416 x_u$

$T_u = f_{yd} \cdot A_{st}$

$R_{lim} = M_{u,lim} / b d^2 = 0.8095 f_{cd} \cdot (x_{u,lim} / d) \cdot (1 - 0.416 \cdot x_{u,lim} / d)$

	Basic Comb	Accidental Comb	Seismic Comb
$x_{u,lim} / d$	0.46	0.44	0.46
$R_{lim} = M_{u,lim} / b d^2$	4.01	4.85	4.01

Here R_{lim} is in MPa

Calculation of Reinforcement

Width of section $b = 1000$ mm

Depth of section $D = 200$ mm

Clear cover at top = 40

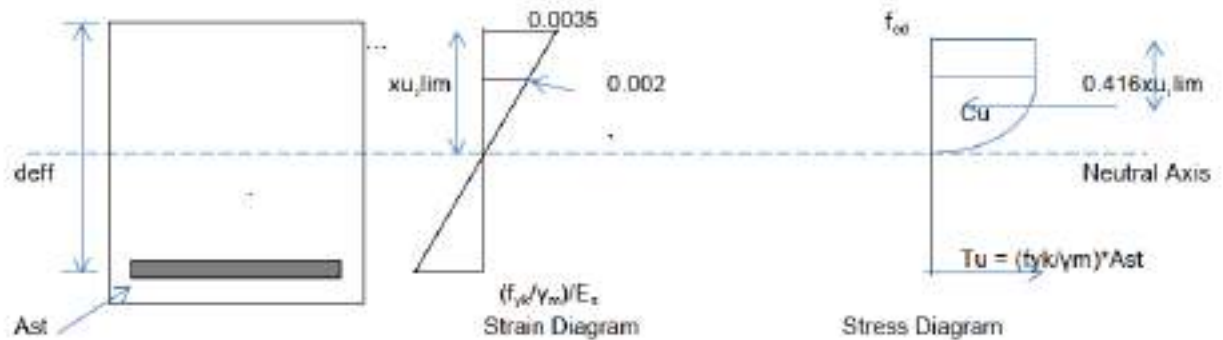
Clear cover at Bottom = 40

2.1.12. Verification of structural strength for top slab

Moment on the section	Top slab Top End support			Top slab Bottom Mid Span		
	Basic			Basic		
	Comb			Comb		
Actual moment (KNm)	24.1			45.8		
b	1000			1000		
D	200			200		
c	40			40		
d	155.0			146.0		
f_{yk}	13.40			13.40		
f_{yk}	435			435		
xU_{lim}/d	0.46			0.46		
$R_{sds} = M_{u,ds}/bd^2$	4.01			4.01		
$M_{u,lim}$ (KNm)	96			85		
	OK			OK		
Ast Req.	372			794		
Dia of bar (main tension) (mm)	10			12		
Spacing (mm)	150			100		
+ dia of bar (main tension) (mm)	10			0		
Spacing (mm)	150			200		
Ast provided (sq mm)	1047			1131		
% Steel	0.68			0.73		
Dia of bar (main compression) (mm)	0			10		
Spacing (mm)	200			150		
Area of main compression (mm ²)	0			524		
f_{ctm}	2.5			2.5		
f_{yk}	500			500		
cl. 16.6.1 (2) of IRC :112-2011						
$A_{s,min} = 0.26 f_{ctm} b_l d / f_{yk} \geq 0.0013 b_l d$	202			190		
A_{ct}	158026			154668		
$f_{ct,eff}$	2.9			2.9		
$k_c = 0.4 \{ 1 - s_c / (k_1 f_{ct,eff} h/h') \} \leq 1$	0.4			0.4		
For Bending or bending combined with axial force:						
k	1.000			1.0000		
s_y	500			500		
cl. 12.3.6 (4) of IRC :112-2011						
$A_{s,min} = k_c k f_{ct,eff} A_{ct} / s_y$	367			359		
	OK			OK		
$A_{s,max} = 0.025 A_c$ (main tension)	5000			5000		
cl. 16.5.1.1 (2) of IRC :112-2011	OK			OK		
$A_{s,max} = 0.04 A_c$ (tension + compression)	8000			8000		
x (mm)	42			45		
x/d	0.271			0.310		
	OK			OK		
z (mm)	138			127		
MR (KNm)	63			63		
	OK			OK		
Calculation of Transverse Steel as per Clause 16.6.1.1						
$A_{ST,min} = 20\%$ of main reinforcement	74.4			158.8		
Dia of bar (Horizontal Bar) (mm)	10			10		
Spacing (mm)	200			200		
Area of distribution bar (mm ²)	392.7			392.7		
	OK			OK		

Min shear stress	0.480
cl. 10.3.2(5) Eq. 10.6 of IRC : 112-2010	
$n = 0.6 (1 - f_{ck} / 310)$	0.542
cl. 10.3.2(5) Eq. 10.5 of IRC : 112-2011	
$0.5 b_w d n f_{cd}$	563
	OK
Min shear force for providing reinf., V_E (N)	114583.0
No. of link for shear reinf.	4
Dia. of bar for shear reinf.	8
$S = A_{sw} \times 0.9 \times d \times \cot \theta \times f_y / V_E$	266
S (mm)	75
A_{sw}	201
cl. 16.5.2(7) Eq. 16.6 of IRC : 112-2011	
$S_{l,max} = 0.75 d$	116
Spacing Required in Long. Direction (mm)	116.3
Spacing provided in Long. Direction (mm)	100
	OK
cl. 16.5.2(9) Eq. 16.8 of IRC : 112-2011	
$S_{l,max} = 0.75 d \leq 600 \text{ mm}$	116
Spacing provided in Trans. Direction, S_{\perp} mm	100
	OK
z (mm)	138
f_{ywd}	400
cl. 10.3.3.3 Eq. 10.17 of IRC : 112-2010	
$V_{Ed} \leq A_{sw} f_{ywd}$ (KN)	80
cl. 10.3.3.3 (6) of IRC : 112-2010	
$M_{Ed} / z + 0.5 V_{Ed}$ (KN)	215
$M_{Ed,max} / z$ (KN)	455
	OK
cl. 10.3.3.2 Eq. 10.7 of IRC : 112-2011	
$V_{Rd,s} = A_{sw} z f_{ywd} / S$ (KN)	147
	OK
$a_{cw} =$ ($s_{cp} = N_{Ed} / A_c = 0$)	1.0
n_1	0.6
cl. 10.3.3.2 Eq. 10.8 of IRC : 112-2011	
$V_{Rd,max} = a_{cw} b_w z n_1 f_{cd}$ (KN)	1106
	OK
cl. 10.3.3.2 Eq. 10.10 of IRC : 112-2011	
$A_{sw,max} \leq 0.5 a_{cw} n_1 f_{cd} b_w S / f_{ywd}$	754
	OK
cl. 10.3.1 of IRC : 112-2011	
$r_w = A_{sw} / (S b_w \sin \alpha)$	0.0027
cl. 10.3.3.5 of IRC : 112-2011	
$r_{w,min} = (0.072 f_{yk}^{0.5}) / f_{yk}$	0.0008
	OK

2.1.13. Verification for serviceability limit state for Top slab



SERVICEABILITY LIMIT STATE

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 12.2.1, IRC:112-2011	f_{cd}	=	14.40	N/mm ²	For Rare Combination
	f_{cd}	=	14.40	N/mm ²	For Frequent Combination
	f_{cd}	=	10.80	N/mm ²	For Quasi-Perma. Combination
As per clause 12.2.2, IRC:112-2011					
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	400	N/mm ²	For Rare Combination
	f_{yd}	=	400	N/mm ²	For Frequent Combination
	f_{yd}	=	400	N/mm ²	For Quasi-Perma. Combination

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

Minimum strain in steel reinforcement = $0.87 f_y / E_s$

$E_s = 2.0E+05$ MPa

$E_c = 31000$ MPa

$Cu = f_{cd} * b * (3/7 * xu,lim + 2/3 * 4/7 * xu,lim)$

$= 17/21 * f_{cd} * b * xu$

$= 0.8095 * f_{cd} * b * xu$

cg of compression block from top = $0.416 xu$

$Tu = f_{yd} * Ast$

$R_{sb} = M_{u,sb} / b d^2 = 0.8095 f_{cd} * (xu/d) * (1 - 0.416 * xu/d)$

	Rare Comb	Frequent Comb	Quasi-Perma. Comb
$xu,sls/d$	0.47	0.47	0.47
$R_{sb} = M_{u,sb} / b d^2$	4.38	4.38	3.29

Here R_{sb} is in MPa

Calculation of Reinforcement

Width of section $b = 1000$ mm

Depth of section $d = 200$ mm

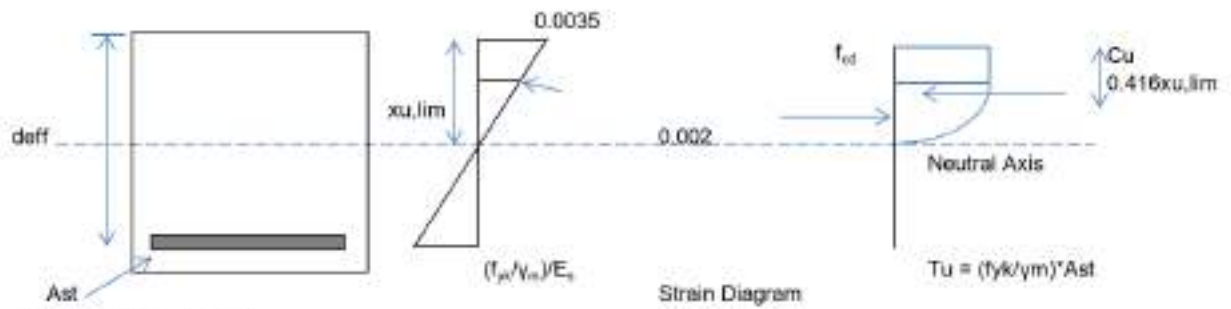
Clear cover at top = **40**

Clear cover at Bottom = **40**

Moment on the section	Top slab Top End support		Top slab Bottom Mid Span			
	Rare Comb		Quasi-Perma. Comb	Rare Comb		Quasi-Perma. Comb
Actual moment (KNm)	13.5		12.6	37.951		19.162
b	1000		1000	1000		1000
D	200		200	200		200
c	40		40	40		40
d	147.0		147.0	146.0		146.0
f_{cd}	14.40		10.80	14.40		10.80
f_{yd}	400		400	400		400
$x_{u,sls}/d$	0.47		0.47	0.47		0.47
$R_{sls} = M_{u,sls}/bd^2$	4.38		3.29	4.38		3.29
$M_{u,sls}$ (KNm)	95		71	93		70
	OK		OK	OK		OK
Ast Req.	236		221	697		343
Dia of bar (main tension) (mm)	10		10	12		12
Spacing (mm)	150		150	100		100
+ dia of bar (main tension) (mm)	10		10	0		0
Spacing (mm)	150		150	200		200
Ast provided (sq mm)	1047		1047	1131		1131
Dia of bar (main compression) (mm)	0		0	10		10
Spacing (mm)	200		200	150		150
Area of main compression (mm ²)	0		0	524		524
f_{ctm}	2.5		2.5	2.5		2.5
x (mm)	35.9		47.9	38.8		51.7
x/d	0.244		0.326	0.266		0.354
	OK		OK	OK		OK
z (mm)	132		127	130		124
MR_{d5} (KNm)	55		53	59		56
	OK		OK	OK		OK
$s_{sls} = M/(A_s z)$	98		95	258		136
	OK		OK	OK		OK
$s_{cs} = M/(0.8095 z b x_u)$	3.53		2.56	9.30		3.68
	OK		OK	OK		OK

Calculation of crack width	Top slab Top End support			Top slab Bottom Mid Span		
n_1			7			10
n_2			7			5
$f_{eq} = (n_1 f_1^2 + n_2 f_2^2) / (n_1 f_1 + n_2 f_2)$			10			12
cl. 12.3.4 (3) of IRC :112-2011						
c			40			40
k1			0.8			0.8
k2			0.50			0.50
For skew slab refer eq. 12.10 of IRC :112-2011						
$r_{p,eff} = A_s / A_{c,eff}$			0.010			0.011
$S_{l,max} = \{ 3.4 c + (0.425 k_1 k_2 f) / r_{p,eff} \}$			298			316
cl. 12.3.4 (3) of IRC :112-2011						
k_f			0.5			0.5
$f_{ct,eff}$			2.90			2.90
E_s			200000			200000
E_{cm}			31000			31000
$a_e = E_s / E_{cm}$			6.45			6.45
$(e_{sm} - e_{cm}) = (s_{sc} - k_f f_{ct,eff} (1 + a_e r_{p,eff}) / r_{p,eff}) / E_s$ $\geq 0.6 s_{sc} / E_s$			0.0003			0.0004
cl. 12.3.4 (2) of IRC :112-2011						
$W_k = S_{l,max} (e_{sm} - e_{cm})$			0.08			0.13
cl. 12.3.4 (1) of IRC :112-2011						
			OK			OK
Calculation of deflection						
Span (mm)					2200	
span/800					2.8	
cl. 12.4.1 (2) of IRC :112-2011						
Short term elastic deflection from STAAD					0.5	
					OK	

2.1.14. Verification of structural strength for bottom slab



ULTIMATE LIMIT STATE

Grade of Concrete
As per clause 6.4.2.8, IRC:112-2011

$$f_{ck} = 30 \text{ N/mm}^2$$

$$f_{cd} = 13.40 \text{ N/mm}^2 \quad \text{Combination (1)}$$

$$f_{cd} = 16.75 \text{ N/mm}^2 \quad \text{Accidental Comb.}$$

$$f_{cd} = 13.40 \text{ N/mm}^2 \quad \text{Combination (2)}$$

$$E_c = 31000 \text{ MPa}$$

Grade of steel

$$f_y = 500 \text{ N/mm}^2$$

$$f_{yd} = 435 \text{ N/mm}^2 \quad \text{Combination (1)}$$

$$f_{yd} = 500 \text{ N/mm}^2 \quad \text{Accidental Comb.}$$

$$f_{yd} = 435 \text{ N/mm}^2 \quad \text{Combination (2)}$$

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

$$\text{Minimum strain in steel reinforcement} = 0.87 f_y / E_s$$

$$E_s = 2.0 \times 10^5 \text{ MPa}$$

$$E_c = 31000 \text{ MPa}$$

$$C_u = f_{cd} \cdot b \cdot \left(\frac{3}{7} x_{u,lim} + \frac{2}{3} \cdot \frac{4}{7} x_{u,lim} \right)$$

$$= 17/21 \cdot f_{cd} \cdot b \cdot x_u$$

$$= 0.8095 \cdot f_{cd} \cdot b \cdot x_u$$

$$\text{cg of compression block from top} = 0.416 x_u$$

$$T_u = f_{yd} \cdot A_{st}$$

$$R_{lim} = M_{u,lim} / b d^2 = 0.8095 f_{cd} (x_{u,lim} / d) (1 - 0.416 x_{u,lim} / d)$$

	Basic Comb	Accidental Comb	Seismic Comb
$x_{u,lim} / d$	0.46	0.44	0.46
$R_{lim} = M_{u,lim} / b d^2$	4.01	4.85	4.01

Here R_{lim} is in MPa

Calculation of Reinforcement

$$\text{Width of section } b = 1000 \text{ mm}$$

$$\text{Depth of section } D = 225 \text{ mm}$$

$$\text{Clear cover at bott.} = 75$$

$$\text{Clear cover at top} = 40$$

Moment on the section	Bottom End support			Top Mid Span		
	Combination (1)			Combination (1)		
Actual moment (Klm)	22.0			51.3		
b	1000			1000		
D	225			225		
c	75			40		
d	144.0			171.0		
f_{cd}	13.40			13.40		
f_{yd}	435			435		
xu_{lim}/d	0.46			0.46		
$R_{lim} = M_{u,lim}/bd^2$	4.01			4.01		
$M_{u,lim}$ (KNm)	83			117		
	OK			OK		
Asl Req.	366			744		
Dis of bar (main tension) (mm)	12			12		
Spacing (mm)	200			100		
+ dia of bar (main tension) (mm)	10			0		
Spacing (mm)	150			200		
Asl provided (sq mm)	1089			1131		
% Steel	0.76			0.79		
Dis of bar (main compression) (mm)	0			10		
Spacing (mm)	200			150		
Area of main compression (mm ²)	0			524		
f_{cdm}	2.5			2.5		
f_{yk}	500			500		
cl. 16.6.1 (2) of IRC :112-2011						
$A_{s,min} = 0.26 f_{cdm} b_1 d / f_{yk} \geq 0.0013 b_1 d$	187			222		
A_{cs}	181347			179668		
$f_{ct,eff}$	2.9			2.9		
$k_s = 0.4 \{ 1 - \alpha_s / (k_1 f_{ct,eff} h/h^2) \} \leq 1$	0.4			0.4		
For Bending or bending combined with axial force						
k	1.0000			1.0000		
S_b	500			500		
cl. 12.3.6 (4) of IRC :112-2011						
$A_{s,min} = k_s k f_{ct,eff} A_{cs} / S_b$	421			417		
	OK			OK		
$A_{s,max} = 0.025 A_{cs}$ (main tension)	5625			5625		
cl. 16.5.1.1 (2) of IRC :112-2011	OK			OK		
$A_{s,max} = 0.04 A_{cs}$ (tension + compression)	9000			9000		
x (mm)	44			45		
x/d	0.303			0.265		
	OK			OK		
z (mm)	126			152		
MR (Klm)	60			75		
	OK			OK		
Calculation of Transverse Steel as per Clause 16.6.1.1						
$A_{ot,min} = 20\%$ of main reinforcement	84.1			148.8		
Dis of bar (Horizontal Bar) (mm)	10			10		
Spacing (mm)	200			200		
Area of distribution bar (mm ²)	392.7			392.7		
	OK			OK		

Shear on the section		Bottom End support	
Actual shear V_{Ed} (KN)	103.7		
Actual shear stress (N/mm ²)	0.800		
Max shear capacity, $0.135 f_{ck}(1-f_{ck}/310)$	3.7		
	OK.		
Min shear capacity, $0.0924 f_{ck}(1-f_{ck}/310)$	2.5		
$\Theta = 0.5 \times \sin^{-1}$ (Applied shear stress / $0.135/f_{ck}/(1-f_{ck}/310)$)			
Min angle of inclination, Θ (deg)	21.8		
cl. 10.3.2(2) Eq. 10.2 of IRC :112-2010			
$K = 1 + \sqrt{200/d} \leq 2.0$	2.000		
cl. 10.3.2(2) Eq. 10.3 of IRC :112-2010			
$n_{min} = 0.031 K^{3/2} f_{ck}^{1/2}$	0.480		
cl. 10.3.1 of IRC :112-2011			
$r_1 = A_s/(b_w d) \leq 0.02$	0.008		
	OK		
$0.12 K (80 r_1 f_{ck})^{0.33}$	0.625		
Axial compressive force N_{Ed} (KN)	0		
$s_{cp} = N_{Ed} / A_c \leq 0.2 f_{cd}$	0.0		
cl. 10.3.2(2) Eq. 10.1 of IRC :112-2010			
$V_{Rd,c} = [0.12K(80\rho_1 f_{ck})^{0.33} + 0.15\sigma_{cp}]b_w d \leq (n_{min} + 0.15 s_{cp}) b_w d$ (KN)	90.0		
Provide Shear Reinf.			
Min shear stress	0.625		
cl. 10.3.2(5) Eq. 10.6 of IRC :112-2010			
$n = 0.6 (1 - f_{ck} / 310)$	0.542		
cl. 10.3.2(5) Eq. 10.5 of IRC :112-2011			
$0.5 b_w d n f_{cd}$	523		
	OK		
Min shear force for providing reinf., V_E (N)	22699.6		
No. of link for shear reinf.	4		
Dia. of bar for shear reinf.	8		
$S = A_{sw} \times 0.9 \times d \times \cot \Theta \times f_y / V_E$	1248		
S (mm)	25		
A_{sw}	201		
cl. 16.5.2(7) Eq. 16.6 of IRC :112-2011			
$S_{l,max} = 0.75 d$	108		
Spacing Required in Long. Direction (mm)	108.0		
Spacing provided in Long. Direction (mm)	100		
	OK		
cl. 16.5.2(9) Eq. 16.8 of IRC :112-2011			
$S_{l,max} = 0.75 d \leq 600\text{mm}$	108		
Spacing provided in Trans. Direction, S_t mm	100		

	OK		
z (mm)	126		
f_{ywd}	400		
cl. 10.3.3.3 Eq. 10.17 of IRC :112-2010			
$V_{Ed} \leq A_{SW} f_{ywd}$ (KN)	80		
cl. 10.3.3.3 (6) of IRC :112-2010			
$M_{Ed} / z + 0.5 V_{Ed}$ (KN)	215		
$M_{Ed\ max} / z$ (KN)	474		
	OK		
cl. 10.3.3.2 Eq. 10.7 of IRC :112-2011			
$V_{Rd,s} = A_{SW} z f_{ywd} / S$ (KN)	405		
	OK		
$a_{cw} = (s_{cp} = N_{Ed} / A_c = 0)$	1.0		
n_1	0.6		
cl. 10.3.3.2 Eq. 10.8 of IRC :112-2011			
$V_{Rd,max} = a_{cw} b_w z n_1 f_{cd}$ (KN)	1012		
	OK		
cl. 10.3.3.2 Eq. 10.10 of IRC :112-2011			
$A_{SW,max} \leq 0.5 a_{cw} n_1 f_{cd} b_w S / f_{ywd}$	251		
	OK		
cl. 10.3.1 of IRC :112-2011			
$r_w = A_{SW} / (S b_w \sin \alpha)$	0.0080		
cl. 10.3.3.5 of IRC :112-2011			
$r_{w,min} = (0.072 f_{ck}^{0.5}) / f_{yk}$	0.0008		
	OK		

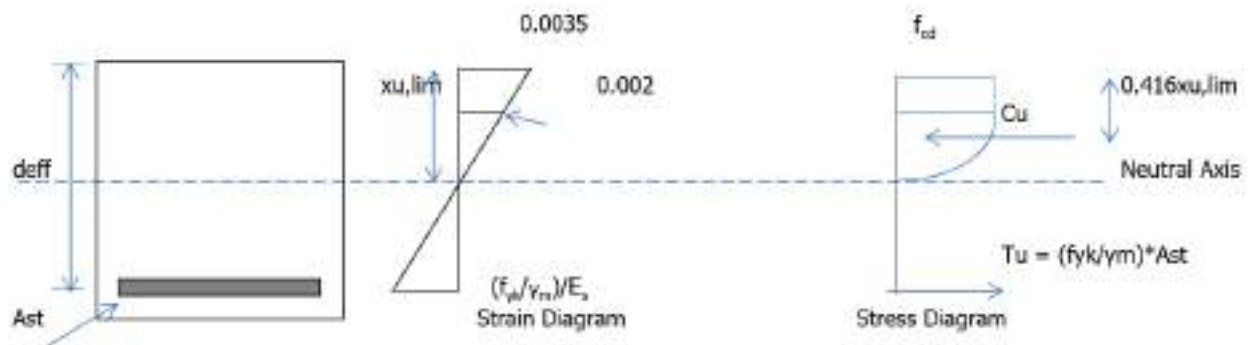
2.1.15. Verification for serviceability limit state for bottom slab

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 12.2.1, IRC:112-2011	f_{cd}	=	14.40	N/mm ²	For Rare Combination
	f_{cd}	=	14.40	N/mm ²	For Frequent Combination
	f_{cd}	=	10.80	N/mm ²	For Quasi-Perma. Combination
As per clause 12.2.2, IRC:112-2011					
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	400	N/mm ²	For Rare Combination
	f_{yd}	=	400	N/mm ²	For Frequent Combination
	f_{yd}	=	400	N/mm ²	For Quasi-Perma. Combination
Refer Fig. 6.2 of IRC:112-2011					
For steel reinforcement, simplified bilinear diagram is used					
Minimum strain in steel reinforcement		=	0.87 f_y / E_s		
	E_s	=	2.0E+05 MPa		$E_c = 31000$ MPa
C_u	=	$f_{cd} \cdot b \cdot (3/7 x_{u,lim} + 2/3 \cdot 4/7 x_{u,lim})$			
	=	$17/21 \cdot f_{cd} \cdot b \cdot x_u$			Refer Chapter 5 of Reinforced Concrete
	=	$0.8095 \cdot f_{cd} \cdot b \cdot x_u$			Limit State Design by Ashok K. Jain
cg of compression block from top		=	0.416 x_u		
T_u	=	$f_{yd} \cdot A_{st}$			
$R_{sb} = M_{u,sb} / b d^2$	=	$0.8095 \cdot f_{cd} \cdot (x_u/d) \cdot (1 - 0.416 \cdot x_u/d)$			
	Rare Comb	Frequent Comb	Quasi-Perma. Comb		
$x_{u,sb}/d$	0.47	0.47	0.47		
$R_{sb} = M_{u,sb} / b d^2$	4.38	4.38	3.29		Here R_{sb} is in MPa
Calculation of Reinforcement					
Width of section b	=	1000 mm			
Depth of section d	=	225 mm			
Clear cover	=	75 mm	Clear cover at top	=	40

Moment on the section	Bottom End support		Top Mid Span			
	For Rare Combination		For Quasi-Perma. Combination	For Rare Combination		For Quasi-Perma. Combination
Actual moment (KNm)	23.4		18.1	44.211		22.804
b	1000		1000	1000		1000
D	225		225	225		225
c	75		75	40		40
d	136.0		136.0	171.0		171.0
f_{cd}	14.40		10.80	14.40		10.80
f_{yd}	400		400	400		400
$x_{u,sls}/d$	0.47		0.47	0.47		0.47
$R_{ds} = M_{u,sls}/bd^2$	4.38		3.29	4.38		3.29
$M_{u,sls}$ (KNm)	81		61	128		96
	OK		OK	OK		OK
Asl Req.	451		349	686		344
Dia of bar (main tension) (mm)	12		12	12		12
Spacing (mm)	200		200	100		100
+ dia of bar (main tension) (mm)	10		10	0		0
Spacing (mm)	150		150	200		200
Asl provided (sq mm)	1089		1089	1131		1131
Dia of bar (main compression) (mm)	0		0	10		10
Spacing (mm)	200		200	150		150
Area of main compression (mm ²)	0		0	524		524
f_{cm}	2.5		2.5	2.5		2.5
x (mm)	37.4		49.8	38.8		51.7
x/d	0.275		0.366	0.227		0.303
	OK		OK	OK		OK
z (mm)	120		115	155		149
MR_{ds} (KNm)	52		50	70		68
	OK		OK	OK		OK
$s_{sls} = M/(A_s z)$	178		144	252		134
	OK		OK	OK		OK
$s_{sls} = M/(0.8095 z b x_{u,sls})$	6.42		3.89	9.09		3.61
	OK		OK	OK		OK

Calculation of crack width	Bottom End support			Top Mid Span		
n_1			5			10
n_2			7			5
$f_{eq} = \{ n_1 f_1^2 + n_2 f_2^2 \} / (n_1 f_1 + n_2 f_2)$			11			12
cl. 12.3.4 (3) of IRC :112-2011						
c			75			40
k_1			0.8			0.8
k_2			0.50			0.50
For skew slab refer						
$r_{p,eff} = A_s / A_{c,eff}$			0.010			0.010
$S_{r,max} = \{ 3.4 c + (0.425 k_1 k_2 f) / r_{p,eff} \}$			447			339
cl. 12.3.4 (3) of IRC :112-2011						
k_3			0.5			0.5
$f_{cl,eff}$			2.90			2.90
E_s			200000			200000
E_{cr}			31000			31000
$a_s = E_s / E_{cr}$			6.45			6.45
$(e_{syn} - e_{cr}) = (s_{sy} - k_3 f_{cl,eff} (1 + a_s r_{p,eff}) / r_{p,eff}) / E_s$ $\geq 0.6 s_{sy} / E_s$			0.0004			0.0004
cl. 12.3.4 (2) of IRC :112-2011						
$W_k = S_{r,max} (e_{syn} - e_{cr})$			0.19			0.14
cl. 12.3.4 (1) of IRC :112-2011						
			OK			OK

2.1.16. Verification of structural strength for outer wall



ULTIMATE LIMIT STATE

Grade of Concrete
As per clause 6.4.2.8, IRC:112-2011

$$f_{ck} = 30 \text{ N/mm}^2$$

$$f_{cd} = 13.40 \text{ N/mm}^2$$

$$f_{ct} = 16.75 \text{ N/mm}^2$$

$$f_{ot} = 13.40 \text{ N/mm}^2$$

$$E_c = 31000 \text{ MPa}$$

Grade of steel

$$f_y = 500 \text{ N/mm}^2$$

$$f_{yd} = 435 \text{ N/mm}^2$$

$$f_{vd} = 500 \text{ N/mm}^2$$

$$f_{vd} = 435 \text{ N/mm}^2$$

For Basic Combination

For Accidental Combination

For Seismic Combination

For Basic Combination

For Accidental Combination

For Seismic Combination

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

$$\text{Minimum strain in steel reinforcement} = 0.87 f_y / E_s$$

$$E_s = 2.0 \times 10^5 \text{ MPa}$$

$$E_c = 31000 \text{ MPa}$$

$$C_u = f_{cd} * b * (3/7 * x_{u,lim} + 2/3 * 4/7 * x_{u,lim})$$

$$= 17/21 * f_{cd} * b * x_u$$

$$= 0.8095 * f_{cd} * b * x_u$$

$$\text{cg of compression block from top} = 0.416 x_u$$

$$T_u = f_{yd} * A_{st}$$

$$R_{lim} = M_{u,lim} / b d^2 = 0.8095 f_{cd} * (x_{u,lim} / d) * (1 - 0.416 * x_{u,lim} / d)$$

	Basic Comb	Accidental Comb	Seismic Comb
$x_{u,lim} / d$	0.46	0.44	0.46
$R_{lim} = M_{u,lim} / b d^2$	4.01	4.85	4.01

Here R_{lim} is in MPa

Calculation of Reinforcement

$$\text{Width of section } b = 1000 \text{ mm}$$

$$\text{Depth of section } D = 200 \text{ mm}$$

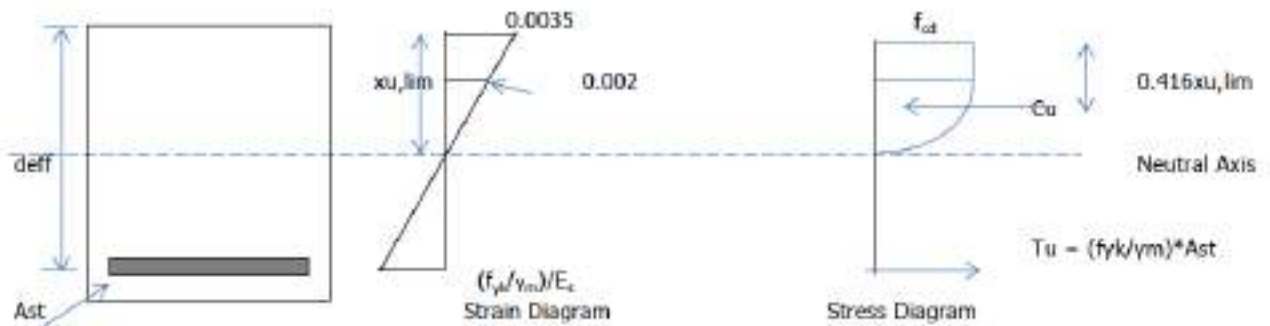
$$\text{Clear cover at Earther} = 75$$

$$\text{Clear cover at open side} = 50$$

Moment on the section	Bottom End support			Top End support		
	Basic			Basic	Comb	Mid Span
Actual moment (KNm)	25.2			25.2		5.8
b	1000			1000		1000
D	200			200		200
c	75			75		50
d	109.0			110.0		145.0
f_{at}	13.40			13.40		13.40
f_{yd}	435			435		435
xu_{lim}/d	0.46			0.46		0.46
$R_{sbc} = M_{u,lim}/bd^2$	4.01			4.01		4.01
$M_{u,lim}$ (KNm)	48			49		84
	OK			OK		OK
Ast Req.	583			577		92
Dia of bar (main tension) (mm)	10			10		10
Spacing (mm)	150			150		150
+ dia of bar (main tension) (mm)	12			10		0
Spacing (mm)	200			150		150
Ast provided (sq mm)	1089			1047		524
% Steel	1.00			0.96		0.36
Dia of bar (main compression) (mm)	10			12		10
Spacing (mm)	150			200		150
Area of main compression (mm ²)	524			565		524
f_{dm}	2.5			2.5		2.5
f_{yk}	500			500		500
cl. 16.6.1 (2) of IRC :112-2011						
$A_{smin} = 0.26 f_{dm} b_t d / f_{yk} > = 0.0013 b_t d$	142			143		189
A_{ct}	156347			158026		179013
$f_{ct,eff}$	2.9			2.9		2.9
$k_c = 0.4 \{ 1 - \sigma_c / (k_1 f_{ct,eff} h/h^*) \} < = 1$	0.4			0.4		0.4
For Bending or bending combined with axial force						
k	1.0000			1.0000		1.0000
σ_s	500			500		500
cl. 12.3.6 (4) of IRC :112-2011						
$A_{smin} = k_c k f_{ct,eff} A_{ct} / \sigma_s$	363			367		415
	OK			OK		OK
$A_{s,max} = 0.025 A_c$ (main tension)	5000			5000		5000
cl. 16.5.1.1 (2) of IRC :112-2011	OK			OK		OK
$A_{s,max} = 0.04 A_c$ (tension + compression)	8000			8000		8000
x (mm)	44			42		21
x/d	0.400			0.382		0.145
	OK			OK		OK
z (mm)	91			93		136
MR (KNm)	43			42		31
	OK			OK		OK
Calculation of Transverse Steel as per Clause 16.3.1						
$A_{ST min} = 25\%$ of main reinforcement in each side or 0.001Ac in each side whichever greater	145.8			144.2		103.8
Dia of bar (Horizontal Bar) (mm)	10	OK		10	OK	10
Spacing (mm)	200			200		200
Area of distribution bar (mm ²)	392.7			392.7		392.7
	OK			OK		OK

Shear on the section	Bottom End support
Actual shear V_{Fd} (KN)	47.5
Actual shear stress (N/mm ²)	0.484
Max shear capacity, $0.135 f_{ck}(1-f_{ck}/310)$	3.7
	OK.
Min shear capacity, $0.0924 f_{ck}(1-f_{ck}/310)$	2.5
$\theta = 0.5 \times \sin^{-1} (\text{Applied shear stress} / 0.135/f_{ck}/(1-f_{ck}/310))$	
Min angle of inclination, θ (deg)	21.8
cl. 10.3.2(2) Eq. 10.2 of IRC :112-2010	
$K = 1 + \sqrt{200/d} \leq 2.0$	2.000
cl. 10.3.2(2) Eq. 10.3 of IRC :112-2010	
$v_{min} = 0.031 K^{3/2} f_{ck}^{1/2}$	0.480
cl. 10.3.1 of IRC :112-2011	
$\rho_1 = A_{sl}/(b_w d) \leq 0.02$	0.010
	OK
$0.12 K (80 \rho_1 f_{ck})^{0.33}$	0.685
Axial compressive force N_{Fd} (KN)	0
$\sigma_{cp} = N_{Fd} / A_c \leq 0.2 f_{cd}$	0.0
cl. 10.3.2(2) Eq. 10.1 of IRC :112-2010	
$V_{Rd,c} = [0.12K(80\rho_1 f_{ck})^{0.33} + 0.15\sigma_{cp}] b_w d \leq (v_{min} + 0.15 \sigma_{cp}) b_w d$ (KN)	75
hence, no reqd to provide reinforcement	

2.1.17. Verification for serviceability limit state for Outer Wall



SERVICEABILITY LIMIT STATE

Grade of Concrete
As per clause 12.2.1, IRC:112-2011

$$f_{ck} = 30 \text{ N/mm}^2$$

$$f_{cd} = 14.40 \text{ N/mm}^2$$

$$f_{rd} = 14.40 \text{ N/mm}^2$$

$$f_{cd} = 10.80 \text{ N/mm}^2$$

For Rare Combination

For Frequent Combination

For Quasi-Perma. Combination

As per clause 12.2.2, IRC:112-2011

Grade of steel

$$f_y = 500 \text{ N/mm}^2$$

$$f_{yd} = 400 \text{ N/mm}^2$$

$$f_{rd} = 400 \text{ N/mm}^2$$

$$f_{yd} = 400 \text{ N/mm}^2$$

For Rare Combination

For Frequent Combination

For Quasi-Perma. Combination

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

$$\text{Minimum strain in steel reinforcement} = 0.87 f_y / E_s$$

$$E_s = 2.0 \times 10^5 \text{ MPa}$$

$$E_c = 31000 \text{ MPa}$$

$$C_u = f_{cd} * b * (3/7 x_{u,lim} + 2/3 * 4/7 x_{u,lim})$$

$$= 17/21 * f_{cd} * b * x_u$$

$$= 0.8095 * f_{cd} * b * x_u$$

$$\text{cg of compression block from top} = 0.416 x_u$$

$$T_u = f_{yd} * A_{st}$$

Refer Chapter 5 of Reinforced Concrete Limit State Design by Ashok K. Jain

$$R_{sk} = M_{u,sk} / b d^2 = 0.8095 f_{cd} * (x_u/d) * (1 - 0.416 * x_u/d)$$

	Basic Comb	Accidental Comb	Seismic Comb
$x_{u,sk}/d$	0.47	0.47	0.47
$R_{sk} = M_{u,sk} / b d^2$	4.38	4.38	3.29

Here R_{sk} is in MPa

Calculation of Reinforcement

$$\text{Width of section } b = 1000 \text{ mm}$$

$$\text{Depth of section } d = 200 \text{ mm}$$

$$\text{Clear cover} = 75$$

Moment on the section	Bottom End support		Top End support		Mid SPAN	
	Rare Comb	Quasi-Perma. Comb	Rare Comb	Quasi-Perma. Comb	Rare Comb	Quasi-Perma. Comb
Actual moment (KNm)	20.8	12.5	20.776	12.537	11.7	1.2
b	1000	1000	1000	1000	1000	1000
D	200	200	200	200	200	200
c	75	75	75	75	75	75
d	109.0	109.0	110.0	110.0	110.0	110.0
f_{cd}	14.40	10.80	14.40	10.80	14.40	10.80
f_{re}	400	400	400	400	400	400
$x_u, sfs/d$	0.47	0.47	0.47	0.47	0.47	0.47
$R_{sk} = M_{ult}/bd^2$	4.38	3.29	4.38	3.29	4.38	3.29
M_{sk} (KNm)	52	39	53	40	53	40
	OK	OK	OK	OK	OK	OK
Ast Req.	511	304	505	301	276	28
Dia of bar (main tension) (mm)	10	10	10	10	10	10
Spacing (mm)	150	150	150	150	150	150
+ dia of bar (main tension) (mm)	12	12	10	10	0	0
Spacing (mm)	200	200	150	150	150	150
Ast provided (sq mm)	1089	1089	1047	1047	524	524
Dia of bar (main compression) (mm)	10	10	12	10	10	10
Spacing (mm)	150	150	200	150	150	150
Area of main compression (mm ²)	524	524	565	524	524	524
f_{ctm}	2.5	2.5	2.5	2.5	2.5	2.5
x (mm)	37.4	49.8	35.9	47.9	18.0	24.0
x/d	0.343	0.457	0.327	0.436	0.163	0.218
	OK	OK	OK	OK	OK	OK
z (mm)	93	88	95	90	103	100
MR_{sk} (KNm)	41	38	40	38	21	21
	OK	OK	OK	OK	OK	OK
$\sigma_{sc} = M/(A_s z)$	204	130	209	133	218	23
	OK	OK	OK	OK	OK	OK
$\sigma_{cs} = M/(0.8095 z b x_u)$	7.35	3.52	7.51	3.59	7.84	0.62
	OK	OK	OK	OK	OK	OK

Calculation of crack width	Bottom End support	Top End support	Span
n_1	7	7	7
n_2	5	7	7
$\phi_{eq} = \{ n_1 \phi_1^2 + n_2 \phi_2^2 \} / (n_1 \phi_1 + n_2 \phi_2)$	11	10	10
d. 12.3.4 (3) of IRC :112-2011			
c	75	75	75
k1	0.8	0.8	0.8
k2	0.50	0.50	0.50
For skew slab refer eq. 12.10 of IRC :112-2011			
$\rho_{p,eff} = A_s / A_{c,eff}$	0.011	0.010	0.005
$S_{r,max} = \{ 3.4 c + \{ 0.425 k_1 k_2 \phi \} / \rho_{p,eff} \}$	426	417	580
d. 12.3.4 (3) of IRC :112-2011			
k_1	0.5	0.5	0.5
$f_{ct,eff}$	2.90	2.90	2.90
E_s	200000	200000	200000
E_{cm}	31000	31000	31000
$\alpha_s = E_s / E_{cm}$	6.45	6.45	6.45
$(\epsilon_{sm} - \epsilon_{cm}) = (\sigma_{sc} - k_1 f_{ct,eff} (1 + \alpha_s \rho_{p,eff})) / \rho_{p,eff} / E_s$ $> = 0.6 \sigma_{sc} / E_s$	0.0004	0.0004	0.0001
d. 12.3.4 (2) of IRC :112-2011			
$W_k = S_{r,max} (\epsilon_{sm} - \epsilon_{cm})$	0.17	0.17	0.04
d. 12.3.4 (1) of IRC :112-2011			
	OK	OK	OK

ANNEXTURES

ANNEXURE

MSA CALCULATIONS

Carriageway			Mand atory Input →	Enter the Input Load Unit (either Kg or T)		kg	Mandatory Input →	Enter Whether Input Load is for Wheel or Axle (W or A)				w	Individual Axle Load (KN)						Gross Vehicle Weight GVW (KN)	Equivalency Factor (EF) or VDF							
Chainage		Mand atory Input	Origin	Destination	Mandat ory Input↓ Axle Config. (See Note above)	Commod ity Type	Individual Wheel Load (kg)																				
Sl. No.	Direction	Vehicle Type					1 st Wheel Load	2 nd Wheel Load	3 rd Wheel Load	4 th Wheel Load	5 th Wheel Load	6 th Wheel Load	1 st Axle Load (KN)	2 nd Axle Load (KN)	3 rd Axle Load (KN)	4 th Axle Load (KN)	5 th Axle Load (KN)	6 th Axle Load (KN)		Steering Single Axle	2 nd	3 rd	4 th	5 th	6 th	Total EF per Vehicle	
1	LHS	3AT	Kandla	Rajasthan	1.22	CORN	1900	8090	8120	0	0	0	37.3	158.7	159.3	0.0	0.0	0.0	355.3	0.108	-	21.32				21.43	
2	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2300	2230	2200	1760	2080	0	45.1	43.8	43.2	34.5	40.8	0.0	207.4	0.232	0.089	-	-	0.08		0.40	
3	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2100	2150	2130	0	0	0	41.2	42.2	41.8	0.0	0.0	0.0	125.2	0.161	-	0.10				0.26	
4	LHS	MAV	Kandla	Shantilaal	1.1.22	EMPTY	2400	1700	1800	2200	0	0	47.1	33.4	35.3	43.2	0.0	0.0	158.9	0.275	0.069	-	0.08			0.42	
5	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1830	1920	1995	1430	0	0	35.9	37.7	39.1	28.1	0.0	0.0	140.8	0.093	0.049	-	0.04			0.18	
6	LHS	MAV	Kandla	Anjaar	1.2.222	CAR	2830	2470	4020	3710	4255	0	55.5	48.5	78.9	72.8	83.5	0.0	339.1	0.532	0.135	-	-	1.21		1.88	
7	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	4870	5660	7800	8240	0	0	95.5	111.0	153.0	161.7	0.0	0.0	521.3	4.669	8.519	-	20.44			33.63	
8	LHS	3AT	Kandla	Shantilaal	1.22	SALT	3000	7850	8050	0	0	0	58.9	154.0	157.9	0.0	0.0	0.0	370.8	0.672	-	19.74				20.41	
9	LHS	MAV	Kandla	Pune	1.2.22	RICE	2050	5705	7800	7700	0	0	40.2	111.9	153.0	151.1	0.0	0.0	456.3	0.147	3.832	-	17.83			21.81	
10	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1710	2210	2470	0	0	0	33.6	43.4	48.5	0.0	0.0	0.0	125.4	0.071	-	0.15				0.22	
11	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1900	2000	2200	0	0	0	37.3	39.2	43.2	0.0	0.0	0.0	119.7	0.108	-	0.10				0.20	
12	LHS	MAV	Kandla	RuchSoya Comp.	1.22.222	CLOTHES	2130	1960	3420	5400	5045	5525	41.8	38.5	67.1	105.9	99.0	108.4	460.7	0.171	-	0.26	-	-	3.83	4.26	
13	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2610	4890	5950	6350	0	0	51.2	95.9	116.7	124.6	0.0	0.0	388.5	0.385	2.069	-	7.07			9.52	
14	LHS	MAV	Kandla	Mundra	1.2.22	GAS	3200	3250	4700	6700	0	0	62.8	63.8	92.2	131.5	0.0	0.0	350.2	0.870	0.404	-	5.22			6.49	
15	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1870	2250	2190	0	0	0	36.7	44.1	43.0	0.0	0.0	0.0	123.8	0.102	-	0.12				0.22	
16	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1870	1920	2140	0	0	0	36.7	37.7	42.0	0.0	0.0	0.0	116.3	0.102	-	0.08				0.19	
17	LHS	MAV	Kandla	Rajasthan	1.2.22	EMPTY	1730	1580	2395	2000	0	0	33.9	31.0	47.0	39.2	0.0	0.0	151.2	0.074	0.023	-	0.12			0.21	
18	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2145	4805	5550	5420	0	0	42.1	94.3	108.9	106.3	0.0	0.0	351.6	0.176	1.928	-	4.47			6.58	
19	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2110	1940	0	1880	1720	0	41.4	38.1	0.0	36.9	33.7	0.0	150.1	0.165	0.051	-	-	0.01		0.23	
20	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	2515	7310	0	5630	4820	0	49.3	143.4	0.0	110.5	94.6	0.0	397.8	0.332	#####	-	-	0.70		11.36	
21	LHS	MAV	Kandla	Shantilaal	1.1.22	SALT	2640	7030	6470	6040	0	0	51.8	137.9	126.9	118.5	0.0	0.0	435.2	0.403	#####	-	7.56			28.24	
22	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1820	1435	1840	1345	0	0	35.7	28.2	36.1	26.4	0.0	0.0	126.4	0.091	0.015	-	0.03			0.14	
23	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2760	2250	2505	0	0	0	54.2	44.1	49.1	0.0	0.0	0.0	147.4	0.482	-	0.16				0.64	
24	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2480	6670	6090	5860	0	0	48.7	130.9	119.5	115.0	0.0	0.0	414.0	0.314	7.160	-	6.30			13.77	
25	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1710	1610	0	1710	1640	0	33.6	31.6	0.0	33.6	32.2	0.0	130.9	0.071	0.024	-	-	0.01		0.10	
26	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1900	2000	1900	0	0	0	37.3	39.2	37.3	0.0	0.0	0.0	113.8	0.108	-	0.07				0.18	
27	LHS	MAV	Kandla	Gandhidham	1.1.22	Petroleum	2800	4400	5500	6700	0	0	54.9	86.3	107.9	131.5	0.0	0.0	380.6	0.510	3.111	-	6.84			10.46	
28	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2250	4550	5770	4090	0	0	44.1	89.3	113.2	80.2	0.0	0.0	326.9	0.213	1.551	-	2.92			4.68	
29	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	3265	4710	5825	5440	0	0	64.1	92.4	114.3	106.7	0.0	0.0	377.5	0.943	1.780	-	4.97			7.70	
30	LHS	MAV	Kandla	Shantilaal	1.2.22	Petroleum	2450	6800	6700	6400	0	0	48.1	133.4	131.5	125.6	0.0	0.0	438.5	0.299	7.735	-	9.10			17.13	
31	LHS	MAV	Kandla	Shantilaal	1.22.22	EMPTY	2960	3140	3260	3870	3910	0	58.1	61.6	64.0	75.9	76.7	0.0	336.3	0.637	-	0.52	-	1.13		2.29	
32	LHS	MAV	Kandla	Shantilaal	1.2.22	CHEMICAL	3105	5505	5900	7800	0	0	60.9	108.0	115.8	153.0	0.0	0.0	437.7	0.772	3.323	-	10.88			14.97	

33	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1770	2315	2020	1790	1830	0	34.7	45.4	39.6	35.1	35.9	0.0	190.8	0.081	0.104	-	-	0.06		0.24
34	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	2120	1980	2030	2170	0	0	41.6	38.8	39.8	42.6	0.0	0.0	162.8	0.168	0.056	-	0.10			0.32
35	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1950	2170	2050	0	0	0	38.3	42.6	40.2	0.0	0.0	0.0	121.1	0.120	-	0.10				0.22
36	LHS	MAV	Kandla	Shantilaal	1.22.222	EMPTY	2410	2040	1870	0	1925	1830	47.3	40.0	36.7	0.0	37.8	35.9	197.7	0.280	-	0.07	-	-	0.01	0.36
37	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2130	1910	2050	2190	0	0	41.8	37.5	40.2	43.0	0.0	0.0	162.5	0.171	0.048	-	0.10			0.32
38	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1800	1950	1900	0	0	0	35.3	38.3	37.3	0.0	0.0	0.0	110.9	0.087	-	0.07				0.15
39	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	1935	5610	0	6330	6135	0	38.0	110.1	0.0	124.2	120.4	0.0	392.6	0.116	3.583	-	-	1.42		5.12
40	LHS	MAV	Kandla	Anjaar	1.1.22	TILES	3550	0	4130	4260	0	0	69.7	0.0	81.0	83.6	0.0	0.0	234.3	1.318	0.000	-	1.53			2.85
41	LHS	MAV	Kandla	Shantilaal	1.22.222	EMPTY	2110	1980	1760	0	1810	1740	41.4	38.8	34.5	0.0	35.5	34.1	184.4	0.165	-	0.06	-	-	0.01	0.23
42	LHS	3AT	Kandla	Mithi	1.22	EMPTY	2200	2400	2450	0	0	0	43.2	47.1	48.1	0.0	0.0	0.0	138.3	0.194	-	0.17				0.36
43	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	1965	5650	5965	5810	0	0	38.6	110.9	117.0	114.0	0.0	0.0	380.4	0.124	3.687	-	5.94			9.75
44	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1820	1660	1910	1510	0	0	35.7	32.6	37.5	29.6	0.0	0.0	135.4	0.091	0.027	-	0.04			0.16
45	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	3610	0	5970	6010	0	0	70.8	0.0	117.1	117.9	0.0	0.0	305.9	1.410	0.000	-	6.36			7.77
46	LHS	MAV	Kandla	Shantilaal	1.2.222	CLOTHES	3310	6510	0	4115	4630	0	64.9	127.7	0.0	80.7	90.8	0.0	364.2	0.996	6.498	-	-	0.34		7.84
47	LHS	MAV	Kandla	Mithi	1.22.222	CLOTHES	2560	3970	3770	5830	5070	4830	50.2	77.9	74.0	114.4	99.5	94.8	510.7	0.357	-	1.11	-	-	3.60	5.07
48	LHS	MAV	Kandla	Shantilaal	1.22.22	EMPTY	2210	1930	1870	1605	1575	0	43.4	37.9	36.7	31.5	30.9	0.0	180.3	0.198	-	0.06	-	0.03		0.29
49	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1850	2270	2100	0	0	0	36.3	44.5	41.2	0.0	0.0	0.0	122.0	0.097	-	0.11				0.21
50	LHS	MAV	Kandla	RuchSoya Comp.	1.22.22	Petroleum	2760	3640	6700	7200	9600	0	54.2	71.4	131.5	141.3	188.4	0.0	586.6	0.482	-	3.53	-	24.60		28.62
51	LHS	MAV	Kandla	Shantilaal	1.22.222	CLOTHES	2330	3290	3380	5340	5005	4610	45.7	64.5	66.3	104.8	98.2	90.4	470.0	0.245	-	0.61	-	-	2.94	3.80
52	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1900	1950	2200	0	0	0	37.3	38.3	43.2	0.0	0.0	0.0	118.7	0.108	-	0.09				0.20
53	LHS	MAV	Kandla	Ahmedab	1.1.22	CORN	2100	6705	6500	7800	0	0	41.2	131.6	127.5	153.0	0.0	0.0	453.3	0.161	#####	-	12.91			29.85
54	LHS	MAV	Kandla	Shantilaal	1.1.22	TILES	3390	0	4640	5100	0	0	66.5	0.0	91.0	100.1	0.0	0.0	257.6	1.096	0.000	-	2.78			3.88
55	LHS	MAV	Kandla	Mithi	1.22.22	GAS	3300	6700	6900	7700	8800	0	64.7	131.5	135.4	151.1	172.7	0.0	655.3	0.984	-	10.57	-	22.89		34.44
56	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1850	1910	2170	0	0	0	36.3	37.5	42.6	0.0	0.0	0.0	116.3	0.097	-	0.09				0.18
57	LHS	MAV	Kandla	Anjaar	1.2.222	POWDER	3240	4560	4850	5970	5330	0	63.6	89.5	95.2	117.1	104.6	0.0	469.9	0.915	1.564	-	-	4.00		6.48
58	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1980	2240	2700	0	0	0	38.8	43.9	53.0	0.0	0.0	0.0	135.8	0.128	-	0.18				0.31
59	LHS	MAV	Kandla	Ahmedab	1.22.222	POWDER	2670	4370	4130	0	6205	6270	52.4	85.7	81.0	0.0	121.7	123.0	463.9	0.422	-	1.61	-	-	1.43	3.46
60	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2150	1960	2180	2540	0	0	42.2	38.5	42.8	49.8	0.0	0.0	173.2	0.177	0.053	-	0.15			0.38
61	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1670	1925	1775	1950	0	0	32.8	37.8	34.8	38.3	0.0	0.0	143.6	0.065	0.050	-	0.06			0.17
62	LHS	MAV	Kandla	GT Rd	1.2.22	Petroleum	3200	6700	6800	7200	0	0	62.8	131.5	133.4	141.3	0.0	0.0	468.9	0.870	7.290	-	11.86			20.02
63	LHS	MAV	Kandla	Mithi	1.22.22	Petroleum	2405	4870	5900	6700	6800	0	47.2	95.5	115.8	131.5	133.4	0.0	523.4	0.278	-	4.16	-	10.26		14.69
64	LHS	MAV	Kandla	Shantilaal	1.2.22	WOOD	2350	3270	6070	7200	0	0	46.1	64.2	119.1	141.3	0.0	0.0	370.6	0.253	0.414	-	9.58			10.24
65	LHS	MAV	Kandla	Mundra	1.2.22	SALT	2580	5490	6290	4200	0	0	50.6	107.7	123.4	82.4	0.0	0.0	364.1	0.368	3.286	-	3.74			7.39
66	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1785	1825	0	2175	1970	0	35.0	35.8	0.0	42.7	38.7	0.0	152.2	0.084	0.040	-	-	0.02		0.14
67	LHS	MAV	Kandla	Shantilaal	1.1.22	EMPTY	1750	0	1860	1840	0	0	34.3	0.0	36.5	36.1	0.0	0.0	106.9	0.078	0.000	-	0.06			0.14
68	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1870	1950	2140	0	0	0	36.7	38.3	42.0	0.0	0.0	0.0	116.9	0.102	-	0.09				0.19
69	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1820	1430	1840	1340	0	0	35.7	28.1	36.1	26.3	0.0	0.0	126.2	0.091	0.015	-	0.03			0.14
70	LHS	MAV	Kandla	Mundra	1.2.22	GAS	2760	5500	6700	7800	0	0	54.2	107.9	131.5	153.0	0.0	0.0	446.6	0.482	3.310	-	13.65			17.45
71	LHS	MAV	Kandla	Anjaar	1.2.222	TILES	1980	4550	0	4670	4925	0	38.8	89.3	0.0	91.6	96.6	0.0	316.4	0.128	1.551	-	-	0.50		2.18
72	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	1560	1800	6750	5900	0	0	30.6	35.3	132.4	115.8	0.0	0.0	314.1	0.049	0.038	-	7.91			8.00
73	LHS	MAV	Kandla	Anjaar	1.2.222	SALT	2080	3050	2930	3210	3560	0	40.8	59.8	57.5	63.0	69.8	0.0	291.0	0.155	0.313	-	-	0.52		0.99
74	LHS	MAV	Kandla	GT Rd	1.2.22	D.O.C	3460	4935	6670	5830	0	0	67.9	96.8	130.9	114.4	0.0	0.0	410.0	1.190	2.146	-	7.54			10.88
75	LHS	MAV	Kandla	Gandhida am	1.2.22	TILES	1980	5025	5135	5025	0	0	38.8	98.6	100.7	98.6	0.0	0.0	336.8	0.128	2.307	-	3.29			5.73
76	LHS	MAV	Kandla	Mundra	1.22.2.22	RICE	2830	4690	5130	5230	7655	7835	55.5	92.0	100.7	102.6	150.2	153.7	654.7	0.532	-	2.87	2.71	-	17.78	23.89
77	LHS	MAV	Kandla	Shantilaal	1.22.22	GCB	2200	8800	8850	7700	9070	0	43.2	172.7	173.6	151.1	178.0	0.0	718.5	0.194	-	29.97	-	24.43		54.59

78	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	2785	3875	5640	5700	0	0	54.6	76.0	110.7	111.8	0.0	0.0	353.2	0.499	0.816	-	5.11			6.42
79	LHS	3AT	Kandla	Gandhidham	1.22	EMPTY	2050	2270	2370	0	0	0	40.2	44.5	46.5	0.0	0.0	0.0	131.3	0.147	-	0.14				0.29
80	LHS	MAV	Kandla	Mundra	1.2.22	GAS	2970	3100	4750	4200	0	0	58.3	60.8	93.2	82.4	0.0	0.0	294.7	0.646	0.334	-	1.98			2.96
81	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1860	2240	2170	0	0	0	36.5	43.9	42.6	0.0	0.0	0.0	123.0	0.099	-	0.12				0.22
82	LHS	MAV	Kandla	Shantilaal	1.1.22	CLOTHES	2575	0	3058	3870	0	0	50.5	0.0	60.0	75.9	0.0	0.0	186.4	0.365	0.000	-	0.71			1.08
83	LHS	MAV	Kandla	IOCL	1.1.22	TILES	2150	4670	5615	5260	0	0	42.2	91.6	110.2	103.2	0.0	0.0	347.2	0.177	3.948	-	4.32			8.45
84	LHS	MAV	Kandla	Shantilaal	1.2.222	Handcraft	2160	3200	0	3520	3710	0	42.4	62.8	0.0	69.1	72.8	0.0	247.0	0.181	0.379	-	-	0.16		0.72
85	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2010	1730	1635	1540	0	0	39.4	33.9	32.1	30.2	0.0	0.0	135.7	0.135	0.032	-	0.03			0.20
86	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1970	1670	2145	1980	0	0	38.7	32.8	42.1	38.8	0.0	0.0	152.3	0.125	0.028	-	0.09			0.24
87	LHS	MAV	Kandla	Haryana	1.2.222	EMPTY	2300	2080	0	1990	2540	0	45.1	40.8	0.0	39.0	49.8	0.0	174.8	0.232	0.068	-	-	0.02		0.32
88	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2230	2450	2300	0	0	0	43.8	48.1	45.1	0.0	0.0	0.0	136.9	0.205	-	0.16				0.36
89	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1250	2840	2530	2310	2680	0	24.5	55.7	49.6	45.3	52.6	0.0	227.8	0.020	0.235	-	-	0.19		0.44
90	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	2880	3810	5130	5630	0	0	56.5	74.8	100.7	110.5	0.0	0.0	342.4	0.571	1.749	-	4.14			6.46
91	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2550	7020	6720	5870	0	0	50.0	137.7	131.8	115.2	0.0	0.0	434.8	0.351	8.786	-	7.76			16.90
92	LHS	MAV	Kandla	Anjaar	1.2.22	GAS	3200	6700	6800	6905	0	0	62.8	131.5	133.4	135.5	0.0	0.0	463.1	0.870	7.290	-	10.90			19.06
93	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1760	2230	2450	0	0	0	34.5	43.8	48.1	0.0	0.0	0.0	126.4	0.080	-	0.15				0.23
94	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2380	5240	7290	6810	0	0	46.7	102.8	143.0	133.6	0.0	0.0	426.1	0.266	2.727	-	12.21			15.20
95	LHS	2AT	Kandla	Shantilaal	1.2	EMPTY	2200	2150	0	0	0	0	43.2	42.2	0.0	0.0	0.0	0.0	85.3	0.194	0.077	-				0.27
96	LHS	MAV	Kandla	Mundra	1.2.22	D.O.C	3460	4935	6670	5840	0	0	67.9	96.8	130.9	114.6	0.0	0.0	410.2	1.190	2.146	-	7.56			10.90
97	LHS	3AT	Kandla	Shantilaal	1.22	GAS	3260	5740	6700	0	0	0	64.0	112.6	131.5	0.0	0.0	0.0	308.0	0.938	-	7.40				8.33
98	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	2085	1210	1390	1460	0	0	40.9	23.7	27.3	28.6	0.0	0.0	120.6	0.157	0.008	-	0.02			0.19
99	LHS	MAV	Kandla	Shantilaal	1.1.22	TILES	2280	0	5310	5840	0	0	44.7	0.0	104.2	114.6	0.0	0.0	263.5	0.224	0.000	-	4.77			5.00
100	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2005	1900	2360	0	0	0	39.3	37.3	46.3	0.0	0.0	0.0	122.9	0.134	-	0.10				0.24
101	LHS	3AT	Kandla	Mithi	1.22	EMPTY	2270	3200	3100	0	0	0	44.5	62.8	60.8	0.0	0.0	0.0	168.1	0.220	-	0.49				0.71
102	LHS	MAV	Kandla	RuchSoya Comp.	1.2.222	RICE	2750	4730	5620	5840	5630	0	54.0	92.8	110.3	114.6	110.5	0.0	482.1	0.475	1.811	-	-	5.02		7.31
103	LHS	MAV	Kandla	Shantilaal	1.1.22	GAS	3505	4050	5760	7240	0	0	68.8	79.5	113.0	142.0	0.0	0.0	403.3	1.253	2.233	-	8.82			12.31
104	LHS	MAV	Kandla	Mithi	1.2.222	RICE	2970	6640	0	7110	6840	0	58.3	130.3	0.0	139.5	134.2	0.0	462.2	0.646	7.032	-	-	2.23		9.91
105	LHS	MAV	Kandla	Mithi	1.22.222	SALT	2140	2980	4300	4820	4635	5615	42.0	58.5	84.4	94.6	90.9	110.2	480.5	0.174	-	0.87	-	-	3.04	4.08
106	LHS	MAV	Kandla	Punjab	1.22.22	GAS	9200	6970	7200	7800	7900	0	180.5	136.8	141.3	153.0	155.0	0.0	766.6	59.469	-	12.45	-	18.76		90.69
107	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1710	1830	1610	1530	0	0	33.6	35.9	31.6	30.0	0.0	0.0	131.1	0.071	0.041	-	0.03			0.14
108	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2180	1960	2140	2310	0	0	42.8	38.5	42.0	45.3	0.0	0.0	168.5	0.187	0.053	-	0.12			0.36
109	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1750	1900	2105	0	0	0	34.3	37.3	41.3	0.0	0.0	0.0	112.9	0.078	-	0.08				0.16
110	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1550	1340	1530	1480	0	0	30.4	26.3	30.0	29.0	0.0	0.0	115.8	0.048	0.012	-	0.03			0.09
111	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2185	2560	2470	0	0	0	42.9	50.2	48.5	0.0	0.0	0.0	141.6	0.189	-	0.20				0.39
112	LHS	MAV	Kandla	Shantilaal	1.1.22	STONE	3205	2990	7070	7860	0	0	62.9	58.7	138.7	154.2	0.0	0.0	414.5	0.876	0.663	-	15.35			16.89
113	LHS	2AT	Kandla	Shantilaal	1.2	EMPTY	2300	2150	0	0	0	0	45.1	42.2	0.0	0.0	0.0	0.0	87.3	0.232	0.077	-				0.31
114	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2170	2400	2570	0	0	0	42.6	47.1	50.4	0.0	0.0	0.0	140.1	0.184	-	0.19				0.37
115	LHS	MAV	Kandla	Ahmedab	1.2.22	EMPTY	1820	1660	1910	1510	0	0	35.7	32.6	37.5	29.6	0.0	0.0	135.4	0.091	0.027	-	0.04			0.16
116	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	2485	6675	6130	5615	0	0	48.8	131.0	120.3	110.2	0.0	0.0	410.2	0.317	7.182	-	5.88			13.38
117	LHS	MAV	Kandla	Mundra	1.2.22	IRON	2600	2700	3900	4250	0	0	51.0	53.0	76.5	83.4	0.0	0.0	263.9	0.379	0.192	-	1.36			1.93
118	LHS	3AT	Kandla	Shantilaal	1.22	GAS	2705	4800	4805	0	0	0	53.1	94.2	94.3	0.0	0.0	0.0	241.5	0.444	-	2.63				3.07
119	LHS	MAV	Kandla	Punjab	1.22.22	RICE	3540	7610	7700	9000	7770	0	69.5	149.3	151.1	176.6	152.4	0.0	698.9	1.304	-	16.97	-	24.43		42.70
120	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1900	2300	2400	0	0	0	37.3	45.1	47.1	0.0	0.0	0.0	129.5	0.108	-	0.15				0.26
121	LHS	MAV	Kandla	GT Rd	1.2.222	TILES	2515	7310	0	5630	4820	0	49.3	143.4	0.0	110.5	94.6	0.0	397.8	0.332	#####	-	-	0.70		11.36
122	LHS	MAV	Kandla	Ahmedab	1.2.22	RICE	2160	4050	5750	7805	0	0	42.4	79.5	112.8	153.1	0.0	0.0	387.8	0.181	0.973	-	10.43			11.58

123	LHS	MAV	Kandla	Shantilaal	1.1.22	EMPTY	3160	3260	3310	3300	0	0	62.0	64.0	64.9	64.7	0.0	0.0	255.6	0.828	0.938	-	0.59			2.36
124	LHS	MAV	Kandla	Mundra	1.2.22	TILES	1910	4765	4710	4500	0	0	37.5	93.5	92.4	88.3	0.0	0.0	311.7	0.110	1.865	-	2.22			4.20
125	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	4045	4600	0	6140	5575	0	79.4	90.3	0.0	120.5	109.4	0.0	399.5	2.222	1.620	-	-	1.11		4.95
126	LHS	MAV	Kandla	Shantilaal	1.1.22	Furnitures	2155	1515	4890	3990	0	0	42.3	29.7	95.9	78.3	0.0	0.0	246.2	0.179	0.044	-	1.92			2.14
127	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2140	5240	5670	5280	0	0	42.0	102.8	111.2	103.6	0.0	0.0	359.6	0.174	2.727	-	4.44			7.34
128	LHS	2AT	Kandla	Shantilaal	1.2	EMPTY	1900	1700	0	0	0	0	37.3	33.4	0.0	0.0	0.0	0.0	70.6	0.108	0.030					0.14
129	LHS	MAV	Kandla	Gandhida am	1.1.22	TILES	2160	4775	5515	5460	0	0	42.4	93.7	108.2	107.1	0.0	0.0	351.4	0.181	4.316	-	4.48			8.98
130	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	3140	5610	6430	6045	0	0	61.6	110.1	126.2	118.6	0.0	0.0	416.4	0.807	3.583	-	7.48			11.87
131	LHS	MAV	Kandla	Badona	1.2.22	EMPTY	1270	2190	2550	2015	0	0	24.9	43.0	50.0	39.5	0.0	0.0	157.5	0.022	0.083	-	0.13			0.24
132	LHS	MAV	Kandla	Mithi	1.2.222	EMPTY	2530	2840	0	2080	2730	0	49.6	55.7	0.0	40.8	53.6	0.0	199.7	0.340	0.235	-	-	0.03		0.61
133	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1970	1940	1980	1510	0	0	38.7	38.1	38.8	29.6	0.0	0.0	145.2	0.125	0.051	-	0.05			0.22
134	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1760	2140	2210	0	0	0	34.5	42.0	43.4	0.0	0.0	0.0	119.9	0.080	-	0.11				0.19
135	LHS	MAV	Kandla	Shantilaal	1.2.22	Petroleum	2700	4005	4200	4800	0	0	53.0	78.6	82.4	94.2	0.0	0.0	308.1	0.441	0.931	-	2.03			3.40
136	LHS	MAV	Kandla	Mundra	1.2.22	EMPTY	3150	4800	4700	5550	0	0	61.8	94.2	92.2	108.9	0.0	0.0	357.1	0.817	1.920	-	3.41			6.15
137	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2120	2360	2210	0	0	0	41.6	46.3	43.4	0.0	0.0	0.0	131.3	0.168	-	0.13				0.30
138	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1840	1730	2045	1870	0	0	36.1	33.9	40.1	36.7	0.0	0.0	146.9	0.095	0.032	-	0.07			0.20
139	LHS	MAV	Kandla	Anjaar	1.1.22	EMPTY	3750	4205	7745	8050	0	0	73.6	82.5	152.0	157.9	0.0	0.0	466.0	1.642	2.595	-	19.22			23.46
140	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1970	2010	2170	0	0	0	38.7	39.4	42.6	0.0	0.0	0.0	120.7	0.125	-	0.09				0.22
141	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1850	1910	2140	0	0	0	36.3	37.5	42.0	0.0	0.0	0.0	115.8	0.097	-	0.08				0.18
142	LHS	MAV	Kandla	Shantilaal	1.2.22	COAL	3350	7850	9450	9400	0	0	65.7	154.0	185.4	184.4	0.0	0.0	589.6	1.045	#####	-	38.99			53.78
143	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	2340	5920	0	6045	6180	0	45.9	116.2	0.0	118.6	121.3	0.0	401.9	0.249	4.443	-	-	1.31		6.01
144	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	1430	1735	1430	1130	0	0	28.1	34.0	28.1	22.2	0.0	0.0	112.3	0.035	0.033	-	0.01			0.08
145	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	2185	1930	2090	2240	0	0	42.9	37.9	41.0	43.9	0.0	0.0	165.7	0.189	0.050	-	0.11			0.35
146	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	1510	1855	1730	1340	0	0	29.6	36.4	33.9	26.3	0.0	0.0	126.3	0.043	0.043	-	0.03			0.11
147	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1930	1880	1630	1690	0	0	37.9	36.9	32.0	33.2	0.0	0.0	139.9	0.115	0.045	-	0.04			0.20
148	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1900	2240	2310	0	0	0	37.3	43.9	45.3	0.0	0.0	0.0	126.5	0.108	-	0.13				0.24
149	LHS	MAV	Kandla	Shantilaal	1.2.222	Furnitures	2200	3275	0	3515	3640	0	43.2	64.3	0.0	69.0	71.4	0.0	247.8	0.194	0.416	-	-	0.15		0.76
150	LHS	3AT	Kandla	Rajasthan	1.22	EMPTY	2300	1700	1900	0	0	0	45.1	33.4	37.3	0.0	0.0	0.0	115.8	0.232	-	0.05				0.28
151	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1870	2260	2340	0	0	0	36.7	44.3	45.9	0.0	0.0	0.0	126.9	0.102	-	0.14				0.24
152	LHS	MAV	Kandla	Badona	1.2.22	ZEERA	2025	3440	7130	7270	0	0	39.7	67.5	139.9	142.6	0.0	0.0	389.8	0.140	0.507	-	13.28			13.93
153	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	2870	6700	6280	5600	0	0	56.3	131.5	123.2	109.9	0.0	0.0	420.8	0.563	7.290	-	6.15			14.01
154	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	3170	4470	6230	6430	0	0	62.2	87.7	122.2	126.2	0.0	0.0	398.3	0.838	3.314	-	7.93			12.09
155	LHS	MAV	Kandla	Shantilaal	1.2.22	PARCEL	2250	3950	4350	3970	0	0	44.1	77.5	85.3	77.9	0.0	0.0	284.9	0.213	0.881	-	1.48			2.57
156	LHS	MAV	Kandla	Mithi	1.2.22	COAL	3705	5000	7000	8200	0	0	72.7	98.1	137.3	160.9	0.0	0.0	469.0	1.564	2.261	-	16.49			20.31
157	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	1800	4230	5740	5360	0	0	35.3	83.0	112.6	105.2	0.0	0.0	336.1	0.087	1.158	-	4.69			5.93
158	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2005	1800	1700	1670	0	0	39.3	35.3	33.4	32.8	0.0	0.0	140.8	0.134	0.038	-	0.04			0.21
159	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1710	1610	0	1710	1640	0	33.6	31.6	0.0	33.6	32.2	0.0	130.9	0.071	0.024	-	-	0.01		0.10
160	LHS	MAV	Kandla	Anjaar	1.2.222	TILES	2210	5240	0	5740	4805	0	43.4	102.8	0.0	112.6	94.3	0.0	353.1	0.198	2.727	-	-	0.73		3.65
161	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2570	1930	2030	2130	0	0	50.4	37.9	39.8	41.8	0.0	0.0	169.9	0.362	0.050	-	0.09			0.50
162	LHS	MAV	Kandla	Anjaar	1.22.22	WOOD	2470	5560	6970	7850	8150	0	48.5	109.1	136.8	154.0	159.9	0.0	608.2	0.309	-	7.61	-	20.24		28.16
163	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2730	6830	6715	6540	0	0	53.6	134.0	131.7	128.3	0.0	0.0	447.6	0.461	7.873	-	9.53			17.87
164	LHS	MAV	Kandla	Shantilaal	1.1.222	SALT	2640	3250	4280	3480	4160	0	51.8	63.8	84.0	68.3	81.6	0.0	349.4	0.403	0.926	-	-	1.19		2.52
165	LHS	3AT	Kandla	Anjaar	1.22	RICE	3240	5760	6780	0	0	0	63.6	113.0	133.0	0.0	0.0	0.0	309.6	0.915	-	7.64				8.55
166	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1900	1700	2100	0	0	0	37.3	33.4	41.2	0.0	0.0	0.0	111.8	0.108	-	0.06				0.17
167	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1740	2190	1850	0	0	0	34.1	43.0	36.3	0.0	0.0	0.0	113.4	0.076	-	0.08				0.16
168	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1790	1850	2150	0	0	0	35.1	36.3	42.2	0.0	0.0	0.0	113.6	0.085	-	0.08				0.16

169	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1905	1800	1700	0	0	0	37.4	35.3	33.4	0.0	0.0	0.0	106.0	0.109	-	0.05				0.16
170	LHS	MAV	Kandla	Mithi	1.1.22	SALT	2840	0	4960	5340	0	0	55.7	0.0	97.3	104.8	0.0	0.0	257.8	0.540	0.000	-	3.48			4.02
171	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1760	2200	2450	0	0	0	34.5	43.2	48.1	0.0	0.0	0.0	125.8	0.080	-	0.14				0.22
172	LHS	MAV	Kandla	Mithi	1.1.22	EMPTY	1700	1800	1700	1600	0	0	33.4	35.3	33.4	31.4	0.0	0.0	133.4	0.069	0.087	-	0.04			0.19
173	LHS	MAV	Kandla	Shantilaal	1.2.22	CAR	2230	2930	4260	3730	0	0	43.8	57.5	83.6	73.2	0.0	0.0	258.0	0.205	0.267	-	1.26			1.73
174	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1870	1970	2105	0	0	0	36.7	38.7	41.3	0.0	0.0	0.0	116.6	0.102	-	0.09				0.19
175	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	2380	5610	0	5710	6245	0	46.7	110.1	0.0	112.0	122.5	0.0	391.3	0.266	3.583	-	-	1.20		5.05
176	LHS	MAV	Kandla	Pune	1.2.22	EMPTY	3090	2560	2720	2050	0	0	60.6	50.2	53.4	40.2	0.0	0.0	204.4	0.757	0.155	-	0.16			1.07
177	LHS	3AT	Kandla	Shantilaal	1.22	GAS	3140	6870	8010	0	0	0	61.6	134.8	157.2	0.0	0.0	0.0	353.6	0.807	-	15.14				15.95
178	LHS	MAV	Kandla	Mithi	1.2.22	Petroleum	2450	3450	7670	7800	0	0	48.1	67.7	150.5	153.0	0.0	0.0	419.3	0.299	0.513	-	17.69			18.50
179	LHS	MAV	Kandla	Anjaar	1.1.22	EMPTY	2160	2260	2115	2270	0	0	42.4	44.3	41.5	44.5	0.0	0.0	172.8	0.181	0.217	-	0.11			0.51
180	LHS	MAV	Kandla	Shantilaal	1.2.222	Furnitures	2160	3525	0	3045	3610	0	42.4	69.2	0.0	59.7	70.8	0.0	242.1	0.181	0.559	-	-	0.12		0.86
181	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1470	2270	1960	0	0	0	28.8	44.5	38.5	0.0	0.0	0.0	111.8	0.039	-	0.10				0.14
182	LHS	MAV	Kandla	Gandhida am	1.2.22	EMPTY	2140	1860	2070	2250	0	0	42.0	36.5	40.6	44.1	0.0	0.0	163.2	0.174	0.043	-	0.11			0.32
183	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1760	2260	2515	0	0	0	34.5	44.3	49.3	0.0	0.0	0.0	128.2	0.080	-	0.16				0.24
184	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1980	1730	1540	1710	0	0	38.8	33.9	30.2	33.6	0.0	0.0	136.6	0.128	0.032	-	0.03			0.19
185	LHS	MAV	Kandla	Mundra	1.2.22	GAS	3200	6770	7700	7950	0	0	62.8	132.8	151.1	156.0	0.0	0.0	502.7	0.870	7.600	-	18.53			27.00
186	LHS	2AT	Kandla	IOCL	1.2	EMPTY	2040	1840	0	0	0	0	40.0	36.1	0.0	0.0	0.0	0.0	76.1	0.144	0.041					0.19
187	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1790	2190	2230	0	0	0	35.1	43.0	43.8	0.0	0.0	0.0	121.8	0.085	-	0.12				0.20
188	LHS	MAV	Kandla	Shantilaal	1.2.22	Petroleum	2700	4800	5400	6700	0	0	53.0	94.2	105.9	131.5	0.0	0.0	384.6	0.441	1.920	-	6.62			8.98
189	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	1930	3180	2560	1640	0	0	37.9	62.4	50.2	32.2	0.0	0.0	182.7	0.115	0.370	-	0.10			0.58
190	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2160	6840	7080	6930	0	0	42.4	134.2	138.9	136.0	0.0	0.0	451.5	0.181	7.919	-	11.90			20.00
191	LHS	MAV	Kandla	Shantilaal	1.22.22	GOC	3250	6700	6500	9700	9800	0	63.8	131.5	127.5	190.3	192.3	0.0	705.3	0.926	-	9.38	-	44.66		54.96
192	LHS	2AT	Kandla	Hari Rd	1.2	EMPTY	2340	1950	0	0	0	0	45.9	38.3	0.0	0.0	0.0	0.0	84.2	0.249	0.052					0.30
193	LHS	MAV	Kandla	Shantilaal	1.2.222	CLOTHES	1950	3650	4130	4140	6070	0	38.3	71.6	81.0	81.2	119.1	0.0	391.2	0.120	0.642	-	-	2.49		3.25
194	LHS	MAV	Kandla	Anjaar	1.2.2.22	ROLL	2260	3740	0	4860	5010	0	44.3	73.4	0.0	95.4	98.3	0.0	311.4	0.217	0.708	0.00	-	2.93		3.86
195	LHS	MAV	Kandla	Mundra	1.2.222	GEL	1990	3940	0	3710	4190	0	39.0	77.3	0.0	72.8	82.2	0.0	271.3	0.130	0.872	-	-	0.23		1.23
196	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2700	2900	3250	0	0	0	53.0	56.9	63.8	0.0	0.0	0.0	173.6	0.441	-	0.44				0.88
197	LHS	MAV	Kandla	Anjaar	1.2.22	GAS	3300	7200	8700	9000	0	0	64.7	141.3	170.7	176.6	0.0	0.0	553.3	0.984	9.722	-	30.31			41.02
198	LHS	MAV	Kandla	Anjaar	1.2.222	EMPTY	1760	1640	1820	1925	1810	0	34.5	32.2	35.7	37.8	35.5	0.0	175.7	0.080	0.026	-	-	0.06		0.16
199	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2040	2100	2240	0	0	0	40.0	41.2	43.9	0.0	0.0	0.0	125.2	0.144	-	0.11				0.25
200	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1970	2240	2230	0	0	0	38.7	43.9	43.8	0.0	0.0	0.0	126.4	0.125	-	0.12				0.25
201	LHS	MAV	Kandla	Mithi	1.2.222	EMPTY	2110	1940	0	1880	1710	0	41.4	38.1	0.0	36.9	33.6	0.0	149.9	0.165	0.051	-	-	0.01		0.23
202	LHS	3AT	Kandla	Shantilaal	1.22	RICE	3210	5940	6870	0	0	0	63.0	116.5	134.8	0.0	0.0	0.0	314.3	0.881	-	8.32				9.20
203	LHS	MAV	Kandla	Mithi	1.2.222	EMPTY	2110	2060	0	1710	1610	0	41.4	40.4	0.0	33.6	31.6	0.0	147.0	0.165	0.065	-	-	0.01		0.24
204	LHS	MAV	Kandla	Shantilaal	1.2.22	hiding Mate	2610	4275	6510	6345	0	0	51.2	83.9	127.7	124.5	0.0	0.0	387.3	0.385	1.208	-	8.43			10.03
205	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1810	2210	0	2740	2130	0	35.5	43.4	0.0	53.8	41.8	0.0	174.4	0.089	0.086	-	-	0.03		0.21
206	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1800	2100	2300	0	0	0	35.3	41.2	45.1	0.0	0.0	0.0	121.6	0.087	-	0.12				0.20
207	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	4010	0	6830	6645	0	0	78.7	0.0	134.0	130.4	0.0	0.0	343.1	2.146	0.000	-	10.18			12.33
208	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2190	1895	0	1610	2215	0	43.0	37.2	0.0	31.6	43.5	0.0	155.2	0.191	0.047	-	-	0.01		0.25
209	LHS	3AT	Kandla	RuchSoya Comp.	1.22	EMPTY	2200	2300	2200	0	0	0	43.2	45.1	43.2	0.0	0.0	0.0	131.5	0.194	-	0.13				0.32
210	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1940	2240	2310	0	0	0	38.1	43.9	45.3	0.0	0.0	0.0	127.3	0.118	-	0.13				0.25
211	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2060	1820	1760	1940	0	0	40.4	35.7	34.5	38.1	0.0	0.0	148.7	0.149	0.040	-	0.06			0.25
212	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2200	2170	0	1880	2840	0	43.2	42.6	0.0	36.9	55.7	0.0	178.3	0.194	0.080	-	-	0.03		0.30
213	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	2150	1970	2270	0	0	0	42.2	38.7	44.5	0.0	0.0	0.0	125.4	0.177	-	0.10				0.28

214	LHS	MAV	Kandla	Hari Rd	1.2.222	SALT	1980	5630	5970	5850	5030	0	38.8	110.5	117.1	114.8	98.7	0.0	479.9	0.128	3.635	-	-	4.74		8.51
215	LHS	MAV	Kandla	Mundra	1.2.2.22	TILES	3380	1940	720	4660	4280	0	66.3	38.1	14.1	91.4	84.0	0.0	293.9	1.083	0.051	0.00	-	1.97		3.11
216	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2150	2270	2970	0	0	0	42.2	44.5	58.3	0.0	0.0	0.0	145.0	0.177	-	0.23				0.41
217	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	2150	2760	1900	1800	0	0	42.2	54.2	37.3	35.3	0.0	0.0	168.9	0.177	0.210	-	0.06			0.44
218	LHS	MAV	Kandla	Shantilaal	1.2.22	PIPE	1850	4690	5940	5820	0	0	36.3	92.0	116.5	114.2	0.0	0.0	359.0	0.097	1.750	-	5.91			7.75
219	LHS	MAV	Kandla	Shantilaal	1.2.22	Petroleum	2800	3700	3950	4250	0	0	54.9	72.6	77.5	83.4	0.0	0.0	288.4	0.510	0.678	-	1.40			2.58
220	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2340	2970	2910	2410	2450	0	45.9	58.3	57.1	47.3	48.1	0.0	256.6	0.249	0.281	-	-	0.21		0.75
221	LHS	MAV	Kandla	Anjaar	1.2.22	PIPE	2110	4680	5985	5770	0	0	41.4	91.8	117.4	113.2	0.0	0.0	363.9	0.165	1.735	-	5.90			7.80
222	LHS	MAV	Kandla	Anjaar	1.2.22	Petroleum	2905	3760	5140	6700	0	0	57.0	73.8	100.8	131.5	0.0	0.0	363.1	0.591	0.723	-	6.07			7.38
223	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2900	3200	4400	0	0	0	56.9	62.8	86.3	0.0	0.0	0.0	206.0	0.587	-	1.03				1.62
224	LHS	MAV	Kandla	Anjaar	1.22.22	WOOD	2500	5560	6870	7800	8200	0	49.1	109.1	134.8	153.0	160.9	0.0	606.8	0.324	-	7.37	-	20.24		27.94
225	LHS	MAV	Kandla	Mithi	1.2.222	TABACOO	1650	4430	0	4815	4765	0	32.4	86.9	0.0	94.5	93.5	0.0	307.2	0.062	1.393	-	-	0.50		1.95
226	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	3580	0	5975	6610	0	0	70.2	0.0	117.2	129.7	0.0	0.0	317.2	1.364	0.000	-	7.75			9.11
227	LHS	MAV	Kandla	Shantilaal	1.22.22	CORN	2000	2890	3250	3900	4070	0	39.2	56.7	63.8	76.5	79.9	0.0	316.1	0.133	-	0.44	-	1.25		1.82
228	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1905	2170	2190	0	0	0	37.4	42.6	43.0	0.0	0.0	0.0	122.9	0.109	-	0.11				0.22
229	LHS	3AT	Kandla	RuchSoya Comp.	1.22	Petroleum	2600	5700	5950	0	0	0	51.0	111.8	116.7	0.0	0.0	0.0	279.6	0.379	-	5.69				6.07
230	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	1810	1610	1540	1620	0	0	35.5	31.6	30.2	31.8	0.0	0.0	129.1	0.089	0.024	-	0.03			0.14
231	LHS	MAV	Kandla	Haryana	1.2.222	Petroleum	3400	10340	11400	11790	12070	0	66.7	202.9	223.7	231.3	236.8	0.0	961.4	1.109	#####	-	-	90.98		133.44
232	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2230	2370	2450	0	0	0	43.8	46.5	48.1	0.0	0.0	0.0	138.3	0.205	-	0.17				0.37
233	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2040	1780	1630	1550	0	0	40.0	34.9	32.0	30.4	0.0	0.0	137.3	0.144	0.036	-	0.03			0.21
234	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1900	2100	2500	0	0	0	37.3	41.2	49.1	0.0	0.0	0.0	127.5	0.108	-	0.14				0.25
235	LHS	3AT	Kandla	Mithi	1.22	Petroleum	2200	2900	4400	0	0	0	43.2	56.9	86.3	0.0	0.0	0.0	186.4	0.194	-	0.88				1.07
236	LHS	MAV	Kandla	Ahmedab	1.2.22	Petroleum	2370	6270	7550	8600	0	0	46.5	123.0	148.1	168.7	0.0	0.0	486.4	0.262	5.591	-	21.01			26.86
237	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1950	1630	1250	1150	0	0	38.3	32.0	24.5	22.6	0.0	0.0	117.3	0.120	0.026	-	0.01			0.16
238	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1630	1850	1300	1440	1810	0	32.0	36.3	25.5	28.3	35.5	0.0	157.5	0.059	0.042	-	-	0.03		0.13
239	LHS	MAV	Kandla	Shantilaal	1.2.22	DIESEL	3620	4600	5625	5970	0	0	71.0	90.3	110.4	117.1	0.0	0.0	388.8	1.426	1.620	-	5.58			8.63
240	LHS	MAV	Kandla	Mithi	1.2.222	EMPTY	2190	1895	0	1610	2215	0	43.0	37.2	0.0	31.6	43.5	0.0	155.2	0.191	0.047	-	-	0.01		0.25
241	LHS	MAV	Kandla	Shantilaal	1.22.222	CLOTHES	2390	3720	3510	5320	4325	4580	46.9	73.0	68.9	104.4	84.9	89.9	467.8	0.271	-	0.84	-	-	2.41	3.52
242	LHS	3AT	Kandla	Gandhidh am	1.22	EMPTY	2050	2170	2290	0	0	0	40.2	42.6	44.9	0.0	0.0	0.0	127.7	0.147	-	0.12				0.27
243	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2250	1900	2300	0	0	0	44.1	37.3	45.1	0.0	0.0	0.0	126.5	0.213	-	0.10				0.31
244	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2240	5530	7380	6360	0	0	43.9	108.5	144.8	124.8	0.0	0.0	422.0	0.209	3.383	-	11.01			14.60
245	LHS	3AT	Kandla	Badona	1.22	Petroleum	3600	7800	8200	0	0	0	70.6	153.0	160.9	0.0	0.0	0.0	384.6	1.394	-	20.24				21.63
246	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1960	2240	2310	0	0	0	38.5	43.9	45.3	0.0	0.0	0.0	127.7	0.123	-	0.13				0.26
247	LHS	MAV	Kandla	Shantilaal	1.2.222	POWDER	2530	3995	4245	4360	5740	0	49.6	78.4	83.3	85.5	112.6	0.0	409.5	0.340	0.922	-	-	2.49		3.75
248	LHS	MAV	Kandla	Shantilaal	1.1.22	EMPTY	1705	2160	2540	2220	0	0	33.5	42.4	49.8	43.6	0.0	0.0	169.2	0.070	0.181	-	0.16			0.41
249	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2680	5540	6315	5480	0	0	52.6	108.7	123.9	107.5	0.0	0.0	392.7	0.428	3.408	-	5.98			9.81
250	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2130	1850	2180	1940	0	0	41.8	36.3	42.8	38.1	0.0	0.0	158.9	0.171	0.042	-	0.09			0.30
251	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1280	2640	2360	2030	0	0	25.1	51.8	46.3	39.8	0.0	0.0	163.0	0.022	0.176	-	0.11			0.31
252	LHS	MAV	Kandla	Shantilaal	1.2.222	SOIL	3430	3820	0	6810	6125	0	67.3	74.9	0.0	133.6	120.2	0.0	396.0	1.149	0.770	-	-	1.65		3.57
253	LHS	MAV	Kandla	RuchSoya Comp.	1.1.22	POWDER	2510	4460	5870	6040	0	0	49.2	87.5	115.2	118.5	0.0	0.0	370.4	0.329	3.285	-	6.21			9.83
254	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1630	1850	1300	1440	1810	0	32.0	36.3	25.5	28.3	35.5	0.0	157.5	0.059	0.042	-	-	0.03		0.13
255	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2060	1810	1760	1940	0	0	40.4	35.5	34.5	38.1	0.0	0.0	148.5	0.149	0.039	-	0.06			0.25
256	LHS	MAV	Kandla	Punjab	1.2.222	OOD GRAIN	2260	4815	0	5265	4920	0	44.3	94.5	0.0	103.3	96.5	0.0	338.6	0.217	1.945	-	-	0.63		2.79
257	LHS	MAV	Kandla	Shantilaal	1.22.222	Petroleum	3500	7700	7670	5600	5970	5540	68.7	151.1	150.5	109.9	117.1	108.7	705.9	1.246	-	17.24	-	-	5.04	23.53

258	LHS	MAV	Kandla	Shantilaal	1.1.22	SALT	2460	7090	5768	5970	0	0	48.3	139.1	113.2	117.1	0.0	0.0	417.7	0.304	#####	-	5.86			27.14
259	LHS	MAV	Kandla	Mundra	1.2.22	GAS	2870	3190	6700	5900	0	0	56.3	62.6	131.5	115.8	0.0	0.0	366.1	0.563	0.375	-	7.78			8.72
260	LHS	MAV	Kandla	Shantilaal	1.2.222	POWDER	2350	6030	0	5065	6435	0	46.1	118.3	0.0	99.4	126.3	0.0	390.0	0.253	4.783	-	-	1.03		6.07
261	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2200	2730	2330	2020	0	0	43.2	53.6	45.7	39.6	0.0	0.0	182.1	0.194	0.201	-	0.11			0.51
262	LHS	MAV	Kandla	Anjaar	1.1.22	LEMON	3210	0	5565	4845	0	0	63.0	0.0	109.2	95.1	0.0	0.0	267.2	0.881	0.000	-	3.63			4.51
263	LHS	MAV	Kandla	Shantilaal	1.2.22	SUGAR	5160	5050	7500	7800	0	0	101.2	99.1	147.2	153.0	0.0	0.0	500.5	5.885	2.353	-	16.92			25.16
264	LHS	2AT	Kandla	Anjaar	1.2	EMPTY	2250	1920	0	0	0	0	44.1	37.7	0.0	0.0	0.0	0.0	81.8	0.213	0.049					0.26
265	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	2040	4075	0	6310	5740	0	40.0	80.0	0.0	123.8	112.6	0.0	356.4	0.144	0.998	-	-	1.24		2.38
266	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1240	2130	2060	1930	0	0	24.3	41.8	40.4	37.9	0.0	0.0	144.4	0.020	0.074	-	0.08			0.17
267	LHS	MAV	Kandla	Shantilaal	1.1.22	CLOTHES	3370	0	4320	4220	0	0	66.1	0.0	84.8	82.8	0.0	0.0	233.7	1.071	0.000	-	1.64			2.71
268	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2120	4850	5590	5630	0	0	41.6	95.2	109.7	110.5	0.0	0.0	356.9	0.168	2.002	-	4.89			7.06
269	LHS	MAV	Kandla	Shantilaal	1.2.22	COAL	2800	7800	6900	9800	0	0	54.9	153.0	135.4	192.3	0.0	0.0	535.6	0.510	#####	-	24.02			37.92
270	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1780	1830	2150	1815	0	0	34.9	35.9	42.2	35.6	0.0	0.0	148.6	0.083	0.041	-	0.08			0.20
271	LHS	MAV	Kandla	Mundra	1.22.222	BOX	2810	6140	6470	0	6740	6415	55.1	120.5	126.9	0.0	132.2	125.9	560.6	0.518	-	7.81	-	-	1.76	10.09
272	LHS	MAV	Kandla	Ahmedab	1.2.22	TILES	3295	4765	5110	5190	0	0	64.6	93.5	100.3	101.8	0.0	0.0	360.2	0.979	1.865	-	3.48			6.32
273	LHS	MAV	Kandla	Shantilaal	1.2.22	COAL	2950	4780	6700	7800	0	0	57.9	93.8	131.5	153.0	0.0	0.0	436.2	0.629	1.889	-	13.65			16.17
274	LHS	MAV	Kandla	Anjaar	1.2.22	CAR	2150	2870	4110	3870	0	0	42.2	56.3	80.6	75.9	0.0	0.0	255.1	0.177	0.245	-	1.25			1.67
275	LHS	MAV	Kandla	Shantilaal	1.2.22	ZEERA	2025	3440	7380	7270	0	0	39.7	67.5	144.8	142.6	0.0	0.0	394.7	0.140	0.507	-	14.23			14.87
276	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1860	2210	2310	0	0	0	36.5	43.4	45.3	0.0	0.0	0.0	125.2	0.099	-	0.13				0.23
277	LHS	3AT	Kandla	Anjaar	1.22	WATER	2200	3700	4100	0	0	0	43.2	72.6	80.4	0.0	0.0	0.0	196.2	0.194	-	1.14				1.34
278	LHS	MAV	Kandla	Punjab	1.2.2.22	EMPTY	1045	2035	2180	1345	1180	0	20.5	39.9	42.8	26.4	23.2	0.0	152.7	0.010	0.062	0.08	-	0.01		0.17
279	LHS	MAV	Kandla	Anjaar	1.2.222	BOX	2160	3525	0	3045	3630	0	42.4	69.2	0.0	59.7	71.2	0.0	242.5	0.181	0.559	-	-	0.12		0.86
280	LHS	3AT	Kandla	Shantilaal	1.22	PARCEL	1900	10700	11700	0	0	0	37.3	209.9	229.6	0.0	0.0	0.0	476.8	0.108	-	77.76				77.87

Carriageway			Mandatory Input →	Enter the Input Load		Kg	Mandatory Input →	Enter Whether Input Load is for Wheel or Axle				w	Individual Axle Load (KN)						Gross Vehicle Weight GVW (KN)	Equivalency Factor (EF) or VDF						
Chainage		Man dator	Origin	Destination	Man dato ry	Individual Wheel Load (Kg)																				
Sl. No.	Direction	Vehicle Type			Axle Config. (See Note above)	Commo dity Type	1 st Wheel Load	2 nd Wheel Load	3 rd Wheel Load	4 th Wheel Load	5 th Wheel Load	6 th Wheel Load	1 st Axle Load (KN)	2 nd Axle Load (KN)	3 rd Axle Load (KN)	4 th Axle Load (KN)	5 th Axle Load (KN)	6 th Axle Load (KN)		Steering Single Axle	2 nd	3 rd	4 th	5 th	6 th	Total EF per Vehicle
1	RHS	MAV	Mandunagar	Kandla			1.2.22	EMPTY	1815	2220	2010	1985	0	0	35.6	43.6	39.4	38.9	0.0	0.0	157.5	0.090	0.088	-	0.08	
2	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1970	2210	1950	1730	0	0	38.7	43.4	38.3	33.9	0.0	0.0	154.2	0.125	0.086	-	0.06			0.27
3	RHS	MAV	ANJAR	Kandla	1.2.222	POWDE	2210	5570	0	4710	6725	0	43.4	109.3	0.0	92.4	131.9	0.0	377.0	0.198	3.482	-	-	1.01		4.69
4	RHS	3AT	HPCL	Kandla	1.22	EMPTY	1910	1970	1650	0	0	0	37.5	38.7	32.4	0.0	0.0	0.0	108.5	0.110	-	0.05				0.16
5	RHS	MAV	ManchuNaga	Kandla	1.2.222	EMPTY	2010	2270	0	2110	2000	0	39.4	44.5	0.0	41.4	39.2	0.0	164.6	0.135	0.096	-	-	0.02		0.25
6	RHS	MAV	Shantilaal	Kandla	1.2.22	EMPTY	1795	1500	1270	1380	0	0	35.2	29.4	24.9	27.1	0.0	0.0	116.6	0.086	0.018	-	0.02			0.12
7	RHS	3AT	HPCL	Kandla	1.22	EMPTY	2840	2750	2910	0	0	0	55.7	54.0	57.1	0.0	0.0	0.0	166.8	0.540	-	0.32				0.86
8	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1810	1360	1420	1150	0	0	35.5	26.7	27.9	22.6	0.0	0.0	112.6	0.089	0.012	-	0.01			0.11
9	RHS	MAV	Gandhidham	Kandla	1.2.222	Chemica	3250	9210	0	7570	7090	0	63.8	180.7	0.0	148.5	139.1	0.0	532.1	0.926	26.030	-	-	2.72		29.67
10	RHS	MAV	Gandhidham	Kandla	1.1.22	EMPTY	1740	2120	1620	1700	0	0	34.1	41.6	31.8	33.4	0.0	0.0	140.9	0.076	0.168	-	0.04			0.28
11	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1870	1845	2055	2060	0	0	36.7	36.2	40.3	40.4	0.0	0.0	153.6	0.102	0.042	-	0.09			0.23
12	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2110	2290	2410	2170	2010	0	41.4	44.9	47.3	42.6	39.4	0.0	215.6	0.165	0.099	-	-	0.11		0.38
13	RHS	MAV	Gandhidham	Kandla	1.2.22	Patriliu	2985	3710	7910	7750	0	0	58.6	72.8	155.2	152.1	0.0	0.0	438.6	0.659	0.685	-	18.57			19.92
14	RHS	3AT	Shantilaal	Kandla	1.22	ANAJ	2660	6010	6770	0	0	0	52.2	117.9	132.8	0.0	0.0	0.0	302.9	0.416	-	8.24				8.65
15	RHS	MAV	MADNA	Kandla	1.2.222	EMPTY	1710	1730	1170	1800	2430	0	33.6	33.9	23.0	35.3	47.7	0.0	173.4	0.071	0.032	-	-	0.05		0.15
16	RHS	MAV	RADARPUR	Kandla	1.2.22	TILES	1970	4970	5430	5845	0	0	38.7	97.5	106.5	114.7	0.0	0.0	357.4	0.125	2.207	-	4.99			7.32
17	RHS	3AT	Shantilaal	Kandla	1.22	RICE	4250	6880	6910	0	0	0	83.4	135.0	135.6	0.0	0.0	0.0	353.9	2.708	-	11.17				13.88
18	RHS	MAV	Shantilaal	Kandla	1.2.222	RICE	2935	7430	0	7635	6975	0	57.6	145.8	0.0	149.8	136.8	0.0	490.0	0.616	11.025	-	-	2.68		14.32
19	RHS	3AT	Shantilaal	Kandla	1.22	ANAJ	2815	6770	6045	0	0	0	55.2	132.8	118.6	0.0	0.0	0.0	306.7	0.521	-	8.33				8.85
20	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2210	3510	3140	3015	0	0	43.4	68.9	61.6	59.2	0.0	0.0	233.0	0.198	0.549	-	0.44			1.19
21	RHS	MAV	BIHAR	Kandla	1.2.222	EMPTY	1950	2350	0	1730	1910	0	38.3	46.1	0.0	33.9	37.5	0.0	155.8	0.120	0.110	-	-	0.01		0.24
22	RHS	MAV	Gandhidham	Kandla	1.2.22	TILES	3610	4225	5115	5190	0	0	70.8	82.9	100.4	101.8	0.0	0.0	355.9	1.410	1.153	-	3.48			6.05
23	RHS	MAV	HPCL	Kandla	1.2.222	EMPTY	1450	1730	0	1310	1180	0	28.4	33.9	0.0	25.7	23.2	0.0	111.2	0.037	0.032	-	-	0.00		0.07
24	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2350	2390	1910	1790	0	0	46.1	46.9	37.5	35.1	0.0	0.0	165.6	0.253	0.118	-	0.06			0.43
25	RHS	MAV	Gandhidham	Kandla	1.22.222	ZINK	3250	5230	5425	0	5680	5360	63.8	102.6	106.4	0.0	111.4	105.2	489.4	0.926	-	3.98	-	-	0.87	5.78
26	RHS	MAV	IOCL	Kandla	1.1.22	Chemica	3830	0	6990	6335	0	0	75.1	0.0	137.1	124.3	0.0	0.0	336.6	1.786	0.000	-	9.74			11.52
27	RHS	MAV	Gandhidham	Kandla	1.1.22	Patriliu	2210	0	5110	6250	0	0	43.4	0.0	100.3	122.6	0.0	0.0	266.2	0.198	0.000	-	5.14			5.34
28	RHS	MAV	BHAVNAGAR	Kandla	1.1.222	GUM	4135	3910	3380	7850	6940	0	81.1	76.7	66.3	154.0	136.2	0.0	514.3	2.427	1.940	-	-	6.42		10.78
29	RHS	MAV	Shantilaal	Kandla	1.2.22	EMPTY	2190	2110	1680	1990	0	0	43.0	41.4	33.0	39.0	0.0	0.0	156.4	0.191	0.072	-	0.06			0.32
30	RHS	MAV	BACHAU	Kandla	1.2.222	EMPTY	2275	2665	0	2560	2015	0	44.6	52.3	0.0	50.2	39.5	0.0	186.7	0.222	0.182	-	-	0.03		0.43
31	RHS	3AT	RADARPUR	Kandla	1.22	EMPTY	1910	1890	1710	0	0	0	37.5	37.1	33.6	0.0	0.0	0.0	108.1	0.110	-	0.05				0.16
32	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1995	2350	0	2450	2110	0	39.1	46.1	0.0	48.1	41.4	0.0	174.7	0.131	0.110	-	-	0.03		0.27
33	RHS	3AT	ManchuNaga	Kandla	1.22	EMPTY	2260	1950	1800	0	0	0	44.3	38.3	35.3	0.0	0.0	0.0	117.9	0.217	-	0.06				0.28
34	RHS	MAV	Gandhidham	Kandla	1.1.22	TILES	3390	0	4600	4830	0	0	66.5	0.0	90.3	94.8	0.0	0.0	251.5	1.096	0.000	-	2.44			3.54
35	RHS	MAV	MP	Kandla	1.2.22	GAS	2550	3250	3430	3730	0	0	50.0	63.8	67.3	73.2	0.0	0.0	254.3	0.351	0.404	-	0.81			1.57
36	RHS	MAV	IOCL	Kandla	1.22.222	SALT	2130	2985	4300	4820	4635	5615	41.8	58.6	84.4	94.6	90.9	110.2	480.4	0.171	-	0.87	-	-	3.04	4.08

37	RHS	MAV	ANJAR	Kandla	1.22.222	Chemica l	3455	7440	6880	0	8535	7670	67.8	146.0	135.0	0.0	167.5	150.5	666.7	1.183	-	12.99	-	-	4.06	18.23
38	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1720	1480	1625	1360	0	0	33.7	29.0	31.9	26.7	0.0	0.0	121.3	0.073	0.017	-	0.02			0.11
39	RHS	MAV	IOCL	Kandla	1.2.222	EMPTY	1775	2180	0	2610	2240	0	34.8	42.8	0.0	51.2	43.9	0.0	172.8	0.082	0.082	-	-	0.03		0.20
40	RHS	MAV	MORBI	Kandla	1.1.22	POWDE	2490	4130	5845	5960	0	0	48.9	81.0	114.7	116.9	0.0	0.0	361.5	0.319	2.415	-	6.00			8.73
41	RHS	3AT	Shantilaal	Kandla	1.22	RICE	4020	5340	6860	0	0	0	78.9	104.8	134.6	0.0	0.0	0.0	318.2	2.168	-	6.84				9.01
42	RHS	MAV	Gandhidham	Kandla	1.22.222	EMPTY	2735	1810	1950	0	2250	2010	53.7	35.5	38.3	0.0	44.1	39.4	211.0	0.464	-	0.06	-	-	0.02	0.55
43	RHS	MAV	Mithi Rd	Kandla	1.2.22	EMPTY	2210	2000	1880	2310	0	0	43.4	39.2	36.9	45.3	0.0	0.0	164.8	0.198	0.058	-	0.10			0.35
44	RHS	MAV	Mithi Rd	Kandla	1.1.22	RICE	5230	0	6630	7550	0	0	102.6	0.0	130.1	148.1	0.0	0.0	380.8	6.211	0.000	-	12.49			18.70
45	RHS	MAV	Bhatinda	Kandla	1.1.22	EMPTY	2340	0	1745	1640	0	0	45.9	0.0	34.2	32.2	0.0	0.0	112.3	0.249	0.000	-	0.04			0.29
46	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	1690	2070	0	2160	2650	0	33.2	40.6	0.0	42.4	52.0	0.0	168.1	0.068	0.066	-	-	0.03		0.17
47	RHS	MAV	Kandla	Kandla	1.2.22	EMPTY	1970	1940	1970	1610	0	0	38.7	38.1	38.7	31.6	0.0	0.0	147.0	0.125	0.051	-	0.05			0.23
48	RHS	MAV	Gandhidham	Kandla	1.1.22	EMPTY	1980	1830	1590	1730	0	0	38.8	35.9	31.2	33.9	0.0	0.0	139.9	0.128	0.093	-	0.04			0.26
49	RHS	MAV	Mithi Rd	Kandla	1.2.222	Chemica	3210	3950	0	7990	7850	0	63.0	77.5	0.0	156.8	154.0	0.0	451.3	0.881	0.881	-	-	3.71		5.47
50	RHS	3AT	Mithi Rd	Kandla	1.22	ANAJ	3940	6810	6230	0	0	0	77.3	133.6	122.2	0.0	0.0	0.0	333.1	2.000	-	8.93				10.93
51	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1580	1795	0	1940	1755	0	31.0	35.2	0.0	38.1	34.4	0.0	138.7	0.052	0.038	-	-	0.01		0.10
52	RHS	MAV	Mithi Rd	Kandla	1.22.222	BOX	2915	5160	6130	0	5800	5930	57.2	101.2	120.3	0.0	113.8	116.3	508.8	0.599	-	5.02	-	-	1.11	6.73
53	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1695	2195	2078	1995	0	0	33.3	43.1	40.8	39.1	0.0	0.0	156.2	0.069	0.084	-	0.08			0.24
54	RHS	MAV	GT ROAD	Kandla	1.2.22	EMPTY	1250	2850	2475	2220	0	0	24.5	55.9	48.6	43.6	0.0	0.0	172.6	0.020	0.239	-	0.15			0.41
55	RHS	MAV	Gandhidham	Kandla	1.22.22	EMPTY	2330	2250	2410	2210	2190	0	45.7	44.1	47.3	43.4	43.0	0.0	223.5	0.245	-	0.15	-	0.12		0.51
56	RHS	MAV	ManchuNaga r	Kandla	1.2.22	Building Matarial	2130	4130	6100	4840	0	0	41.8	81.0	119.7	95.0	0.0	0.0	337.5	0.171	1.053	-	4.42			5.65
57	RHS	3AT	Rajashthan	Kandla	1.22	RICE	4810	7010	6560	0	0	0	94.4	137.5	128.7	0.0	0.0	0.0	360.6	4.443	-	10.47				14.92
58	RHS	MAV	IOCL	Kandla	1.2.222	Chemica	2910	8830	0	7850	7290	0	57.1	173.2	0.0	154.0	143.0	0.0	527.4	0.595	21.993	-	-	3.09		25.68
59	RHS	3AT	MORBI	Kandla	1.22	RICE	4415	7930	6895	0	0	0	86.6	155.6	135.3	0.0	0.0	0.0	377.5	3.154	-	14.92				18.07
60	RHS	MAV	IOCL	Kandla	1.1.22	SALT	2610	0	3930	3805	0	0	51.2	0.0	77.1	74.7	0.0	0.0	203.0	0.385	0.000	-	1.11			1.49
61	RHS	MAV	Shantilaal	Kandla	1.1.22	RICE	3510	4110	5150	5540	0	0	68.9	80.6	101.0	108.7	0.0	0.0	359.2	1.260	2.369	-	4.03			7.66
62	RHS	MAV	Shantilaal	Kandla	1.2.22	DIESEL	3280	5130	5825	6130	0	0	64.4	100.7	114.3	120.3	0.0	0.0	399.6	0.961	2.506	-	6.31			9.78
63	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2030	2330	2535	2175	2090	0	39.8	45.7	49.7	42.7	41.0	0.0	219.0	0.141	0.107	-	-	0.13		0.37
64	RHS	MAV	Rajashthan	Kandla	1.2.222	TILES	1980	4915	0	4690	5215	0	38.8	96.4	0.0	92.0	102.3	0.0	329.6	0.128	2.111	-	-	0.57		2.81
65	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2140	1940	2090	2250	0	0	42.0	38.1	41.0	44.1	0.0	0.0	165.2	0.174	0.051	-	0.11			0.33
66	RHS	MAV	HPCL	Kandla	1.2.222	EMPTY	1765	2300	0	1470	1545	0	34.6	45.1	0.0	28.8	30.3	0.0	138.9	0.081	0.101	-	-	0.00		0.19
67	RHS	MAV	Rajashthan	Kandla	1.2.222	EMPTY	2040	2380	1470	1110	1770	0	40.0	46.7	28.8	21.8	34.7	0.0	172.1	0.144	0.116	-	-	0.02		0.28
68	RHS	MAV	Gandhidham	Kandla	1.2.22	PARCEL	2830	6860	6570	8010	0	0	55.5	134.6	128.9	157.2	0.0	0.0	476.2	0.532	8.012	-	13.96			22.50
69	RHS	3AT	Mithi Rd	Kandla	1.22	SALT	5670	6440	6190	0	0	0	111.2	126.4	121.4	0.0	0.0	0.0	359.0	8.580	-	7.86				16.44
70	RHS	MAV	Gandhidham	Kandla	1.2.222	TILES	3265	4710	5825	5710	5235	0	64.1	92.4	114.3	112.0	102.7	0.0	485.5	0.943	1.780	-	-	4.66		7.38
71	RHS	MAV	Gandhidham	Kandla	1.2.22	Chemica	2485	7010	7850	6830	0	0	48.8	137.5	154.0	134.0	0.0	0.0	474.3	0.317	8.736	-	14.34			23.40
72	RHS	2AT	Gandhidham	Kandla	1.2	EMPTY	2310	1910	0	0	0	0	45.3	37.5	0.0	0.0	0.0	0.0	82.8	0.236	0.048					0.28
73	RHS	MAV	Shantilaal	Kandla	1.22.222	EMPTY	2135	2090	1835	1910	1830	1670	41.9	41.0	36.0	37.5	35.9	32.8	225.0	0.172	-	0.07	-	-	0.05	0.30
74	RHS	3AT	HPCL	Kandla	1.22	Patriliu	1910	2050	1910	0	0	0	37.5	40.2	37.5	0.0	0.0	0.0	115.2	0.110	-	0.08				0.19
75	RHS	MAV	Mithi Rd	Kandla	1.2.222	EMPTY	2250	2150	0	2310	1790	0	44.1	42.2	0.0	45.3	35.1	0.0	166.8	0.213	0.077	-	-	0.02		0.31
76	RHS	MAV	Mandunagar	Kandla	1.1.22	Building Matarial	3940	4360	6780	6940	0	0	77.3	85.5	133.0	136.2	0.0	0.0	432.0	2.000	3.000	-	10.94			15.94
77	RHS	MAV	ANJAR	Kandla	1.2.222	EMPTY	2020	2435	0	2010	2000	0	39.6	47.8	0.0	39.4	39.2	0.0	166.1	0.138	0.127	-	-	0.02		0.28
78	RHS	MAV	Mandunagar	Kandla	1.2.22	TILES	2150	4670	5615	5270	0	0	42.2	91.6	110.2	103.4	0.0	0.0	347.4	0.177	1.721	-	4.34			6.23

79	RHS	MAV	JAIPUR	Kandla	1.1.22	RICE	2950	3410	5740	5210	0	0	57.9	66.9	112.6	102.2	0.0	0.0	339.6	0.629	1.122	-	4.44			6.19
80	RHS	3AT	Shantilaal	Kandla	1.22	RICE	3240	6850	7410	0	0	0	63.6	134.4	145.4	0.0	0.0	0.0	343.4	0.915	-	12.77				13.69
81	RHS	3AT	Gandhidham	Kandla	1.22	WHEAT	4520	8650	7220	0	0	0	88.7	169.7	141.7	0.0	0.0	0.0	400.1	3.465	-	19.59				23.06
82	RHS	3AT	Shantilaal	Kandla	1.22	RICE	2710	6880	7235	0	0	0	53.2	135.0	142.0	0.0	0.0	0.0	330.1	0.448	-	12.26				12.71
83	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2275	2250	1510	1630	0	0	44.6	44.1	29.6	32.0	0.0	0.0	150.4	0.222	0.093	-	0.03			0.34
84	RHS	MAV	Gandhidham	Kandla	1.1.22	EMPTY	2235	0	2010	1935	0	0	43.9	0.0	39.4	38.0	0.0	0.0	121.3	0.207	0.000	-	0.07			0.28
85	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1555	1690	0	760	1410	0	30.5	33.2	0.0	14.9	27.7	0.0	106.2	0.049	0.030	-	-	0.00		0.08
86	RHS	3AT	Shantilaal	Kandla	1.22	ANAJ	4440	6795	6810	0	0	0	87.1	133.3	133.6	0.0	0.0	0.0	354.0	3.226	-	10.58				13.81
87	RHS	MAV	GIDC	Kandla	1.2.22	EMPTY	1935	3015	2915	1520	0	0	38.0	59.2	57.2	29.8	0.0	0.0	184.1	0.116	0.299	-	0.12			0.53
88	RHS	MAV	GT ROAD	Kandla	1.1.22	#N/A	5250	0	7910	7660	0	0	103.0	0.0	155.2	150.3	0.0	0.0	408.5	6.306	0.000	-	18.15			24.46
89	RHS	MAV	Gandhidham	Kandla	1.2.222	Chemica	2550	3850	0	5170	5580	0	50.0	75.5	0.0	101.4	109.5	0.0	336.5	0.351	0.795	-	-	0.79		1.93
90	RHS	3AT	Mithi Rd	Kandla	1.22	RICE	3990	7495	7875	0	0	0	78.3	147.1	154.5	0.0	0.0	0.0	379.8	2.104	-	17.24				19.34
91	RHS	3AT	KATI	Kandla	1.22	ANAJ	3820	6170	7550	0	0	0	74.9	121.1	148.1	0.0	0.0	0.0	344.1	1.768	-	10.94				12.71
92	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1670	1820	1440	1710	0	0	32.8	35.7	28.3	33.6	0.0	0.0	130.3	0.065	0.040	-	0.03			0.14
93	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2115	2575	1995	1910	0	0	41.5	50.5	39.1	37.5	0.0	0.0	168.6	0.166	0.159	-	0.07			0.40
94	RHS	3AT	Gandhidham	Kandla	1.22	WHEAT	4510	6850	6370	0	0	0	88.5	134.4	125.0	0.0	0.0	0.0	347.9	3.434	-	9.43				12.87
95	RHS	MAV	Mithi Rd	Kandla	1.2.222	EMPTY	2170	2390	0	3140	2885	0	42.6	46.9	0.0	61.6	56.6	0.0	207.7	0.184	0.118	-	-	0.08		0.38
96	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1630	1500	0	1440	1405	0	32.0	29.4	0.0	28.3	27.6	0.0	117.2	0.059	0.018	-	-	0.00		0.08
97	RHS	3AT	ManchuNaga	Kandla	1.22	SALT	3015	5560	5010	0	0	0	59.2	109.1	98.3	0.0	0.0	0.0	266.5	0.686	-	3.86				4.54
98	RHS	MAV	MORBI	Kandla	1.2.222	EMPTY	2650	2650	0	2510	2010	0	52.0	52.0	0.0	49.2	39.4	0.0	192.7	0.409	0.178	-	-	0.02		0.61
99	RHS	MAV	Shantilaal	Kandla	1.1.22	RICE	5150	6750	7410	6835	0	0	101.0	132.4	145.4	134.1	0.0	0.0	513.0	5.839	17.233	-	12.72			35.79
100	RHS	3AT	Shantilaal	Kandla	1.22	RICE	5555	6290	6010	0	0	0	109.0	123.4	117.9	0.0	0.0	0.0	350.3	7.905	-	7.07				14.97
101	RHS	3AT	BPCL	Kandla	1.22	EMPTY	2375	2535	2285	0	0	0	46.6	49.7	44.8	0.0	0.0	0.0	141.2	0.264	-	0.17				0.43
102	RHS	MAV	Gandhidham	Kandla	1.2.222	CLOTHE	3210	6460	0	4010	4305	0	63.0	126.7	0.0	78.7	84.5	0.0	352.9	0.881	6.300	-	-	0.28		7.46
103	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2810	2150	0	1970	2110	0	55.1	42.2	0.0	38.7	41.4	0.0	177.4	0.518	0.077	-	-	0.02		0.61
104	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	1525	1500	0	1250	1300	0	29.9	29.4	0.0	24.5	25.5	0.0	109.4	0.045	0.018	-	-	0.00		0.07
105	RHS	MAV	MADNA	Kandla	1.2.222	EMPTY	2010	2510	2010	1990	1850	0	39.4	49.2	39.4	39.0	36.3	0.0	203.5	0.135	0.144	-	-	0.07		0.35
106	RHS	MAV	GIDC	Kandla	1.2.222	EMPTY	2150	1850	1910	2270	1950	0	42.2	36.3	37.5	44.5	38.3	0.0	198.8	0.177	0.042	-	-	0.08		0.30
107	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2575	4010	3235	3645	0	0	50.5	78.7	63.5	71.5	0.0	0.0	264.2	0.365	0.935	-	0.69			1.99
108	RHS	MAV	BAJRANGI	Kandla	1.2.222	RICE	2480	6330	0	7010	6855	0	48.7	124.2	0.0	137.5	134.5	0.0	444.9	0.314	5.808	-	-	2.18		8.30
109	RHS	MAV	Rajashthan	Kandla	1.2.222	TILES	2090	4020	0	4710	6065	0	41.0	78.9	0.0	92.4	119.0	0.0	331.3	0.158	0.945	-	-	0.79		1.90
110	RHS	MAV	Gandhidham	Kandla	1.1.222	TILES	2080	4510	0	6590	5010	0	40.8	88.5	0.0	129.3	98.3	0.0	356.9	0.155	3.434	-	-	1.07		4.66
111	RHS	MAV	Gandhidham	MOTHI BAR	1.22.222	ZINK	2250	4630	3630	5450	5725	5840	44.1	90.8	71.2	106.9	112.3	114.6	540.0	0.213	-	1.44	-	-	4.93	6.58
112	RHS	MAV	IOCL	Kandla	1.2.222	EMPTY	1890	1870	0	2640	1870	0	37.1	36.7	0.0	51.8	36.7	0.0	162.3	0.106	0.044	-	-	0.02		0.17
113	RHS	MAV	Bhatinda	Kandla	1.2.22	TILES	1785	3250	3110	2995	0	0	35.0	63.8	61.0	58.8	0.0	0.0	218.6	0.084	0.404	-	0.43			0.92
114	RHS	MAV	Gandhidham	Kandla	1.22.222	POWDE R	2550	4260	3870	0	6175	5940	50.0	83.6	75.9	0.0	121.2	116.5	447.2	0.351	-	1.35	-	-	1.27	2.97
115	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2150	1935	2050	2250	0	0	42.2	38.0	40.2	44.1	0.0	0.0	164.5	0.177	0.051	-	0.11			0.33
116	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	1930	1870	0	1710	1485	0	37.9	36.7	0.0	33.6	29.1	0.0	137.2	0.115	0.044	-	-	0.01		0.17
117	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1560	1710	1820	1660	0	0	30.6	33.6	35.7	32.6	0.0	0.0	132.4	0.049	0.031	-	0.05			0.13
118	RHS	MAV	IOCL	Kandla	1.2.22	EMPTY	1550	1890	2160	1900	0	0	30.4	37.1	42.4	37.3	0.0	0.0	147.2	0.048	0.046	-	0.08			0.18
119	RHS	MAV	Gandhidham	Kandla	1.1.22	D.O.C	3290	4270	6100	5210	0	0	64.5	83.8	119.7	102.2	0.0	0.0	370.2	0.973	2.760	-	5.05			8.79
120	RHS	MAV	MORBI	Kandla	1.2.222	EMPTY	1935	2010	0	2275	2465	0	38.0	39.4	0.0	44.6	48.4	0.0	170.4	0.116	0.059	-	-	0.03		0.20
121	RHS	MAV	ManchuNaga	Kandla	1.2.22	EMPTY	2340	3830	2810	3200	0	0	45.9	75.1	55.1	62.8	0.0	0.0	239.0	0.249	0.778	-	0.40			1.43
122	RHS	3AT	Shantilaal	Kandla	1.22	RICE	4440	7610	7475	0	0	0	87.1	149.3	146.7	0.0	0.0	0.0	383.1	3.226	-	15.99				19.22
123	RHS	MAV	ANJAR	Kandla	1.2.22	EMPTY	1840	1910	2035	1990	0	0	36.1	37.5	39.9	39.0	0.0	0.0	152.5	0.095	0.048	-	0.08			0.22

124	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2150	3810	3900	3510	0	0	42.2	74.8	76.5	68.9	0.0	0.0	262.3	0.177	0.762	-	0.93			1.87
125	RHS	3AT	Gandhidham	Kandla	1.22	EMPTY	1860	2410	2230	0	0	0	36.5	47.3	43.8	0.0	0.0	0.0	127.5	0.099	-	0.14				0.24
126	RHS	2AT	IOCL	Kandla	1.2	EMPTY	1920	2430	0	0	0	0	37.7	47.7	0.0	0.0	0.0	0.0	85.3	0.113	0.126					0.24
127	RHS	3AT	IOCL	Kandla	1.22	RICE	2955	5650	5560	0	0	0	58.0	110.9	109.1	0.0	0.0	0.0	277.9	0.633	-	4.88				5.51
128	RHS	3AT	HPCL	Kandla	1.22	Patriluu	2150	1930	1780	0	0	0	42.2	37.9	34.9	0.0	0.0	0.0	115.0	0.177	-	0.06				0.24
129	RHS	MAV	Gandhidham	Kandla	1.22.222	EMPTY	1460	1470	1140	0	1760	1555	28.6	28.8	22.4	0.0	34.5	30.5	144.9	0.038	-	0.01	-	-	0.01	0.06
130	RHS	MAV	HPCL	Kandla	1.22.222	CLOTHES	2330	3290	3380	5340	4600	4610	45.7	64.5	66.3	104.8	90.3	90.4	462.1	0.245	-	0.61	-	-	2.64	3.49
131	RHS	MAV	ANJAR	Kandla	1.2.22	EMPTY	1280	2830	2470	2210	0	0	25.1	55.5	48.5	43.4	0.0	0.0	172.5	0.022	0.232	-	0.15			0.40
132	RHS	MAV	ANJAR	Kandla	1.2.222	POWDE	3870	4110	5020	5150	5030	0	75.9	80.6	98.5	101.0	98.7	0.0	454.8	1.862	1.032	-	-	3.14		6.04
133	RHS	MAV	HPCL	Kandla	1.1.22	RICE	2860	3110	4960	4440	0	0	56.1	61.0	97.3	87.1	0.0	0.0	301.6	0.555	0.777	-	2.41			3.74
134	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1555	1360	1260	1130	1300	0	30.5	26.7	24.7	22.2	25.5	0.0	129.6	0.049	0.012	-	-	0.01		0.07
135	RHS	MAV	ManchuNaga	Kandla	1.2.22	SALT	2480	6670	6090	5860	0	0	48.7	130.9	119.5	115.0	0.0	0.0	414.0	0.314	7.160	-	6.30			13.77
136	RHS	3AT	MORBI	Kandla	1.22	RICE	3435	6935	5850	0	0	0	67.4	136.1	114.8	0.0	0.0	0.0	318.2	1.156	-	8.25				9.41
137	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2120	2010	2540	1810	0	0	41.6	39.4	49.8	35.5	0.0	0.0	166.4	0.168	0.059	-	0.11			0.34
138	RHS	3AT	Kandla	Kandla	1.22	EMPTY	1950	1670	1750	0	0	0	38.3	32.8	34.3	0.0	0.0	0.0	105.4	0.120	-	0.04				0.16
139	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	1980	2210	0	1920	1710	0	38.8	43.4	0.0	37.7	33.6	0.0	153.4	0.128	0.086	-	-	0.01		0.22
140	RHS	MAV	Gandhidham	MOTHI BAR	1.2.222	EMPTY	1950	2190	0	1790	1530	0	38.3	43.0	0.0	35.1	30.0	0.0	146.4	0.120	0.083	-	-	0.01		0.21
141	RHS	MAV	Gandhidham	Kandla	1.2.22	GEL	2380	4660	5870	5860	0	0	46.7	91.4	115.2	115.0	0.0	0.0	368.3	0.266	1.706	-	5.85			7.82
142	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	2375	2320	4110	4560	0	0	46.6	45.5	80.6	89.5	0.0	0.0	262.2	0.264	0.240	-	1.75			2.25
143	RHS	MAV	RKT	Kandla	1.2.222	EMPTY	1510	1580	0	1380	1520	0	29.6	31.0	0.0	27.1	29.8	0.0	117.5	0.043	0.023	-	-	0.00		0.07
144	RHS	MAV	RKT	Kandla	1.22.22	EMPTY	2570	0	2210	1950	1650	0	50.4	0.0	43.4	38.3	32.4	0.0	164.4	0.362	-	0.01	-	0.05		0.42
145	RHS	MAV	KARGO	Kandla	1.1.22	EMPTY	2130	0	3135	3010	0	0	41.8	0.0	61.5	59.1	0.0	0.0	162.4	0.171	0.000	-	0.44			0.61
146	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2290	3190	3050	2910	0	0	44.9	62.6	59.8	57.1	0.0	0.0	224.5	0.228	0.375	-	0.39			0.99
147	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2050	2930	0	1990	2140	0	40.2	57.5	0.0	39.0	42.0	0.0	178.7	0.147	0.267	-	-	0.02		0.43
148	RHS	MAV	VINAYAK	Kandla	1.22.222	EMPTY	2130	2010	1905	0	1730	1915	41.8	39.4	37.4	0.0	33.9	37.6	190.1	0.171	-	0.07	-	-	0.01	0.25
149	RHS	MAV	IOCL	Kandla	1.2.222	Chemica	3220	8350	0	7750	7810	0	63.2	163.8	0.0	152.1	153.2	0.0	532.3	0.892	17.587	-	-	3.45		21.93
150	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	5310	0	7790	6950	0	0	104.2	0.0	152.8	136.4	0.0	0.0	393.4	6.600	0.000	-	14.58			21.18
151	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	2810	3360	5645	6110	0	0	55.1	65.9	110.8	119.9	0.0	0.0	351.7	0.518	1.058	-	5.90			7.47
152	RHS	MAV	IOCL	Kandla	1.1.22	RICE	3585	0	5870	5640	0	0	70.3	0.0	115.2	110.7	0.0	0.0	296.2	1.371	0.000	-	5.42			6.79
153	RHS	3AT	Shantilaal	Kandla	1.22	RICE	4250	7490	7570	0	0	0	83.4	147.0	148.5	0.0	0.0	0.0	378.9	2.708	-	15.89				18.60
154	RHS	3AT	Shantilaal	Kandla	1.22	ANAJ	3660	6940	5335	0	0	0	71.8	136.2	104.7	0.0	0.0	0.0	312.6	1.490	-	7.01				8.50
155	RHS	3AT	Gandhidham	Kandla	1.22	Patriluu	2740	5600	5350	0	0	0	53.8	109.9	105.0	0.0	0.0	0.0	268.6	0.468	-	4.44				4.91
156	RHS	MAV	SiriramFood	Kandla	1.2.22	EMPTY	2010	2255	1995	1910	0	0	39.4	44.2	39.1	37.5	0.0	0.0	160.3	0.135	0.094	-	0.07			0.30
157	RHS	3AT	Gandhidham	Kandla	1.22	EMPTY	2150	2310	1975	0	0	0	42.2	45.3	38.7	0.0	0.0	0.0	126.3	0.177	-	0.10				0.28
158	RHS	MAV	IOCL	Kandla	1.2.22	Chemica	3270	3540	8210	7490	0	0	64.2	69.5	161.1	147.0	0.0	0.0	441.6	0.949	0.568	-	18.76			20.28
159	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	1480	1670	1460	1480	0	0	29.0	32.8	28.6	29.0	0.0	0.0	119.5	0.040	0.028	-	0.02			0.09
160	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	4270	0	6380	5870	0	0	83.8	0.0	125.2	115.2	0.0	0.0	324.1	2.760	0.000	-	6.95			9.71
161	RHS	MAV	IOCL	Kandla	1.1.22	BLACK PAPER	3920	0	5555	6035	0	0	76.9	0.0	109.0	118.4	0.0	0.0	304.3	1.960	0.000	-	5.57			7.53
162	RHS	MAV	IOCL	Kandla	1.1.22	Building Matarial	3380	6130	7780	7140	0	0	66.3	120.3	152.6	140.1	0.0	0.0	479.3	1.083	11.722	-	15.30			28.11
163	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2180	4010	3090	2950	0	0	42.8	78.7	60.6	57.9	0.0	0.0	240.0	0.187	0.935	-	0.41			1.53
164	RHS	MAV	Mithi Rd	Kandla	1.2.22	EMPTY	1690	2330	2490	1910	0	0	33.2	45.7	48.9	37.5	0.0	0.0	165.2	0.068	0.107	-	0.12			0.29
165	RHS	MAV	Mithi Rd	Kandla	1.1.22	EMPTY	2110	2250	2090	1975	0	0	41.4	44.1	41.0	38.7	0.0	0.0	165.3	0.165	0.213	-	0.08			0.46

166	RHS	MAV	GIDC	Kandla	1.1.22	EMPTY	2635	0	2390	2030	0	0	51.7	0.0	46.9	39.8	0.0	0.0	138.4	0.400	0.000	-	0.12			0.52
167	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2110	2650	0	2410	2090	0	41.4	52.0	0.0	47.3	41.0	0.0	181.7	0.165	0.178	-	-	0.02		0.37
168	RHS	MAV	BIHAR	Kandla	1.2.22	EMPTY	1670	1925	1775	1945	0	0	32.8	37.8	34.8	38.2	0.0	0.0	143.5	0.065	0.050	-	0.06			0.17
169	RHS	MAV	Shantilaal	Kandla	1.1.22	Patriluu	1980	2810	4190	7010	0	0	38.8	55.1	82.2	137.5	0.0	0.0	313.7	0.128	0.518	-	4.86			5.51
170	RHS	MAV	Gandhidham	Kandla	1.2.222	RICE	2150	4810	4915	5010	5810	0	42.2	94.4	96.4	98.3	114.0	0.0	445.3	0.177	1.936	-	-	3.61		5.72
171	RHS	MAV	Shantilaal	Kandla	1.1.22	CLOTHE	3280	0	4110	3870	0	0	64.4	0.0	80.6	75.9	0.0	0.0	220.9	0.961	0.000	-	1.25			2.21
172	RHS	3AT	BAJRANGI	Kandla	1.22	WHEAT	4450	5910	6270	0	0	0	87.3	116.0	123.0	0.0	0.0	0.0	326.3	3.255	-	6.80				10.05
173	RHS	3AT	Shantilaal	Kandla	1.22	WHEAT	3440	7010	6860	0	0	0	67.5	137.5	134.6	0.0	0.0	0.0	339.6	1.162	-	11.43				12.59
174	RHS	3AT	Shantilaal	Kandla	1.22	RICE	3910	5260	6810	0	0	0	76.7	103.2	133.6	0.0	0.0	0.0	313.5	1.940	-	6.56				8.50
175	RHS	3AT	Gandhidham	Kandla	1.22	SALT	4150	8270	7950	0	0	0	81.4	162.3	156.0	0.0	0.0	0.0	399.7	2.462	-	21.38				23.84
176	RHS	MAV	Shantilaal	Kandla	1.22.222	EMPTY	2255	2150	2090	0	1975	1950	44.2	42.2	41.0	0.0	38.7	38.3	204.4	0.215	-	0.10	-	-	0.01	0.33
177	RHS	MAV	Gandhidham	Kandla	1.1.22	SALT	4490	0	5185	4105	0	0	88.1	0.0	101.7	80.5	0.0	0.0	270.4	3.374	0.000	-	2.30			5.67
178	RHS	MAV	Gandhidham	Kandla	1.2.222	Chemica	2430	4460	4900	6870	7010	0	47.7	87.5	96.1	134.8	137.5	0.0	503.6	0.289	1.431	-	-	7.32		9.04
179	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2130	1540	0	1130	1010	0	41.8	30.2	0.0	22.2	19.8	0.0	114.0	0.171	0.020	-	-	0.00		0.19
180	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2335	3450	2870	3010	0	0	45.8	67.7	56.3	59.1	0.0	0.0	228.9	0.247	0.513	-	0.37			1.13
181	RHS	3AT	Shantilaal	Kandla	1.22	EMPTY	1975	1810	2170	0	0	0	38.7	35.5	42.6	0.0	0.0	0.0	116.8	0.126	-	0.08				0.20
182	RHS	MAV	PALI	Kandla	1.2.222	MEDICI	1795	2930	0	2780	3110	0	35.2	57.5	0.0	54.5	61.0	0.0	208.3	0.086	0.267	-	-	0.07		0.42
183	RHS	3AT	Shantilaal	Kandla	1.22	PAPAD	3780	6070	5920	0	0	0	74.2	119.1	116.2	0.0	0.0	0.0	309.4	1.695	-	6.38				8.08
184	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2185	1935	2090	2240	0	0	42.9	38.0	41.0	43.9	0.0	0.0	165.8	0.189	0.051	-	0.11			0.35
185	RHS	MAV	GT ROAD	Kandla	1.2.222	EMPTY	1310	1510	0	1970	1055	0	25.7	29.6	0.0	38.7	20.7	0.0	114.7	0.024	0.019	-	-	0.00		0.05
186	RHS	3AT	Gandhidham	Kandla	1.22	EMPTY	2530	3540	3410	0	0	0	49.6	69.5	66.9	0.0	0.0	0.0	186.0	0.340	-	0.72				1.06
187	RHS	MAV	Mithi Rd	Kandla	1.1.22	EMPTY	2260	2200	2210	0	0	0	44.3	43.2	43.4	0.0	0.0	0.0	130.9	0.217	0.194	-	0.01			0.42
188	RHS	MAV	IOCL	Kandla	1.2.222	EMPTY	1860	2080	0	2110	1710	0	36.5	40.8	0.0	41.4	33.6	0.0	152.3	0.099	0.068	-	-	0.01		0.18
189	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1870	2110	0	2550	1890	0	36.7	41.4	0.0	50.0	37.1	0.0	165.2	0.102	0.072	-	-	0.02		0.20
190	RHS	MAV	PALI	Kandla	1.2.222	EMPTY	2220	2430	0	2440	2160	0	43.6	47.7	0.0	47.9	42.4	0.0	181.5	0.202	0.126	-	-	0.03		0.35
191	RHS	MAV	Gandhidham	Kandla	1.1.22	Chemica	2530	0	2875	3215	0	0	49.6	0.0	56.4	63.1	0.0	0.0	169.1	0.340	0.000	-	0.42			0.76
192	RHS	MAV	RKT	Kandla	1.2.222	EMPTY	2630	1970	0	1770	1550	0	51.6	38.7	0.0	34.7	30.4	0.0	155.4	0.397	0.054	-	-	0.01		0.46
193	RHS	MAV	Gandhidham	Kandla	1.2.22	RICE	2590	5670	7935	7675	0	0	50.8	111.2	155.7	150.6	0.0	0.0	468.3	0.374	3.739	-	18.34			22.45
194	RHS	3AT	Shantilaal	Kandla	1.22	RICE	5190	6940	6530	0	0	0	101.8	136.2	128.1	0.0	0.0	0.0	366.1	6.023	-	10.17				16.19
195	RHS	3AT	Shantilaal	Kandla	1.22	KOYLA	4040	5690	8010	0	0	0	79.3	111.6	157.2	0.0	0.0	0.0	348.1	2.211	-	10.88				13.09
196	RHS	MAV	IOCL	Kandla	1.2.22	DIESEL	2180	4560	5245	4865	0	0	42.8	89.5	102.9	95.5	0.0	0.0	330.6	0.187	1.564	-	3.23			4.98
197	RHS	MAV	JAIPUR	Kandla	1.1.22	EMPTY	2110	0	2690	2250	0	0	41.4	0.0	52.8	44.1	0.0	0.0	138.3	0.165	0.000	-	0.18			0.35
198	RHS	MAV	IOCL	Kandla	1.1.22	Chemica	3730	0	7445	6990	0	0	73.2	0.0	146.1	137.1	0.0	0.0	356.4	1.607	0.000	-	13.41			15.02
199	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2330	3130	2940	2775	0	0	45.7	61.4	57.7	54.4	0.0	0.0	219.3	0.245	0.347	-	0.33			0.92
200	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	2510	2290	0	2190	1995	0	49.2	44.9	0.0	43.0	39.1	0.0	176.3	0.329	0.099	-	-	0.02		0.45
201	RHS	MAV	Shantilaal	Kandla	1.1.22	EMPTY	1910	0	1810	1750	0	0	37.5	0.0	35.5	34.3	0.0	0.0	107.3	0.110	0.000	-	0.05			0.16
202	RHS	MAV	Shantilaal	Kandla	1.2.22	EMPTY	2155	2335	2110	1910	0	0	42.3	45.8	41.4	37.5	0.0	0.0	167.0	0.179	0.108	-	0.08			0.37
203	RHS	MAV	Mandunagar	Kandla	1.2.222	EMPTY	1990	2270	0	1970	2050	0	39.0	44.5	0.0	38.7	40.2	0.0	162.5	0.130	0.096	-	-	0.02		0.24
204	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	5010	0	6890	7450	0	0	98.3	0.0	135.2	146.2	0.0	0.0	379.6	5.230	0.000	-	13.06			18.29
205	RHS	3AT	Shantilaal	Kandla	1.22	RICE	3785	7935	7245	0	0	0	74.3	155.7	142.1	0.0	0.0	0.0	372.1	1.704	-	16.40				18.10
206	RHS	MAV	GT ROAD	Kandla	1.2.22	EMPTY	1340	1990	1850	1925	0	0	26.3	39.0	36.3	37.8	0.0	0.0	139.4	0.027	0.057	-	0.06			0.15
207	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2070	2210	2035	1905	0	0	40.6	43.4	39.9	37.4	0.0	0.0	161.3	0.152	0.086	-	0.07			0.31
208	RHS	3AT	Shantilaal	Kandla	1.22	EMPTY	2150	2240	2370	0	0	0	42.2	43.9	46.5	0.0	0.0	0.0	132.6	0.177	-	0.14				0.32
209	RHS	MAV	Shantilaal	Kandla	1.1.22	RICE	2380	2770	4140	5210	0	0	46.7	54.3	81.2	102.2	0.0	0.0	284.5	0.266	0.489	-	2.36			3.12
210	RHS	3AT	Mithi Rd	Kandla	1.22	RICE	4115	7075	7550	0	0	0	80.7	138.8	148.1	0.0	0.0	0.0	367.7	2.380	-	14.13				16.51

Indian Roads Congress Guidelines IRC:37-2012												
Calculation of Cumulative Nos of Two Way Commercial Vehicles for the Entire Design Period										and		Design MSA
Carriageway Configuration and Design Life												
Carriageway Configuration (Single-Lane / Undivided 2-lane / Undivided 4-lane / Divided 4-Lane / Divided 6-lane / Divided 8-lane)										Mandatory Input →		Divided 6-Lane
Design Period (Years), n										Mandatory Input →		15
Number of years between the Last Classified Traffic Volume Count and the Year of Completion of Construction, x										Mandatory Input →		1.5
Lane width (m)										Optional Input		3.5
Paved Shoulder Width (m)										Optional Input		yes
Design Traffic (MSA) Estimation												
Base Year CVPD, Two-Way CV Wise as per Last Classified Traffic Volume Count, P (Important Note ! If Any of the CV Wise CVPD is Zero, Enter 0 there)						LCV (CVPD)	M.BUS (CVPD)	BUS (CVPD)	2AT (CVPD)	3AT (CVPD)	MAV (CVPD)	Total CVPD
						258	1	14	19	574	1333	2199
Initial CVPD, Two-Way (CV Wise) at the Start when the Road is Opened, A						263	1	14	20	614	1490	2401
Annual Growth Rate of Commercial Vehicles. (Important Note ! If Any of the CV Wise CVPD is Zero, Enter Corresponding Growth Rate % as Any Non-Zero Value. Don't Put 0 or Don't Leave it Blank)						LCV (Growth %)	M.BUS (Growth %)	BUS (Growth %)	2AT (Growth %)	3AT (Growth %)	MAV (Growth %)	Average Growth % (If Growth Rate Assumed Uniform for all CV)
Growth Rate (%) During the Period 1.5 Years for Design, Project Preparation &		Period in Years →				1	1.2%	0.0%	0.0%	1.9%	4.6%	7.7%
		Period in Years →				0.5	1.2%	0.0%	0.0%	1.9%	4.6%	7.7%
Growth Rate % for the First 'Time		Year	0	To	Year	5	1.1%	0.0%	0.0%	1.8%	5.3%	8.9%
Growth Rate % for the Second 'Time		Year	5	To	Year	10	0.9%	0.0%	0.0%	1.5%	4.6%	7.8%
Growth Rate % for the Third 'Time		Year	10	To	Year	15	0.7%	0.0%	0.0%	1.2%	3.9%	6.7%
Growth Rate % for the Fourth 'Time		Year	15	To	Year	20	0.6%	0.0%	0.0%	1.0%	3.2%	5.8%
Growth Rate % for the Fifth 'Time		Year	20	To	Year	25	0.5%	0.0%	0.0%	0.9%	2.7%	5.1%
Growth Rate % for the Sixth 'Time		Year	25	To	Year	50	0.5%	0.0%	0.0%	0.8%	2.4%	4.9%

Design Two-Way Cumulative Number of Commercial Vehicles (CV) for the Entire Design Period, C		C _{LCV}	C _{M.BUS}	C _{BUS}	C _{2AT}	C _{3AT}	C _{MAV}	C = $\Sigma(C_{LCV}+C_{M.BUS}+C_{BUS}+C_{2AT}+C_{3AT}+C_{MAV})$
		1539742			120064	4809490	15012400	21481696
Whether like to Use Design VDF as CV Wise or Average or by User Input (CV Wise / Average / User Input)							Mandatory Input for VDF	User Input
Design VDF (To be determined from Axle Load Survey, if not, then Enter Value as Per Cl. 4.4.6 of IRC:37-2012), F		LCV (VDF)	M.BUS (VDF)	BUS (VDF)	2AT (VDF)	3AT (VDF)	MAV (VDF)	Average VDF (If VDF Assumed Uniform for
	VDF by User Input →	0	0	0	0.25	6.27	6.6	
Directional Distribution Factor (For Undivided Road 100%, For Divided Road 50%)							B	50%
Lane Distribution Factor (Refer Clause 4.5.1 of IRC:37-2012)							D	0.60
Design MSA							msa	39
Proportion of Front single (steering) Axles,							Not Considered in Fatigue Damage Analysis for Design of Cementitious Flexible	
Proportion of Rear single Axles,							K1	34.5%
Proportion of tandem Axles,							K2	49.4%
Proportion of Tridem Axles, K3 = (1-K1-K2)							K3	16.1%
Total							K1+K2+K3	100.0%



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Consultancy Service for Preparation of Details Project Report for widening & Improvement of Existing 2/4-lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)



FINAL DETAILED PROJECT REPORT

DESIGN REPORT

[VOLUME – II]



MONARCH

SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.

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Consultancy Service for Preparation of Details Project Report (DPR) for widening & Improvement of Existing 2/4 –lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)

**Detailed Project
Report**

DESIGN OF HIGHWAYS

MONARCH Surveyors & Engineering

Deendayal Port Authority

A

Chapter-1: DESIGN OF HIGHWAYS

1.1. Methodology

The project involves a series of inter related activities, both in the field and in the design office. Methodology for carrying out these activities is described in the following paragraphs.

1.2. Site Investigations and Surveys

a) Road Inventory

Inventory of the existing road shall cover all existing physical features such as terrain, land-use, roadway, carriageway, type of cross section (cut or fill), utility lines passing along or crossing the highway, roadside facilities and all other features that may have influence on the project preparation.

b) Road Condition Survey

Inventory of the existing road shall cover all existing physical features such as terrain, land use, roadway, carriageway, type of cross section (cut or fill), utility lines passing along or crossing the highway, roadside facilities and all other features that may have influence on the project preparation.

Detailed field study shall be carried out for road and pavement surface conditions covering the following:

- i. pavement condition (surface distress type and extent);
- ii. shoulder condition;
- iii. embankment condition; and

iv. drainage condition

The process ensures that complete information on condition of existing pavement and shoulder is collected so that design parameters related to pavement can be established.

The information collected shall consist of the details of cracking (narrow and wide), rut depth, raveling, potholing, patching in the form of percentage area as well as edge break in terms of length and rut depth in mm. affected of the existing pavement; and paved shoulder material loss, rut depth, corrugation, edge etc. in the case of unpaved shoulders.

The study shall identify defects and road section with similar characteristics i.e. homogeneous sections.

1.3. Topographic, Drainage and Utility Survey

According to the TOR, detailed topographic survey is required to be carried out for capturing the essential ground features along the alignment and for working out improvements, rehabilitation and upgrading costs.

Hence, the Consultants propose to carry out detailed topographic survey for the project road. Briefly the survey work would include:

- Topographic survey true to ground realities using precision instruments like Total Stations and Auto Levels, and bringing out data in digital form (X,Y,Z format) for developing digital terrain model (DTM)
- Capturing all existing physical features, including utility poles, trees of girth greater than 0.3 m, oil and gas lines, hills, valley etc. within the survey corridor which should be compatible with the widening requirements subject to a minimum of 25 m on either side of the centre line of the road or road land boundary, whichever is more.
- Additional surveys at bridge sites for hydraulic calculations and for all arms of crossing

roads at intersections.

- Where existing road crosses the alignments, the survey will extend a minimum of 100m on either side of the road centre line to allow improvements, including at-grade intersections.
- Longitudinal sections shall be taken at 25 m interval and at the locations of curve points, small streams, and intersections and at change in elevation. Cross-sections, in general covering the full width of survey corridor at 50 m interval shall be taken and should show levels at every 2-5 m intervals also at all breaks in the profile. Cross sections shall be taken at closer interval (15-25 m depending on radius of curve) on curves.

Fixing horizontal and vertical control points with concrete pillars. The Reference Pillars/BMs with levels drawn from GTS bench marks shall be of size 15cmX15cmX45cm, cast in RCC grade M15 with a nail fixed in the centre of the top surface. The reference pillar shall be embedded in concrete up to a depth of 30 cm with CC M 10 (5 CM wide all around). The balance 15 cm above ground shall be painted yellow. The spacing shall be 250m apart.

1.4. Study of Alternatives for Realignments/Poor Geometrics

Alignment, realignment design was done on satellite images and its validity was studied at site. The poor geometrics were corrected by increasing the radii of sharp curves

The revised design was then incorporated on topographic survey finalize to report.

1.5. Junctions/Intersections at Grade

Though there is 1 nos. major junction and most of the minor junctions were T/Y shaped, but they were studied at site for the purpose of improving them.

1.6. Pavement Studies

1.6.1. Sub-grade Characteristics and Strength

Project length is divided into homogeneous sections with respect to pavement condition and structural strength. The delineation of segments homogeneous with respect to roughness and strength should be done using the cumulative difference approach (AASHTO, 1993). For the widening of existing road within the ROW, sampling and testing of at least 3 sub-grade soil samples for each homogeneous road sections or 3 samples for each soil type encountered, whichever is higher. In case of new alignments, the test pits for sub-grade soil shall be @ 5 km interval or for each soil type, whichever is more. A minimum of three samples should be tested corresponding to each homogeneous segment. The testing for sub-grade soils shall include the following:

- i) In situ density and moisture content at each test pit
- ii) Field CBR using DCP at each test pit.
- iii) Characterization (Grain size and Atterberg Limit test) for each test pit sample.
- iv) Laboratory moisture density characteristics (modified AASHTO compaction).
- v) Laboratory CBR (un-soak and 4-day soak compacted at three energy levels) and swell.
- vi) Apart from the above, permeability and consolidation test shall be carried out for problematic soils along project corridor.

1.6.2. Material Investigation

The activities included:

- i) Identification of potential sources (including use of fly-ash/slag), quarry sites and borrow areas.
- ii) Collection of samples and conducting relevant laboratory tests.
- iii) Evaluation of test results and assesses the suitability thereof for incorporation in various works and making recommendation on the use of the materials from different sources based on techno-economic principles.
- iv) Assess adequacy of quality and quantities of various construction materials available

- v) No material shall be used from the ROW except by way of leveling the ground as required from construction point of view or for landscaping and planting of trees. Environmental restrictions, if any and feasibility of availability of these sites to perspective civil works contractors should be duly taken into account.
- vi) Preparation of mass haul diagram and quarry charts indicating the location of selected borrow areas, quarries and the respective estimated quantities.
- vii) Recommend on how to make good this borrow and quarry areas after the exploitation of materials for construction of works.
- viii) Preparation and testing of bituminous mixes for various layers and concrete mixes of different grades using suitable materials (binders, aggregates, sand fillers etc.) as identified during material investigation to conform to latest MORT&H specifications.

1.7. Traffic Studies

Traffic survey stations have been selected by the Consultant on the basis of understanding of the road network as well as consideration of the following aspects:

- to represent homogeneous traffic section
- to be outside urban and local influence area
- to be located at a level with good visibility

1.7.1. Schedule of primary surveys

To capture the traffic flow characteristics and the travel pattern of the users passing through the project road and other characteristics related to miscellaneous requirements as per ToR following primary surveys were conducted.

- 7-days classified traffic volume count surveys at two locations on the project road
- 1 Day (12 hours) OD Survey at two locations on the project road
- 1 Day (24 hours) Axle Load Survey at two locations on the project road (Details included under different section)

- 1 Day (12 hours) Turning Movement Surveys at three major intersections on the project road
- 1 Day (12Hours) Pedestrian Count Surveys at six major town locations
- Speed & Delay Survey - 2 trip of project road

1.8. Design Of Road Features

1.8.1. General

The salient proposals for up gradation and improvement of the project road are classified into the following engineering aspects.

- Widening of the project road based on traffic capacity.
- Improving the horizontal and vertical geometry of the existing road based on the design standards.
- and the subsequent extra widening are presented
- Design of new pavement for widening and strengthening of the existing road.
- Improvement of all major and minor intersections.
- Rehabilitation and widening of the existing structures including bridges, culverts etc. and design of new ones.
- Provision of comprehensive road furniture for complete road safety.

1.8.2. Design Basis, Standards and Specifications:

The design criteria / method applied for important components of the project are as follows:

Geometric Design:	IRC SP 87-2019 Manual of Standards & Specifications for six lan- ing highways with paved shoulder IRC SP:48-1998 Hill Road Manual IRC 73 : Geometric design standards for rural highways
-------------------	---

	IRC-SP 23 – Design of Vertical Alignment
Pavement Design:	Overlay
	IRC-81-1997 for designing and strengthening requirements of existing pavement.
	New Pavement
	IRC 37-2012 for design of flexible pavement
	IRC 58-2015 for design of rigid pavement.
Road Furniture &	
Roadside facilities:	Related standards of IRC manual of specifications & MoRT&H publications.

The basis of preliminary design of various components of the project road is provided in following table.

Table-1: 1 Design Basis, Standards and Specifications

SI No.	Project Component	Basis	Outcome
1	Road alignment and profile	<ul style="list-style-type: none"> • Geometric design standards • Road Inventory • Type of area, rural or urban including available ROW and road-side developments • Suitability of location for new bridges 	<ul style="list-style-type: none"> • Location of widening carriageway • Improvement to sub-standard curves and steep grade sections
2	Intersections/ Junctions	<ul style="list-style-type: none"> • Peak-hour traffic intensities and turning movement data 	<ul style="list-style-type: none"> • Design of at-grade intersections • Installation of traffic control measures

Sl No.	Project Component	Basis	Outcome
3	Pavement design strengthening of existing pavement	<ul style="list-style-type: none"> • Traffic loading in terms of cumulative standard axles for design lane • Benkelman Beam deflection data • CBR of existing sub-grade • Laboratory soaked CBR of sub-grade material • Thickness and composition of existing pavement layers 	Strengthening overlays for applicable stretches
4	Pavement design new pavement	<ul style="list-style-type: none"> • Traffic loading in terms of cumulative standard axles for design lane • Soaked laboratory CBR of soil samples from prospective borrow areas • Initial design life and stage development strategy 	<ul style="list-style-type: none"> • Thickness and composition of various pavement courses • Design life determination
5	Road furniture and safety measures	<ul style="list-style-type: none"> • Road inventory • Alignment plans • Locations of intersections on urban areas 	<ul style="list-style-type: none"> • Identification of different types of signs on linear plans • Identification of locations for installation of crash barriers and pedestrian guard rails • Pavement marking details
6	Roadside Drains	Results from drainage study	Location, type and size of roadside drains to be provided

Sl No.	Project Component	Basis	Outcome
7	Wayside Amenities	Inventory of existing wayside amenities by location, type and quality grade	<ul style="list-style-type: none"> • Evaluation of need and additional amenities • Locations and laybye design for bus stops

1.8.3. Geometric Design Standards

This project is existed as Single lane and intermediate lane of having fair to poor condition of existing pavement. The geometric of this road will be proposed according to Six lane with paved shoulder. The geometric designs are formulated as per the recommendations of IRC: SP: 87-2019.

1.8.4. Design of horizontal and vertical alignment

The existing designs of both horizontal and vertical alignments are not sound with lots of sharp curves and improper gradients. The proposed design is emphasized in adhering to the IRC codes and manual. The design methodology is also supported by various directives received from Project coordinating consultants and as well as at various occasions. The design proposed is mostly eccentric widening with overlay or reconstruction depending on the condition of the existing road. Efforts have been made to follow the existing road in most of the places in order to minimizing the land acquisition and project cost. Realignment has been proposed for minor built-up areas and areas with poor geometrics and all major built-up areas are proposed with Bypasses where found feasible.

1.8.5. Typical Cross Sections

Selection of cross-section has been governed by the widening scheme adopted and by other considerations like land-use, drainage condition, traffic characteristics etc. The following typical cross sections are proposed for the widening/new construction of project highway. These depict

generalized or critical/important main features only within the related stretches.

Following are the Typical cross sections adopted for development of the project highway: -

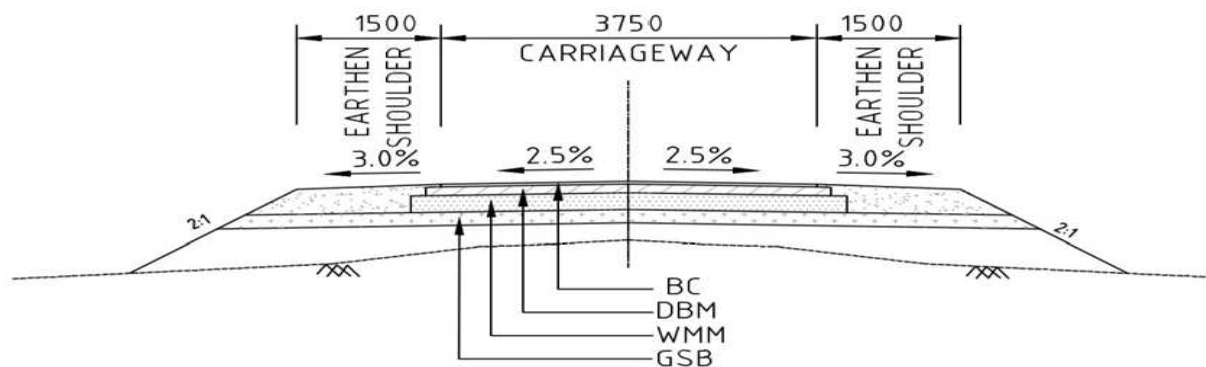


Fig-1: 1 Type-I: Single lane road

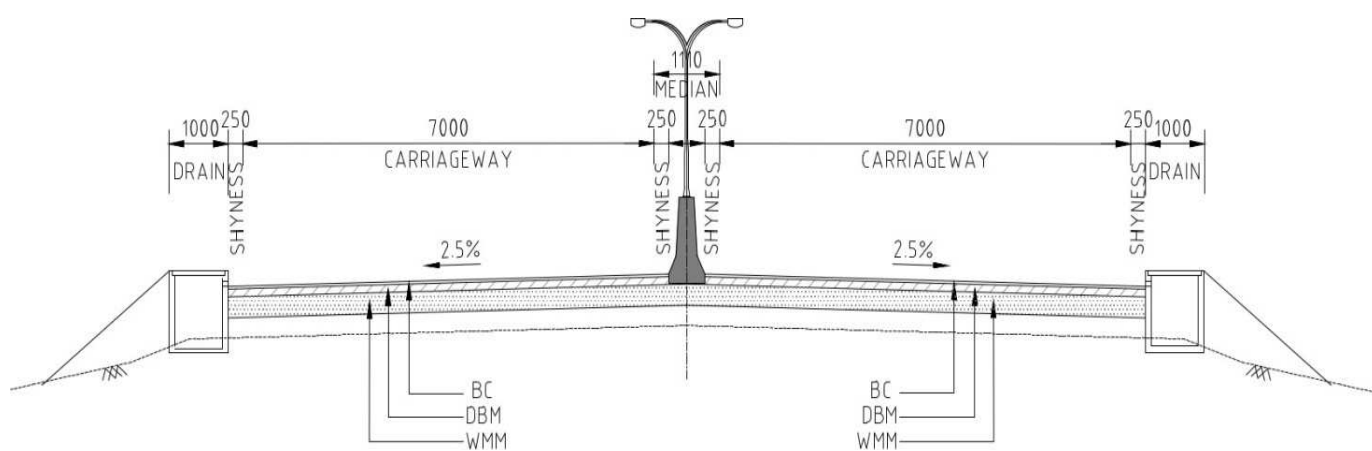


Fig-1: 2 Type-II: Four lane road at Built-up Area

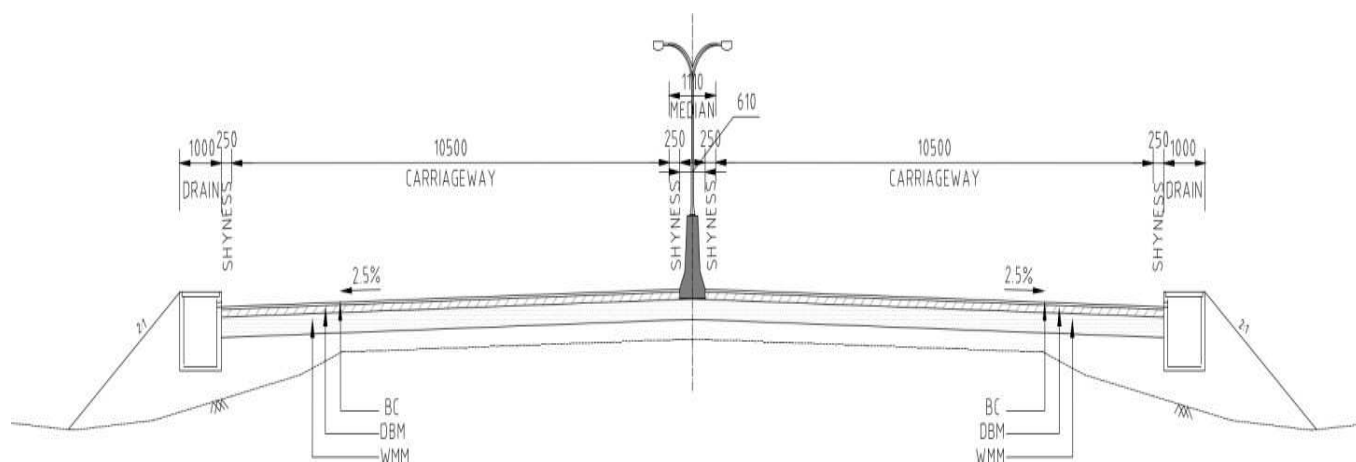


Fig-1: 3 Type-III: Six lane road at Built-up Area

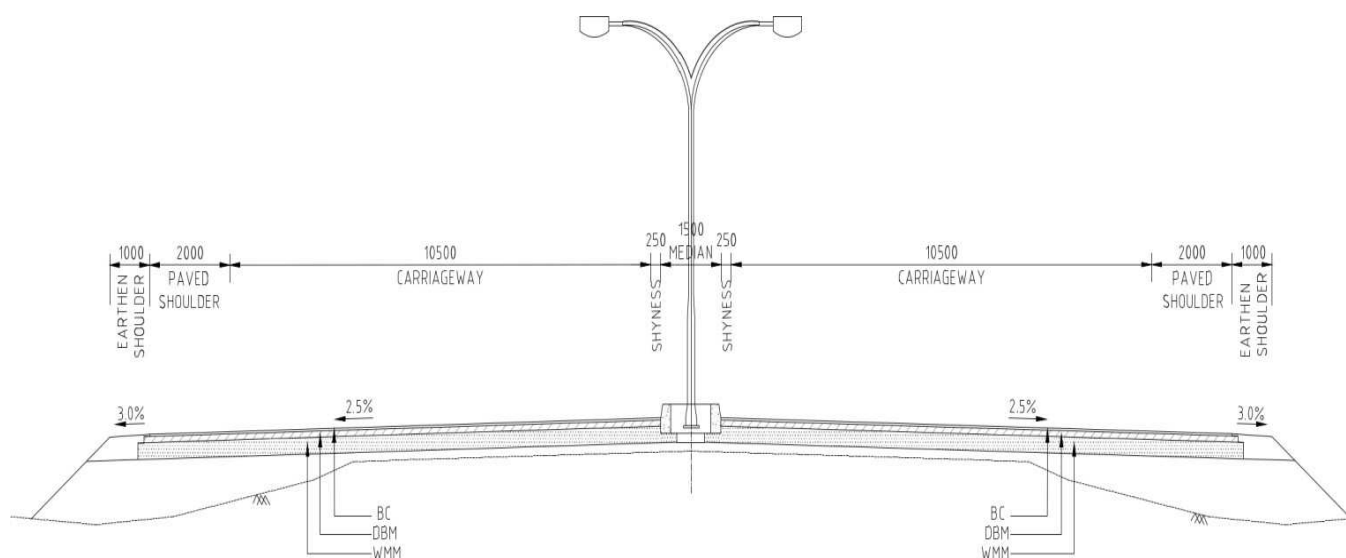


Fig-1: 4 Type-IV: Six lane road at Open Area

1.8.6. Widening and Strengthening of Carriageway

In all the cases the shoulders have to be rebuilt and all sections are required to be widened to four/six lane carriageway.

1.8.7. Proposals for Realignments

Four types of typical cross sections have been prepared for up-gradation of the highway, which conform to the Manual of Specification & Standards 6-laning (IRC: SP 87-2019 for the entire project corridor.

For Phase-I:

- (i) Type-I: Single lane road (km 0+000 to 0+080)
- (ii) Type-II: Four lane road at Built-up Area (km 0+080 to 0+560)
- (iii) Type-III: Six lane road at Built-up Area (km 0+560 to 2+500)
- (iv) Type-IV: Six lane road at Open Area (km 2+500 to 9+000)

1.8.8. Road Side Drains

Due consideration has been given to drainage while preparing the design. The cross-sections incorporating roadside drains have been proposed at various stretches of the highway taking into account the existing and natural conditions as well as anticipated situation. In general, unlined trapezoidal drains have been considered at Hill side of road. Covered drains have been proposed in urban stretches. Details of drains are provided as in following table.

Table-1: 2 Details of Road Side Drains

S.No	Chainage (km)		Design Length	Type of Drains
	From	To	(m)	
1	0+100	2+500	2400	Rectangular Both Side

1.8.9. Major and Minor Junctions

The project highway meets/crosses different category of road like NH, SH, MDR and other roads. The major junctions along the project highway are as below:

Table-1: 3 Major Intersection

S. No.	Chainage (km)	Type	Side (LHS,RHS)
1	03+600	Roundabout	4-leg

These are the intersections with category of roads like ODR, VR and have black top, brick soled or earthen surface. Details of intersections with secondary importance (Minor Junction) are presented as below:

Table-1: 4 Minor Intersection

Sl	Ch	Type	Side	To
1	00+310	T	LHS	Port
2	00+360	T	RHS	IFFCO Gate
3	00+700	T	LHS	Port
4	01+390	T	LHS	
5	01+950	T	LHS	Port
6	03+050	T	LHS	Port
7	06+400	T	RHS	Jetty/Port
8	07+620	+	4-leg	Port
9	08+900	T	LHS	

1.8.10. ROB/RUB

No ROB/RUB has been proposed.

1.8.11. Other road features and facilities

1.8.11.1. Bus Bays

No bus bay has been proposed in this road section.

1.8.11.2. Vehicle Parking Area

Vehicle Parking Area has been proposed in this road section.

1.8.11.3. Passing Places

No passing Places has been proposed.

1.8.11.4. Cattle Crossing

There is no significant cattle movement across the road and hence there is no proposal of separate cattle crossing.

1.8.12. Traffic Safety and Other Appurtenances

Following road furniture and miscellaneous items have been designed keeping safety aspect in mind.

- Road markings
- Road Signs & Delineators
- Crash Barriers
- Parapet Wall
- Noise Barriers
- Hard Topping

1.8.13. Road Markings

Road Markings on the carriageway and on the objects within and adjacent to the roadway are used as a means of guiding and controlling the traffic. They promote road safety and ensure smooth flow of traffic in the required paths of travel.

The location and type of marking lines, material and colour is followed using IRC: 35-2015 – “Code of Practice for Road Markings”.

The road markings were carefully planned on carriageways, intersections, toll plazas and bridge locations.

1.8.14. Road Signs & Delineators

Road signs were planned to supply information, to regulate traffic by imparting messages to the drivers. The type, locations, sizes were planned using IRC: 67-2012 “Code of Practice for Road Sign”.

The role of delineators is to provide visual assistance to driver about alignment of the road ahead, especially at night. Reflectors are used on the delineators for better night visibility. IRC: 79-1981 “Recommended Practice for Road Delineators” was followed to plan locations details. Two types of road delineators were planned i.e. hazard markers and object markers. Hazard markers are to define obstructions like guardrails, and abutments adjacent to the carriageway, for instance at culverts and bridges. Object markers are used to indicate hazards and obstructions within the vehicle flow path, at channeling islands close to intersections.

1.8.15. Crash Barrier

Metal crash barriers are proposed/ provided for safety of the traffic on the stretches on approaches of bridges. It is also proposed on the curves for safety of traffic irrespective of embankment height as per NHAI Circular (NHAI/PH-II/NHDP/ADB/GM (NS)-I dated May 19, 2004).

1.8.16. Parapet Wall

Parapet walls are provided along the edge of the shoulders at the valley side throughout the project stretch excluding the settlement areas. These are provided to prevent the vehicles from toppling over.

ANNEXURES

Annex-I: DESIGN CENTRE LINE REPORT

Easting	Northing	Elevation (m)	Chainage (km)
625024.290	2547225.878	4.280	00+000
625028.933	2547245.331	4.398	00+020
625015.982	2547256.878	4.515	00+040
624996.576	2547261.715	4.633	00+060
624977.565	2547267.856	4.742	00+080
624960.197	2547277.699	4.834	00+100
624944.192	2547289.690	4.908	00+120
624928.280	2547301.807	4.965	00+140
624912.343	2547313.889	5.004	00+160
624895.379	2547324.428	5.027	00+180
624876.592	2547331.181	5.032	00+200
624857.086	2547335.595	5.021	00+220
624837.550	2547339.877	5.009	00+240
624818.014	2547344.159	4.997	00+260
624798.478	2547348.442	4.984	00+280
624778.942	2547352.724	4.972	00+300
624759.416	2547357.053	4.960	00+320
624740.695	2547363.893	4.947	00+340
624726.948	2547377.997	4.935	00+360
624723.973	2547397.511	4.922	00+380
624728.763	2547416.883	4.910	00+400
624735.309	2547435.782	4.898	00+420
624741.861	2547454.678	4.885	00+440
624748.178	2547473.651	4.873	00+460
624750.476	2547493.403	4.861	00+480
624742.692	2547511.445	4.848	00+500
624726.054	2547522.212	4.836	00+520
624706.822	2547527.642	4.824	00+540
624687.372	2547532.298	4.811	00+560
624667.921	2547536.955	4.799	00+580
624648.471	2547541.611	4.786	00+600
624629.021	2547546.267	4.774	00+620
624609.570	2547550.924	4.762	00+640
624590.120	2547555.580	4.749	00+660
624570.669	2547560.236	4.737	00+680
624551.219	2547564.893	4.725	00+700
624531.769	2547569.549	4.712	00+720
624512.318	2547574.205	4.700	00+740
624492.868	2547578.862	4.687	00+760

Easting	Northing	Elevation (m)	Chainage (km)
624473.417	2547583.518	4.675	00+780
624453.967	2547588.175	4.663	00+800
624434.517	2547592.831	4.650	00+820
624415.066	2547597.487	4.638	00+840
624395.616	2547602.144	4.626	00+860
624376.165	2547606.800	4.613	00+880
624356.715	2547611.456	4.601	00+900
624337.265	2547616.113	4.588	00+920
624317.814	2547620.769	4.576	00+940
624298.362	2547625.417	4.564	00+960
624278.900	2547630.027	4.551	00+980
624259.430	2547634.599	4.539	01+000
624239.950	2547639.132	4.527	01+020
624220.468	2547643.652	4.514	01+040
624200.985	2547648.173	4.503	01+060
624181.503	2547652.693	4.493	01+080
624162.020	2547657.213	4.484	01+100
624142.538	2547661.734	4.477	01+120
624123.056	2547666.254	4.471	01+140
624103.573	2547670.774	4.465	01+160
624084.091	2547675.295	4.462	01+180
624064.608	2547679.815	4.459	01+200
624045.126	2547684.335	4.458	01+220
624025.643	2547688.856	4.457	01+240
624006.161	2547693.376	4.458	01+260
623986.678	2547697.896	4.461	01+280
623967.196	2547702.417	4.464	01+300
623947.713	2547706.937	4.469	01+320
623928.231	2547711.457	4.475	01+340
623908.748	2547715.978	4.481	01+360
623889.266	2547720.498	4.487	01+380
623869.783	2547725.018	4.493	01+400
623850.301	2547729.539	4.499	01+420
623830.819	2547734.059	4.505	01+440
623811.336	2547738.579	4.511	01+460
623791.854	2547743.100	4.517	01+480
623772.371	2547747.620	4.523	01+500
623752.889	2547752.140	4.529	01+520
623733.406	2547756.661	4.535	01+540
623713.924	2547761.181	4.541	01+560
623694.441	2547765.701	4.547	01+580
623674.959	2547770.222	4.553	01+600
623655.476	2547774.742	4.559	01+620
623635.994	2547779.262	4.565	01+640

Easting	Northing	Elevation (m)	Chainage (km)
623616.511	2547783.783	4.571	01+660
623597.029	2547788.303	4.577	01+680
623577.546	2547792.823	4.583	01+700
623558.064	2547797.344	4.589	01+720
623538.581	2547801.864	4.595	01+740
623519.099	2547806.384	4.600	01+760
623499.617	2547810.905	4.606	01+780
623480.134	2547815.425	4.612	01+800
623460.652	2547819.945	4.618	01+820
623441.169	2547824.466	4.624	01+840
623421.687	2547828.986	4.630	01+860
623402.204	2547833.506	4.636	01+880
623382.722	2547838.027	4.642	01+900
623363.239	2547842.547	4.648	01+920
623343.757	2547847.067	4.654	01+940
623324.274	2547851.588	4.660	01+960
623304.792	2547856.108	4.666	01+980
623285.309	2547860.628	4.672	02+000
623265.827	2547865.148	4.678	02+020
623246.344	2547869.669	4.684	02+040
623226.862	2547874.189	4.690	02+060
623207.379	2547878.709	4.696	02+080
623187.897	2547883.230	4.702	02+100
623168.415	2547887.750	4.708	02+120
623148.932	2547892.270	4.714	02+140
623129.450	2547896.791	4.720	02+160
623109.967	2547901.311	4.726	02+180
623090.485	2547905.831	4.732	02+200
623071.002	2547910.352	4.738	02+220
623051.520	2547914.872	4.744	02+240
623032.037	2547919.392	4.750	02+260
623012.555	2547923.913	4.756	02+280
622993.072	2547928.433	4.762	02+300
622973.590	2547932.953	4.768	02+320
622954.107	2547937.474	4.774	02+340
622934.625	2547941.994	4.780	02+360
622915.142	2547946.514	4.786	02+380
622895.660	2547951.035	4.792	02+400
622876.177	2547955.555	4.798	02+420
622856.695	2547960.075	4.804	02+440
622837.213	2547964.596	4.810	02+460
622817.730	2547969.116	4.816	02+480
622798.248	2547973.636	4.822	02+500
622778.765	2547978.157	4.828	02+520

Easting	Northing	Elevation (m)	Chainage (km)
622759.283	2547982.677	4.834	02+540
622739.800	2547987.197	4.840	02+560
622720.318	2547991.718	4.846	02+580
622700.835	2547996.238	4.852	02+600
622681.353	2548000.758	4.858	02+620
622661.870	2548005.279	4.864	02+640
622642.388	2548009.799	4.870	02+660
622622.905	2548014.319	4.876	02+680
622603.423	2548018.840	4.882	02+700
622583.940	2548023.360	4.888	02+720
622564.458	2548027.880	4.894	02+740
622544.975	2548032.401	4.900	02+760
622525.493	2548036.921	4.906	02+780
622506.011	2548041.441	4.912	02+800
622486.528	2548045.962	4.918	02+820
622467.046	2548050.482	4.924	02+840
622447.563	2548055.002	4.930	02+860
622428.081	2548059.523	4.936	02+880
622408.598	2548064.043	4.942	02+900
622389.116	2548068.563	4.948	02+920
622369.633	2548073.084	4.954	02+940
622350.151	2548077.604	4.960	02+960
622330.668	2548082.124	4.966	02+980
622311.186	2548086.645	4.972	03+000
622291.703	2548091.165	4.978	03+020
622272.221	2548095.685	4.984	03+040
622252.738	2548100.206	4.990	03+060
622233.256	2548104.726	4.996	03+080
622213.774	2548109.246	5.002	03+100
622194.291	2548113.767	5.008	03+120
622174.809	2548118.287	5.014	03+140
622155.326	2548122.807	5.020	03+160
622135.844	2548127.328	5.026	03+180
622116.361	2548131.848	5.032	03+200
622096.879	2548136.368	5.038	03+220
622077.396	2548140.889	5.044	03+240
622057.914	2548145.409	5.050	03+260
622038.431	2548149.929	5.056	03+280
622018.949	2548154.450	5.062	03+300
621999.466	2548158.970	5.068	03+320
621979.984	2548163.490	5.074	03+340
621960.501	2548168.010	5.080	03+360
621941.019	2548172.531	5.086	03+380
621921.536	2548177.051	5.092	03+400

Easting	Northing	Elevation (m)	Chainage (km)
621902.054	2548181.571	5.098	03+420
621882.572	2548186.094	5.104	03+440
621863.120	2548190.744	5.110	03+460
621843.784	2548195.850	5.116	03+480
621824.665	2548201.716	5.122	03+500
621805.826	2548208.426	5.128	03+520
621787.304	2548215.966	5.134	03+540
621769.135	2548224.322	5.140	03+560
621751.355	2548233.476	5.146	03+580
621733.999	2548243.412	5.152	03+600
621717.102	2548254.109	5.158	03+620
621700.697	2548265.546	5.164	03+640
621684.816	2548277.700	5.170	03+660
621669.491	2548290.549	5.176	03+680
621654.752	2548304.065	5.182	03+700
621640.628	2548318.223	5.188	03+720
621627.147	2548332.994	5.194	03+740
621614.335	2548348.350	5.200	03+760
621602.195	2548364.242	5.206	03+780
621590.541	2548380.496	5.212	03+800
621579.094	2548396.895	5.218	03+820
621567.663	2548413.307	5.224	03+840
621556.232	2548429.719	5.230	03+860
621544.802	2548446.130	5.236	03+880
621533.371	2548462.542	5.242	03+900
621521.941	2548478.954	5.248	03+920
621510.510	2548495.365	5.254	03+940
621499.079	2548511.777	5.260	03+960
621487.649	2548528.188	5.266	03+980
621476.218	2548544.600	5.272	04+000
621464.788	2548561.012	5.278	04+020
621453.357	2548577.423	5.284	04+040
621441.926	2548593.835	5.290	04+060
621430.496	2548610.247	5.296	04+080
621419.065	2548626.658	5.302	04+100
621407.635	2548643.070	5.308	04+120
621396.204	2548659.481	5.314	04+140
621384.773	2548675.893	5.320	04+160
621373.343	2548692.305	5.326	04+180
621361.912	2548708.716	5.332	04+200
621350.482	2548725.128	5.338	04+220
621339.051	2548741.540	5.344	04+240
621327.620	2548757.951	5.350	04+260
621316.190	2548774.363	5.356	04+280

Easting	Northing	Elevation (m)	Chainage (km)
621304.759	2548790.774	5.362	04+300
621293.328	2548807.186	5.368	04+320
621281.898	2548823.598	5.374	04+340
621270.467	2548840.009	5.380	04+360
621259.037	2548856.421	5.386	04+380
621247.606	2548872.832	5.392	04+400
621236.175	2548889.244	5.398	04+420
621224.745	2548905.656	5.404	04+440
621213.314	2548922.067	5.410	04+460
621201.884	2548938.479	5.416	04+480
621190.453	2548954.891	5.422	04+500
621179.022	2548971.302	5.428	04+520
621167.592	2548987.714	5.434	04+540
621156.161	2549004.125	5.440	04+560
621144.731	2549020.537	5.446	04+580
621133.300	2549036.949	5.452	04+600
621121.869	2549053.360	5.458	04+620
621110.439	2549069.772	5.464	04+640
621099.008	2549086.184	5.470	04+660
621087.578	2549102.595	5.476	04+680
621076.147	2549119.007	5.482	04+700
621064.716	2549135.418	5.488	04+720
621053.286	2549151.830	5.494	04+740
621041.855	2549168.242	5.500	04+760
621030.425	2549184.653	5.506	04+780
621018.994	2549201.065	5.512	04+800
621007.563	2549217.476	5.518	04+820
620996.133	2549233.888	5.524	04+840
620984.702	2549250.300	5.530	04+860
620973.272	2549266.711	5.536	04+880
620961.841	2549283.123	5.542	04+900
620950.410	2549299.535	5.547	04+920
620938.980	2549315.946	5.553	04+940
620927.549	2549332.358	5.559	04+960
620916.118	2549348.769	5.565	04+980
620904.688	2549365.181	5.571	05+000
620893.257	2549381.593	5.577	05+020
620881.827	2549398.004	5.583	05+040
620870.396	2549414.416	5.589	05+060
620858.965	2549430.828	5.595	05+080
620847.535	2549447.239	5.601	05+100
620836.104	2549463.651	5.607	05+120
620824.674	2549480.062	5.613	05+140
620813.243	2549496.474	5.619	05+160

Easting	Northing	Elevation (m)	Chainage (km)
620801.812	2549512.886	5.625	05+180
620790.382	2549529.297	5.631	05+200
620778.951	2549545.709	5.637	05+220
620767.521	2549562.120	5.643	05+240
620756.090	2549578.532	5.649	05+260
620744.659	2549594.944	5.655	05+280
620733.229	2549611.355	5.661	05+300
620721.798	2549627.767	5.667	05+320
620710.368	2549644.179	5.673	05+340
620698.937	2549660.590	5.679	05+360
620687.506	2549677.002	5.685	05+380
620676.076	2549693.413	5.691	05+400
620664.645	2549709.825	5.697	05+420
620653.215	2549726.237	5.703	05+440
620641.783	2549742.648	5.709	05+460
620630.307	2549759.028	5.715	05+480
620618.829	2549775.406	5.721	05+500
620607.350	2549791.784	5.727	05+520
620595.872	2549808.162	5.733	05+540
620584.394	2549824.541	5.739	05+560
620572.915	2549840.919	5.745	05+580
620561.437	2549857.297	5.751	05+600
620549.958	2549873.675	5.757	05+620
620538.480	2549890.053	5.763	05+640
620527.001	2549906.431	5.769	05+660
620515.523	2549922.810	5.775	05+680
620504.044	2549939.188	5.781	05+700
620492.566	2549955.566	5.788	05+720
620481.087	2549971.944	5.798	05+740
620469.609	2549988.322	5.811	05+760
620458.130	2550004.701	5.828	05+780
620446.652	2550021.079	5.848	05+800
620435.174	2550037.457	5.871	05+820
620423.695	2550053.835	5.897	05+840
620412.217	2550070.213	5.927	05+860
620400.738	2550086.591	5.960	05+880
620389.260	2550102.970	5.996	05+900
620377.781	2550119.348	6.035	05+920
620366.303	2550135.726	6.078	05+940
620354.824	2550152.104	6.124	05+960
620343.346	2550168.482	6.174	05+980
620331.867	2550184.861	6.226	06+000
620320.389	2550201.239	6.281	06+020
620308.910	2550217.617	6.337	06+040

Easting	Northing	Elevation (m)	Chainage (km)
620297.432	2550233.995	6.392	06+060
620285.954	2550250.373	6.447	06+080
620274.475	2550266.752	6.503	06+100
620262.997	2550283.130	6.558	06+120
620251.518	2550299.508	6.613	06+140
620240.040	2550315.886	6.669	06+160
620228.561	2550332.264	6.724	06+180
620217.083	2550348.642	6.779	06+200
620205.604	2550365.021	6.834	06+220
620194.126	2550381.399	6.890	06+240
620182.647	2550397.777	6.945	06+260
620171.169	2550414.155	7.000	06+280
620159.691	2550430.533	7.056	06+300
620148.212	2550446.912	7.110	06+320
620136.734	2550463.290	7.158	06+340
620125.255	2550479.668	7.199	06+360
620113.777	2550496.046	7.234	06+380
620102.298	2550512.424	7.261	06+400
620090.820	2550528.803	7.282	06+420
620079.341	2550545.181	7.295	06+440
620067.863	2550561.559	7.302	06+460
620056.384	2550577.937	7.302	06+480
620044.906	2550594.315	7.295	06+500
620033.427	2550610.693	7.281	06+520
620021.949	2550627.072	7.261	06+540
620010.474	2550643.452	7.233	06+560
619999.109	2550659.909	7.199	06+580
619987.795	2550676.401	7.157	06+600
619976.480	2550692.893	7.110	06+620
619965.166	2550709.385	7.062	06+640
619953.852	2550725.877	7.014	06+660
619942.537	2550742.369	6.967	06+680
619931.223	2550758.861	6.919	06+700
619919.909	2550775.353	6.871	06+720
619908.594	2550791.845	6.823	06+740
619897.280	2550808.337	6.775	06+760
619885.966	2550824.829	6.727	06+780
619874.651	2550841.321	6.680	06+800
619863.337	2550857.813	6.632	06+820
619852.022	2550874.305	6.584	06+840
619840.708	2550890.797	6.536	06+860
619829.394	2550907.289	6.488	06+880
619818.079	2550923.781	6.440	06+900
619806.765	2550940.273	6.392	06+920

Easting	Northing	Elevation (m)	Chainage (km)
619795.451	2550956.765	6.345	06+940
619784.136	2550973.257	6.297	06+960
619772.822	2550989.749	6.249	06+980
619761.508	2551006.241	6.201	07+000
619750.193	2551022.732	6.153	07+020
619738.794	2551039.167	6.105	07+040
619727.364	2551055.578	6.058	07+060
619715.933	2551071.990	6.010	07+080
619704.502	2551088.401	5.962	07+100
619693.071	2551104.813	5.921	07+120
619681.641	2551121.224	5.887	07+140
619670.210	2551137.636	5.860	07+160
619658.779	2551154.047	5.841	07+180
619647.348	2551170.459	5.830	07+200
619635.918	2551186.870	5.826	07+220
619624.487	2551203.282	5.829	07+240
619613.056	2551219.693	5.840	07+260
619601.625	2551236.105	5.859	07+280
619590.194	2551252.516	5.885	07+300
619578.764	2551268.928	5.919	07+320
619567.333	2551285.339	5.960	07+340
619555.902	2551301.751	6.008	07+360
619544.471	2551318.162	6.065	07+380
619533.041	2551334.574	6.128	07+400
619521.610	2551350.985	6.193	07+420
619510.179	2551367.397	6.258	07+440
619498.748	2551383.808	6.323	07+460
619487.318	2551400.220	6.388	07+480
619475.887	2551416.631	6.453	07+500
619464.456	2551433.043	6.518	07+520
619453.025	2551449.454	6.583	07+540
619441.594	2551465.866	6.648	07+560
619430.164	2551482.277	6.713	07+580
619418.733	2551498.689	6.778	07+600
619407.302	2551515.100	6.843	07+620
619395.871	2551531.512	6.908	07+640
619384.441	2551547.923	6.974	07+660
619373.010	2551564.335	7.039	07+680
619361.579	2551580.746	7.104	07+700
619350.148	2551597.158	7.169	07+720
619338.718	2551613.569	7.234	07+740
619327.287	2551629.981	7.297	07+760
619315.856	2551646.392	7.357	07+780
619304.425	2551662.804	7.415	07+800

Easting	Northing	Elevation (m)	Chainage (km)
619292.994	2551679.215	7.469	07+820
619281.564	2551695.627	7.521	07+840
619270.133	2551712.038	7.569	07+860
619258.702	2551728.450	7.615	07+880
619247.271	2551744.861	7.657	07+900
619235.841	2551761.273	7.697	07+920
619224.410	2551777.684	7.733	07+940
619212.979	2551794.096	7.767	07+960
619201.543	2551810.503	7.798	07+980
619189.960	2551826.808	7.826	08+000
619177.997	2551842.835	7.850	08+020
619165.611	2551858.537	7.872	08+040
619152.811	2551873.903	7.893	08+060
619139.605	2551888.923	7.913	08+080
619126.004	2551903.585	7.934	08+100
619112.016	2551917.880	7.954	08+120
619097.657	2551931.800	7.975	08+140
619083.046	2551945.457	7.996	08+160
619068.388	2551959.064	8.016	08+180
619053.730	2551972.671	8.037	08+200
619039.073	2551986.278	8.057	08+220
619024.415	2551999.885	8.078	08+240
619009.757	2552013.492	8.098	08+260
618995.100	2552027.099	8.119	08+280
618980.442	2552040.707	8.140	08+300
618965.784	2552054.314	8.160	08+320
618951.126	2552067.921	8.181	08+340
618936.469	2552081.528	8.201	08+360
618921.811	2552095.135	8.222	08+380
618907.153	2552108.742	8.247	08+400
618892.496	2552122.349	8.276	08+420
618877.838	2552135.956	8.311	08+440
618863.180	2552149.563	8.351	08+460
618848.523	2552163.170	8.396	08+480
618833.865	2552176.777	8.446	08+500
618819.207	2552190.384	8.501	08+520
618804.549	2552203.991	8.561	08+540
618789.892	2552217.598	8.627	08+560
618775.234	2552231.205	8.697	08+580
618760.576	2552244.812	8.769	08+600
618745.919	2552258.419	8.841	08+620
618731.261	2552272.026	8.913	08+640
618716.603	2552285.633	8.985	08+660
618701.946	2552299.240	9.057	08+680

Easting	Northing	Elevation (m)	Chainage (km)
618687.288	2552312.847	9.129	08+700
618672.630	2552326.455	9.201	08+720
618657.972	2552340.062	9.273	08+740
618643.315	2552353.669	9.345	08+760
618628.657	2552367.276	9.416	08+780
618613.999	2552380.883	9.488	08+800
618599.342	2552394.490	9.560	08+820
618584.684	2552408.097	9.632	08+840
618570.026	2552421.704	9.704	08+860
618555.368	2552435.311	9.776	08+880
618540.711	2552448.918	9.849	08+900
618526.053	2552462.525	9.922	08+920
618511.395	2552476.132	9.996	08+940
618496.738	2552489.739	10.071	08+960
618482.080	2552503.346	10.147	08+980
618468.224	2552517.741	10.223	09+000

Annex-II: HORIZONTAL DESIGN REPORT

	Horizontal Alignment Details																				
Sl. No.	CIRCULAR CURVES								SPIRAL CURVES				Horizontal Intersection Point (HIP)						Design Speed	Super e	Extra Widen
	Curve No.	Start Chainage (km)	End Chainage (km)	Start Easting (x)	Start Northing (y)	End Easting (x)	End Northing (y)	Radius (m)	Direction	Start Chainage (km)	Start Ls (m)	End Ls (m)	End Chainage (km)	Chainage (km)	Easting (x)	Northing (y)	Deflection				
Deg																	Min	Sec			
1	00+020.156	00+032.646	625028.969	2547245.483	625023.118	2547255.103	8	Left	-	-	-	-	00+028.080	625030.808	2547253.191	89	27	18.00	25	3.10	1.5
2	00+075.318	00+091.953	624981.911	2547266.116	624966.934	2547273.301	90	Right	00+055.318	20	20	00+111.953	00+083.659	624974.090	2547269.014	10	35	24.00	20	5.90	0.9
3	00+172.212	00+191.369	624902.224	2547320.719	624884.871	2547328.747	90	Left	00+152.212	20	20	00+211.369	00+181.827	624893.977	2547325.660	12	11	42.00	20	5.90	0.9
4	00+352.979	00+363.644	624730.735	2547372.105	624725.551	2547381.36	30	Right	00+312.979	40	40	00+403.644	00+358.368	624727.312	2547376.267	20	22	1.20	80	NC	1.5
5	00+487.866	00+497.954	624748.837	2547501.078	624744.014	2547509.884	30	Left	00+447.866	40	40	00+537.954	00+492.958	624747.173	2547505.890	19	16	1.20	80	6.30	1.5
6	00+946.470	01+016.347	624311.522	2547622.275	624243.509	2547638.306	10000	Left	-	-	-	-	00+981.409	624277.543	2547630.410	0	24	0.00	80	NC	NR
7	03+483.625	03+764.124	621840.299	2548196.85	621611.78	2548351.586	450	Right	03+433.625	50	50	03+814.124	03+628.599	621701.114	2548237.408	35	42	50.40	80	NC	NR
8	05+457.850	05+463.687	620643.013	2549740.884	620639.67	2549745.669	2000	Left	-	-	-	-	05+460.769	620641.345	2549743.279	0	10	1.20	80	NC	NR
9	06+555.740	06+575.709	620012.916	2550639.961	620001.537	2550656.371	2000	Right	-	-	-	-	06+565.724	620007.185	2550648.138	0	34	19.20	80	3.80	NR
10	07+018.433	07+032.584	619751.08	2551021.44	619743.033	2551033.081	2000	Left	-	-	-	-	07+025.509	619747.077	2551027.275	0	24	18.00	50	7.00	NR
11	08+000.376	08+131.006	619189.739	2551827.112	619104.158	2551925.585	750	Left	07+970.376	30	30	08+161.006	08+065.856	619151.248	2551880.084	9	58	44.40	50	5.80	NR
12	08+983.573	09+022.284	618479.461	2552505.777	618455.792	2552536.196	120	Right	-	-	-	-	09+003.098	618465.152	2552519.061	18	28	58.80	50	5.60	0.6
13	09+087.861	09+172.025	618424.354	2552593.747	618401.407	2552674.008	190	Right	-	-	-	-	09+130.645	618403.844	2552631.294	25	22	48.00	50	5.60	0.6
14	09+320.956	09+356.371	618392.923	2552822.697	618394.039	2552858.049	200	Right	-	-	-	-	09+338.710	618391.912	2552840.422	10	8	45.60	35	7.00	0.6
15	09+404.693	09+425.749	618399.827	2552906.022	618401.246	2552927.022	200	Left	-	-	-	-	09+415.231	618401.090	2552916.485	6	1	55.20	35	5.40	0.6

Annex-III: VERTICAL DESIGN REPORT

Vertical Alignment Details

Vertical Curve No.	Vertical Intersection Points (VIP) Details			Vertical Curve Details				Gradient Details			Curve Type	Curve Length (m)	K Value
	Chainage (Km)	Lavel, Z (m)	M Value	Start Ch. (Km)	Start Z. (m)	End Ch. (Km)	End Z (m)	In (%)	Out (%)	Algebric Diff. (%)			
1	0+135.000	5.074	-0.325	0+035.000	4.486	0+235.000	5.012	0.588	-0.062	-0.65	Hog	200	308
2	1+181.070	4.427	1.281	1+081.070	4.489	1+281.070	6.927	-0.062	2.5	2.562	Sag	200	78
3	1+516.000	12.8	-1.25	1+416.000	10.3	1+616.000	12.8	2.5	0	-2.5	Hog	200	80
4	1+784.000	12.8	-1.25	1+684.000	12.8	1+884.000	10.3	0	-2.5	-2.5	Hog	200	80
5	2+109.180	4.67	1.265	2+009.180	7.17	2+209.180	4.701	-2.5	0.031	2.531	Sag	200	79
6	5+856.000	5.828	0.193	5+706.000	5.782	6+006.000	6.743	0.031	0.61	0.579	Sag	300	518
7	6+462.000	9.526	-0.37	6+312.000	8.611	6+612.000	8.776	0.61	-0.5	-1.11	Hog	300	270
8	7+243.444	5.619	0.275	7+093.444	6.369	7+393.444	6.107	-0.5	0.325	0.825	Sag	300	364
9	7+888.333	7.716	-0.074	7+738.333	7.228	8+038.333	7.87	0.325	0.103	-0.222	Hog	300	1349
10	8+474.886	8.32	0.165	8+374.886	8.217	8+574.886	8.752	0.103	0.433	0.33	Sag	200	607
11	9+701.202	13.624	-0.263	9+551.202	12.975	9+851.202	13.087	0.433	-0.358	-0.79	Hog	300	380

Consultancy Service for Preparation of Details Project Report (DPR) for widening & Improvement of Existing 2/4 –lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)

**Detailed Project
Report**

DESIGN OF PAVEMENTS

MONARCH Surveyors & Engineering

Deendayal Port Authority

A

Chapter-2: DESIGN OF PAVEMENT

2.1. Introduction

Pavement design aims at determining the total thickness of the pavement structure as well as the thickness of the individual structural components for carrying the estimated traffic loading under the prevailing environmental conditions. Many design methods, from purely empirical to rigorous analytical ones are available and these are practiced in different parts of the world. The design methods adopted in other countries may not be applicable to Indian climatic conditions. In India the generally adopted method of design of flexible pavement is based on IRC-37-2018.

2.2. Review of Design Methods for New Construction

The AASHTO and IRC methods of pavement design have been reviewed before recommending the pavement composition. However, in the perspective of such review, it is important to note that no method in practice can be considered better than the other as each method has its own inherent limitations, owing to the characteristics of materials used in construction and their complex interaction, climatic and traffic conditions.

2.3. Guidelines for the Design of Flexible Pavements

The pavement designs given in this guide are based on the results of pavement research work done in India and experience gained over the years on the performance of the designs given therein. Flexible pavement has been modeled as a three-layer structure with stresses and strains at critical locations computed using the linear elastic model FPAVE developed under the Ministry of Road Transport & Highways Research Scheme, R -56 and further updated it with IITPAVE recently. The pavement designs are given for sub-grade CBR values ranging from 2% to 15% for different pavement type options like Cement Treated base and Sub base, use of RAP in asphalt layer with foamed bitumen or emulsion. The pavement compositions given in the design catalogue are relevant to Indian conditions, materials and specifications. Where changes to layer thickness and speci-

fications are considered desirable from practical considerations, the guidelines recommend modifications using an analytical approach. Hence, the design has been carried out based on the procedure given in IRC.

2.4. Design Methodology

The design shall be based on various design parameters as evaluated from various field and laboratory investigations, design procedures with the objective to ascertain optimal pavement structure meeting the structural requirements for the traffic and complying with the provisions of the relevant codes and guidelines. The structural requirements are:

- (i) The total thickness of the pavement and the thickness of individual layers should be designed in such a way that they are not subjected to stresses or strains exceeding those admissible in view of the material characteristics and performance factors,
- (ii) The pavement layers should be able to with stand repeated applications of wheelloads of different magnitudes under the actual conditions of sub grade, climate, drainage, and other environmental factors during the design life without causing
 - ✓ excessive permanent deformation in the form of rutting and undulations;
 - ✓ cracking of bituminous layers; and
 - ✓ other structural and functional deficiencies such as potholes
- (iii) Ensure structural and functional performance under varied conditions and factors affecting the performance of the road i.e. soil type, traffic, environment, etc.

Pavement design guidelines given in IRC:37-2012 adopts are based on the Analytical method which is believed to have been developed based on performance of existing designs and using analytical approach (to limit the vertical compressive strain at the top of sub grade and horizontal tensile strain at bottom of bituminous layer adopting linear elastic model). Flow chart showing the various steps involved in the design process is given in below.

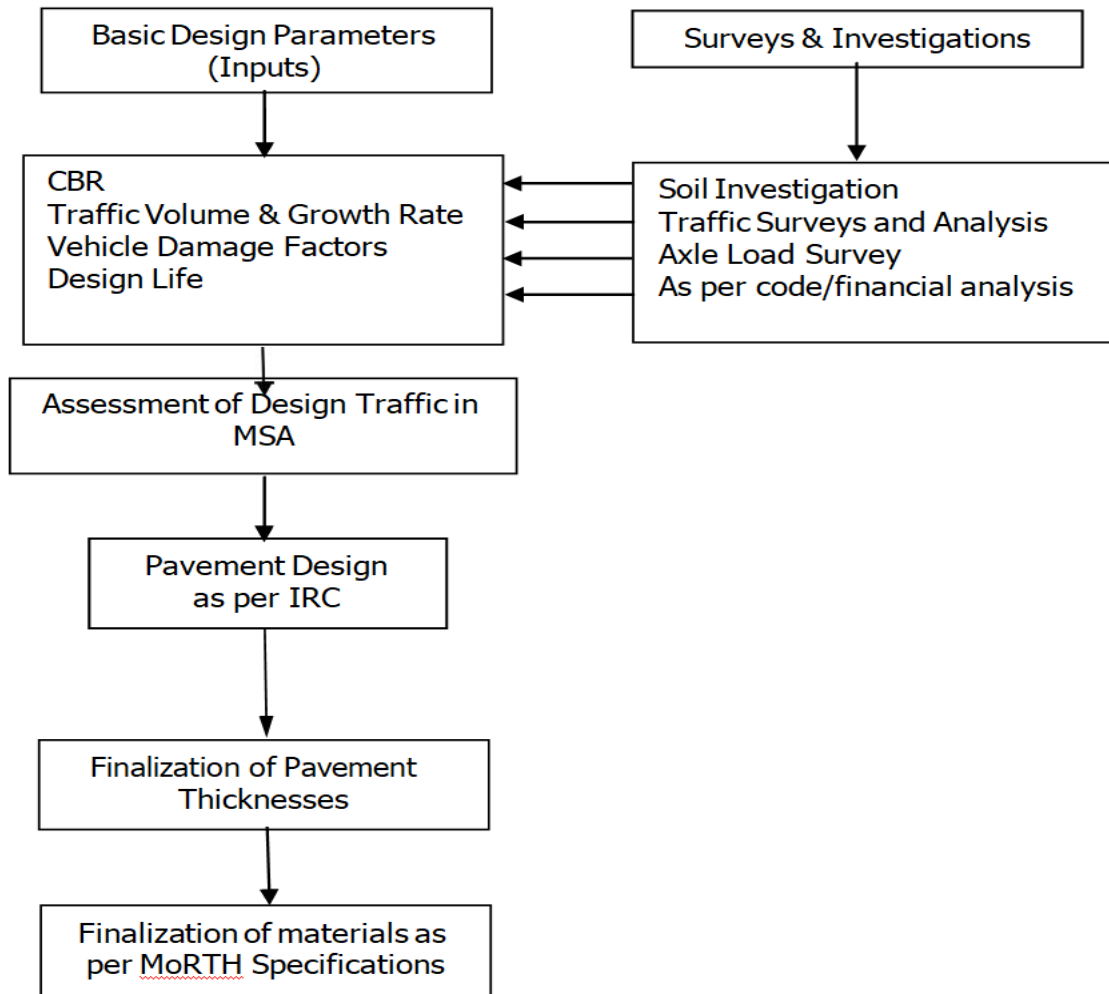


Fig-2: 1 Flow Chart of Pavement Design

2.5. Flexible Pavement Design

Indian Road Congress published Guidelines for the design of Flexible Pavements, IRC: 37. The design of flexible pavements involves the interplay of several variables, such as, the wheel load, traffic, climate, terrain and sub-grade conditions. The IIT-PAVE Software provided by IRC, issued for the design.

2.1.1. Fatigue Criteria for Bituminous Surfacing

The bituminous surfacing of the pavement, displays a flexural fatigue cracking, if tensile strain at bottom of the bituminous layer is beyond certain limit. Based on large amount of field performance data of pavements of south, north, east & west zones in India collected under the research schemes of Ministry of Surface transport, Govt. of India, the relation between the fatigue life of the pavement layers was developed by Indian Road Congress:

$$N_f = 2.21 \times 10^{-4} \times \left(\frac{1}{\epsilon_t} \right)^{3.89} \times \left(\frac{1}{E} \right)^{0.854}$$

2.1.2. Rutting Equation for Sub grade

As large number of data for rutting failure of pavements were obtained from the R search Scheme of MORT&H and other research investigations. Indian Road Congress set the allowable rut depth as 20 mm; the rutting equation was obtained as:

$$N_r = 4.1656 \times 10^{-8} \times \left(\frac{1}{\epsilon_z} \right)^{4.5337}$$

2.1.3. Evaluation of Pavement Design Parameters

i. Design Life (n)

Design life is the time from original construction to a terminal condition for a pavement structure. Structural design is carried to withstand the pavement for a traffic loading encountered over the design life. IRC: 37-2012 suggests design life of 15 years for the flexible pavements and accordingly, design period of 15 years has been considered for the design of pavement.

ii. Design Traffic

A detailed traffic surveys and analysis for the project roads have been conducted in the base year. Design life and growth rates obtained for different types of vehicles are discussed in traffic chapter. For the purpose of pavement design, commercial vehicles of gross vehicle weight more than 3 tonne have been considered. Such vehicles consisted of buses, LCVs, 2 axle trucks, 3 axle trucks and multi axle trucks. From total projected base year AADT and estimated traffic growth rates, vehicle category-wise traffic volume projections have been made for various design periods. Table gives the total base year (2022) traffic volumes in terms of commer-

cial vehicles per day (CVPD) for each of the identified traffic homogeneous section and has been used for the estimation of design traffic in terms of MSA for pavement design.

Table-2: 1 Base Year Traffic Volumes in CVPD

Location		Car	Bus	Truck	Total
A1	FSWAI MAIN TERMINAL	286	14	2062	2361
A2	HPCL Main Terminal	188	16	1844	2047
A3	IOCL Main Terminal	501	16	2025	2542
A4	NH141 near LC236	1679	318	11106	13103

The total projected traffic on to the project road is presented in Main Report. The same is reproduced for cardinal years in the below:

Table-2: 2 Traffic Volumes Forecasting in CVPD

Design Traffic (MSA) Estimation										
Base Year CVPD, Two-Way CV Wise as per Last Classified Traffic Volume Count, P (Important Note				LCV (CVP D)	M.BU S (CVP D)	BUS (CVP D)	2AT (CVP D)	3AT (CVP D)	MAV (CVPD)	Total CVPD
! If Any of the CV Wise CVPD is Zero, Enter 0 there)										
				258	1	14	19	574	1333	2199
Initial CVPD, Two-Way (CV Wise) at the Start when the Road is				263	1	14	20	614	1490	2401
Opened, A										
Annual Growth Rate of Commercial Vehicles.				LCV	M.BU S	BUS	2AT	3AT	MAV	Average Growth %
(Important Note ! If Any of the CV Wise CVPD is Zero, Enter Corresponding Growth Rate % as Any Non-Zero Value. Don't Put 0				(Gro wth	(Gro wth	(Gro wth	(Gro wth	(Gro wth	(Growth	(If Growth Rate Assumed Uniform for all CV)
or Don't Leave it Blank)				%)	%)	%)	%)	%)	%)	
Growth Rate (%) During the Period		Period in Years →								
1.5 Years for Design, Project Pre- parat ion & Con- struc		1		1.20%	0.00%	0.00%	1.90%	4.60%	7.70%	

Design Traffic (MSA) Estimation												
tion	Period in Years →				0	1.20%	0.00%	0.00%	1.90%	4.60%	7.70%	
					5							
Growth Rate % for the First 'Time	Year	0	T	Ye ar	5	1.10%	0.00%	0.00%	1.80%	5.30%	8.90%	
Horizon',			o									
Growth Rate % for the Second 'Time	Year	5	T	Ye ar	1	0.90%	0.00%	0.00%	1.50%	4.60%	7.80%	
Horizon',			o		0							
Growth Rate % for the Third 'Time	Year	1	T	Ye ar	1	0.70%	0.00%	0.00%	1.20%	3.90%	6.70%	
Horizon',		0	o		5							
Growth Rate % for the Fourth 'Time	Year	1	T	Ye ar	2	0.60%	0.00%	0.00%	1.00%	3.20%	5.80%	
Horizon',		5	o		0							
Growth Rate % for the Fifth 'Time	Year	2	T	Ye ar	2	0.50%	0.00%	0.00%	0.90%	2.70%	5.10%	
Horizon',		0	o		5							

Design Traffic (MSA) Estimation													
Growth Rate % for the Sixth 'Time	Year	2	T	Ye ar	5	0.50%	0.00%	0.00%	0.80%	2.40%	4.90%		
Horizon',		5	o		0								
Design Two-Way Cumulative Number of Commercial Vehicles (CV) for the Entire Design Period, C						CLCV	CM.BUS	CBUS	C2AT	C3AT	CMAV	C = (CLCV+CM.BUS+CBUS+C2AT+C3A	
												T+CMAV)	
						15397			1200	48094	2E+06	21481696	
						42			64	90	0		
Whether like to Use Design VDF as CV Wise or Average or by User Input (CV Wise / Average / User Input)											Mandat ory Input for VDF	User Input	
Design VDF (To be determined from Axle Load Survey, if not, then Enter Value as Per Cl. 4.4.6 of IRC:37-2012), F						LCV (VDF)	M.BU	BUS (VDF)	2AT (VDF)	3AT (VDF)	MAV (VDF)	Average VDF	
							S (VDF)					(If VDF Assumed Uniform for all CV)	
		0	0	0	0.25	6.27	→		6.6				
Directional Distribution Factor (For Undivided Road 100%, For Divided Road 50%)											B	50%	
Lane Distribution Factor (Refer Clause 4.5.1 of IRC:37-2012)											D	0.6	
Design MSA											msa	39	

iii. Vehicle Damage Factors (F)

Vehicle damage factor as listed in the table. Axle load surveys were conducted to estimate the loading behavior of commercial vehicles plying on the project road. The detailed analysis and information of axle loads collected from site from axle load surveys is provided in, Surveys & Investigations of Main Report. The summary of VDFs is presented in the following table.

Table-2: 3 Summary of VDF

VEHICLE TYPE	FROM KANDLA	FROM GANDHIDHAM	AVERAGE
LCV	0	0	0
Bus	0	0	0
2 Axle	0.24	0.26	0.25
3 Axle	3.07	9.47	6.27
MAV	8.84	4.36	6.6

For small projects, in the absence of weigh pad, the axle loads of typical commercial vehicles plying on the road may be estimated approximately from the type of goods carried. Where information on the axle loads is not available and the proportion of heavy vehicles using the road is small, the indicative values of Vehicle Damage Factor given in Table below can be used. These indicative VDF values have been worked out based on typical axle load spectrums and taking into consideration the legal axle load limits notified in the Gazette of India dated 16th July, 2018

Table-2: 4 Indicative VDF values

Initial (Two-Way) Traffic Volume in Terms of Commercial Vehicles Per Day	Terrain	
	Rolling/Plain	Hilly
0-150	1.7	0.6
150-1500	3.9	1.7
More than 1500	5	2.8

iv. Traffic Growth Rate (r)

For estimating the cumulative traffic expected to use the pavement over the design period, it is necessary to estimate the rate(s) at which the commercial traffic will grow over the design period. The growth rates may be estimated as per IRC: 108[16]. Typical data required for estimation of the growth rates(r) are:

- (i) Past trends of traffic growth and
- (ii) Demand elasticity of traffic with respect to macro-economic parameters (like the gross domestic product and state domestic product) and the demand expected due to specific developments and land use changes likely to take place during the design life period.

Traffic growth rates shall be established for each category of commercial vehicles. In the absence of data for estimation of the annual growth rate of commercial vehicles or when the estimated growth rate is less than 5 per cent, a minimum annual growth rate of 5 per cent should be used for commercial vehicles for estimating the design traffic.

Table-2: 5 Traffic Growth Rates

Time Period	Cars	Bus	LCV	2-axle Truck	3-axle Truck	MAV
2021-2023	5.92	0	1.21	1.93	4.63	7.72
2023-2028	4.76	0	1.07	1.77	5.32	8.87
2028-2033	3.85	0	0.87	1.48	4.64	7.75
2033-2038	3.13	0	0.7	1.23	3.85	6.74
2038-2043	3.13	0	0.58	1.01	3.18	5.82
2043-2048	2.99	0	0.5	0.85	2.66	5.1
2048-2053	2.99	0	0.46	0.77	2.42	4.85

v. Lane distribution factor (D)

A Lane distribution factor of 0.5 has been considered Clause 4.5 of IRC: 37-2012. Lateral distribution of commercial traffic on the carriageway is required for estimating the design traffic (equivalent standard axle load applications) to be considered for the structural design of pavement. The following lateral distribution factors may be considered for roads with different types of the carriageway:

Two-lane two-way roads

The design should be based on 50 per cent of the total number of commercial vehicles in both the directions.

Four-lane single carriageway roads

40 per cent of the total number (sum) of commercial vehicles in both directions should be considered for design.

Dual carriageway roads

The design of dual two-lane carriageway roads should be based on 75 per cent of the number of commercial vehicles in each direction. For dual three-lane carriageway and dual four-lane carriageway, the distribution factors shall be 60 per cent and 45 per cent respectively.

2.1.4. Evaluation of Design Traffic (MSA) for Pavement Design

Base year traffic (vehicle category-wise & in terms of AADT), traffic growth rates, design life (in terms of number of years) and vehicle damage factors are required to estimate the design traffic in terms of equivalent standard axles. The following data have been considered to arrive at the design traffic (MSA). With the base year traffic in terms of CVPD, annual growth rate of each of commercial vehicle over the design period, design traffic in terms of MSA over the design life can be estimated using the following formula.

$$N = \frac{365 \times ((1+r)^n - 1)}{r} \times A \times D \times F$$

Where,

N = Cumulative number of standard axles to be catered

A = Initial number commercial vehicles per day in the year when the road is operational

n = Design period in years,

r = Annual rate of growth of commercial traffic, D= Lane distribution factor

F= Vehicle Damage Factors

The traffic in the year of completion of construction may be estimated using equation below

$$A = P (1+r)^n$$

Where,

P = number of commercial vehicles per day as per last count.

x = number of years between the last count and the year of completion of construction

Table-2: 6 Design Traffic (MSA) Estimation

Design Traffic (MSA) Estimation									
Base Year CVPD, Two-Way CV Wise as per Last Classified Traffic Volume Count, P (Important Note			LCV (CVP D)	M.BU S	BUS (CVP D)	2AT (CVP D)	3AT (CVP D)	MAV (CVPD)	Total CVPD
! If Any of the CV Wise CVPD is Zero, Enter 0 there)				(CVP D)					
			258	1	14	19	574	1333	2199
Initial CVPD, Two-Way (CV Wise) at the Start when the Road is			263	1	14	20	614	1490	2401
Opened, A									
Annual Growth Rate of Commercial Vehicles.			LCV	M.BU S	BUS	2AT	3AT	MAV	Average Growth %
(Important Note ! If Any of the CV Wise CVPD is Zero, Enter Corresponding Growth Rate % as Any Non-Zero Value. Don't Put 0			(Gro wth	(Gro wth	(Gro wth	(Gro wth	(Gro wth	(Growth	(If Growth Rate Assumed Uniform for all CV)
or Don't Leave it Blank)			%)	%)	%)	%)	%)	%)	
Growth Rate (%) During the Pe- riod	Period in Years →		1	1.20%	0.00%	0.00%	1.90%	4.60%	7.70%

Design Traffic (MSA) Estimation											
1.5 Years for Design, Project Preparation & Construction											
tion	Period in Years →				0	1.20%	0.00%	0.00%	1.90%	4.60%	7.70%
					5						
Growth Rate % for the First 'Time Horizon',	Ye ar	0	T o	Ye ar	5	1.10%	0.00%	0.00%	1.80%	5.30%	8.90%
Growth Rate % for the Second 'Time Horizon',	Ye ar	5	T o	Ye ar	1 0	0.90%	0.00%	0.00%	1.50%	4.60%	7.80%
Growth Rate % for the Third 'Time Horizon',	Ye ar	1 0	T o	Ye ar	1 5	0.70%	0.00%	0.00%	1.20%	3.90%	6.70%

Design Traffic (MSA) Estimation												
Growth Rate % for the Fourth 'Time Horizon',	Ye ar	1	T	Ye ar	2	0.60%	0.00%	0.00%	1.00%	3.20%	5.80%	
		5	o		0							
Growth Rate % for the Fifth 'Time Horizon',	Ye ar	2	T	Ye ar	2	0.50%	0.00%	0.00%	0.90%	2.70%	5.10%	
		0	o		5							
Growth Rate % for the Sixth 'Time Horizon',	Ye ar	2	T	Ye ar	5	0.50%	0.00%	0.00%	0.80%	2.40%	4.90%	
		5	o		0							
Design Two-Way Cumulative Number of Commercial Vehicles (CV) for the Entire Design Period, C						CLCV	CM.BUS	CBUS	C2AT	C3AT	CMAV	C = (CLCV+CM.BUS+CBUS+C2AT+C3A
												T+CMAV)
						15397			1200	48094	2E+06	21481696
						42			64	90	0	
Whether like to Use Design VDF as CV Wise or Average or by User Input (CV Wise / Average / User Input)											Mandatory Input for VDF	User Input

Design Traffic (MSA) Estimation							
Design VDF (To be determined from Axle Load Survey, if not, then Enter Value as Per Cl. 4.4.6 of IRC:37-2012), F	LCV (VDF)	M.BU	BUS (VDF)	2AT (VDF)	3AT (VDF)	MAV (VDF)	Average VDF
		S (VDF)					(If VDF Assumed Uniform for all CV)
	0	0	0	0.25	6.27	→ 6.6	
Directional Distribution Factor (For Undivided Road 100%, For Divided Road 50%)						B	50%
Lane Distribution Factor (Refer Clause 4.5.1 of IRC:37-2012)						D	0.6
Design MSA						msa	39

2.1.5. Design of Pavement Structure for new Construction

Design of new flexible pavement applies to the widened portions of existing carriagewaylanes including paved shoulders. Paved shoulders are proposed to be constructed to the same standard as the main carriageway and thus forming an integral part of the paved carriageway. With the design traffic loading in MSA and the sub grade strength in terms of CBR, the pavement composition has been worked out by IRC design procedure to account for the design period of 15 years. The pavement structure has been worked out for the project road and is given below.

Table-2: 7 Proposed Pavement Composition and Thickness

Design Layer No.	Crust Layers (with individual thickness)				Thickness (mm)
1	BC =	40	DBM =	110	150
2	Base (B) =				300
3	Sub-Base (SB) =				200
4	Subgrade =				-
					500

2.1.6. Design Check with IITPAVE Software

Proposed strengthening Design for reconstruction has been checked with IITPAVE Software, using following input parameters:

Table-2: 8 Proposed Strengthening Design Input Parameters

Layer Designation	Design MSA = 40 MSA
	Thickness(mm)
BC	40
DBM	110
WMM	300
GSB	200
Existing Sub-Grade Soil CBR (8%)	

The output sheet of software and the strain comparison is given below:

Table-2: 9 The output sheet of software

No. of layers	5								
E values (MPa)	3000.00	3000.00	218.19	218.19	66.60				
Mu values	0.350	0.350	0.350	0.350	0.35				
thicknesses (mm)	40.00	110.00	300.00	200.00					
single wheel load (N)	20000.00								
tyre pressure (MPa)	0.56								
Dual Wheel									
Z	R	SigmaZ	SigmaT	SigmaR	TaoRZ	DispZ	epZ	epT	epR
150.00	0.00	-0.1056E+00	0.6805E+00	0.5429E+00	-0.1470E-01	0.3752E+00	-0.1779E-03	0.1758E-03	0.1139E-03
150.00L	0.00	-0.1056E+00	-0.3249E-02	-0.1326E-01	-0.1470E-01	0.3752E+00	-0.4576E-03	0.1758E-03	0.1139E-03
150.00	155.00	-0.9548E-01	0.6020E+00	0.2987E+00	-0.4619E-01	0.3853E+00	-0.1369E-03	0.1770E-03	0.4047E-04
150.00L	155.00	-0.9547E-01	-0.3888E-02	-0.2595E-01	-0.4619E-01	0.3853E+00	-0.3897E-03	0.1770E-03	0.4047E-04
650.00	0.00	-0.1603E-01	0.2461E-01	0.2200E-01	-0.2390E-02	0.2633E+00	-0.1483E-03	0.1032E-03	0.8706E-04
650.00L	0.00	-0.1603E-01	0.1518E-02	0.7120E-03	-0.2390E-02	0.2633E+00	-0.2525E-03	0.1033E-03	0.8698E-04
650.00	0.00	-0.1603E-01	0.2461E-01	0.2200E-01	-0.2390E-02	0.2633E+00	-0.1483E-03	0.1032E-03	0.8706E-04
650.00L	0.00	-0.1603E-01	0.1518E-02	0.7120E-03	-0.2390E-02	0.2633E+00	-0.2525E-03	0.1033E-03	0.8698E-04

Table-2: 10 Strain Comparison

S. No.	Layer	Location of Strain	Permissible Strain as per fatigue equations	Actual Micro- strain Values Obtained	Remarks
1	Bituminous Layer	Bottom of Layer	1.81E-04	1.77E-04	Safe
2	Subgrade	Top of Subgrade	3.90E-04	2.52E-04	Safe

From the above results the proposed strengthening design is safe for CBR 8%.

Consultancy Service for Preparation of Details Project Report (DPR) for widening & Improvement of Existing 2/4 –lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)

**Detailed Project
Report**

DESIGN OF STRUCTURES

MONARCH Surveyors & Engineering

Deendayal Port Authority

A

Chapter-3: DESIGN OF STRUCTURES

Design of RCC BOX Culvert

In this section, detailed design calculations of RCC Box structure are presented.

3.1. Units

Design is presented consistently in SI units; the following apply unless mentioned specifically otherwise:

Table-3: 1Units of measurement

Length	m
Force	kN
Stress	MPa
Bearing Pressure	kN/m ²
Hog Mom/Com Str.	-ve
Sag Mom/Ten Str.	+ve

3.2. Assumptions

The following assumptions have been taken while designing the Box.

- ✓ Structure is designed for per meter width.
- ✓ Deck width taken-24.5 m
- ✓ Carriageway width-23 m
- ✓ Modulus of subgrade reaction - 10000 KN/m³ (Based on the Geotech Report)
- ✓ Shear value is taken at a dist. of deff from the face of the slab.
- ✓ In design sheet under summary of moments, only magnitude of force has been considered.
- ✓ In case of earth pressure and LL surcharge governing case out of Normal earth pressure and Fluid ressure is taken.

- ✓ Structure is designed for standard earth pressure with weep holes.

3.3. Loads

The different types of loads used as per IRC 6 : 2017 are.

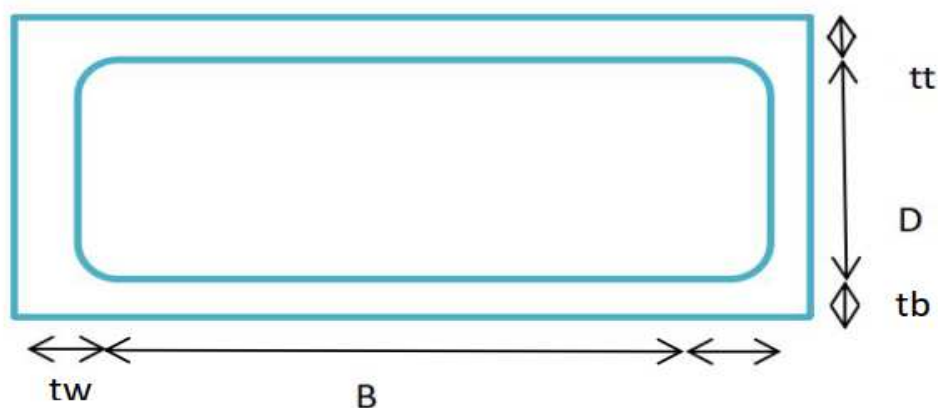
- ✓ Dead load.
- ✓ In SIDL fill & crash barrier load is considered.
- ✓ Normal Earth pressure with drainage arrangement
- ✓ Live load -Class AA Track, 40 T Boggie, 70R Wheel load in case of top slab.
- ✓ Live load surcharge.
- ✓ Breaking load is taken as 20% of the live load on top slab.
- ✓ Temperature loading for uniform rise and temperature gradient is considered.
- ✓ The Earth pressure coefficient at rest 0.5 is considered.

3.4. Load combinations

Load combinations as per IRC 6: 2017 have been considered in staad load combination

3.5. Material properties

- ✓ Grade of Concrete M30
- ✓ Grade of Steel Fe 500.



BOX Culvert (0.2 Cell 2.4m wide x 2.21m height)

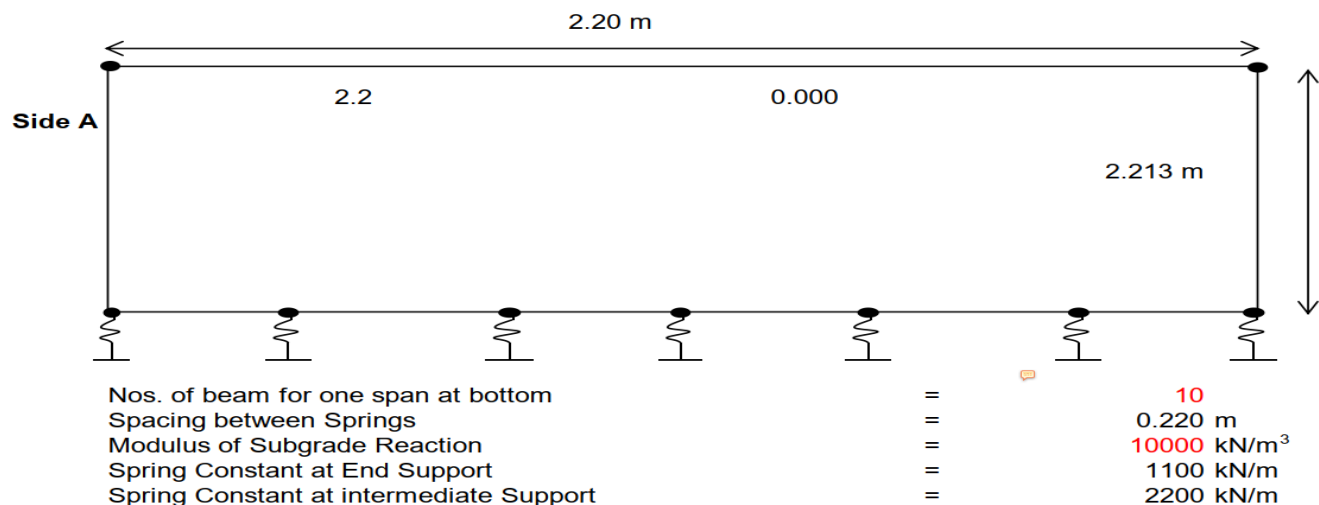
3.6. Structure Dimensions

No. of Cell	=	1	Clear Width of cell	=	2.00 m
Top Slab Thick. (tt)	=	0.200 m	Clear Height of Cell	=	2.00 m
Bot. Slab Thick. (tb)	=	0.225 m	C/C Width of structure	=	2.200 m
Side Wall Thick. (tw)	=	0.200 m	C/C Height of structure	=	2.213 m
Total Deck width	=	24.50 m	Total length of Structure at top =	=	2.40 m
Carrriageway Width	=	23.00 m	Total length of Structure at bottom =	=	2.40 m
Water above bott. Slab	=	0.500 m	Total Height of Structure	=	2.43 m
			Footpath Dimensions	=	0.00 m
			Parapet/ Crash barrier width	=	0.50 m
Wearing coat for SIDL	=	75mm	Height of fill =	=	2.00 m
Haunch size	=	150mm			
SIDL (Top Slab)					
Crash barrier	=				
Due to earth fill	=		2 x 20 =	13.00	kN/m ²
Wt of kerb	=			40.00	kN/m ²
				0.00	
				53.00	kN/m ²
Due to wearing coat & PCC	=			2.00	kN/m ²

3.7. Basic Parameters

Earth Pressure at rest $K_0 = (1 - \sin \phi) =$	=	0.5
Dry Density of fill	=	20 kN/m ³
Density of Concrete	=	25 kN/m ³
Live Load Surcharge	=	0 m
Safe Bearing Pressure	=	200 kN/m ²
Fluid Pressure as per cl. 214.1 of IRC 6 2014		4.80 kN/m ²

3.8. Idealized Structure for Staad Analysis (Analysis is done for 1m Strip)



2.1.1. Earth Pressure and Live Load Calculation

1) a Earth Pressure (Normal Condition)

Earth Pressure	Height
21.75 kN/m ²	2.175 m
43.88 kN/m ²	4.388 m

1) b (Fluid Pressure)

Earth Pressure	Height
10.44 kN/m ²	2.175 m
21.06 kN/m ²	4.388 m

1) c Earth Pressure (HFL) Providing Drainage arrangement

Earth Pressure	Height
10.875 kN/m ²	2.175 m
21.9375 kN/m ²	4.388 m

2) a Live Load Surcharge (Normal Condition)

Live Load Surcharge = 0.000 kN/m

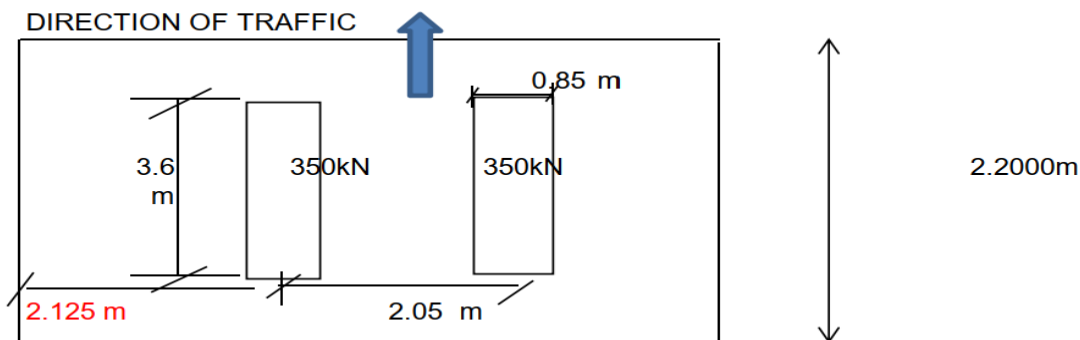
Uniform Load = 5.00 kN/m²

2.1.2. Dead Load

Weight of Top Slab	=	12.00 kN/m	
Weight of earth on Top Slab	=	96.00 kN/m	
Weight of Bottom Slab	=	13.50 kN/m	
Weight of Side wall	=	20.00 kN/m	
Weight of Int. side wall	=	0.00 kN/m	
Weight of the parapet wall	=	0.00 kN	
Weight of the footpath	=	0.00 kN	
Wt of Railing/Crash Barrier	=	24.00 kN	
Weight of wearing coat	=	3.43 kN/m	
Weight of water	=	12 kN/m	
Weight of haunch	=	1.125 kN/m	
<u>Base Pressure Without Live Load</u>			
Base Pressure	=	72.29 kN/m ²	OK
Base Pressure in HFL Case	=	32.01 kN/m ²	OK
<u>Base Pressure With Live Load</u>			
Base Pressure	=	115.34 kN/m ²	OK
Base Pressure in HFL Case	=	75.06 kN/m ²	OK

2.1.3. Live Load on Top Slab

A)



Total Load = **700kN**
 194.44 kN/m
 427.8 kN

3.6 2.2000m

Effective width of Loading

a = 1.10 m
 b1 = 5.00 m
 b/lo = 11.14
 a = 2.60
 beff = 6.43 m

2.05 < 6.43

Therefore overlapping due to load dispersion occurs

Effective width = 7.39 m
 Width along span = 2.2 m
 Load Intensity = 26.31 kN/m²
 Impact factor = 1.25
 Increase due to impact = 32.89 kN/m²
 Say **32.90 kN/m²**

B) Class AA Track at Support

Effective width of Loading

a = 1.10 m
 b1 = 5.00 m
 b/lo = 11.14
 a = 2.60
 beff = 6.43 m

2.05 < 6.43

Therefore overlapping due to load dispersion occurs

Effective width = 7.39 m
 Width along span = 2.200 m
 Load Intensity = 26.31 kN/m²
 Impact factor = 1.25
 Increase due to impact = 32.89 kN/m²
 Say **32.90 kN/m²**

D) 40T Boggie Load at Support

Effective width of Loading

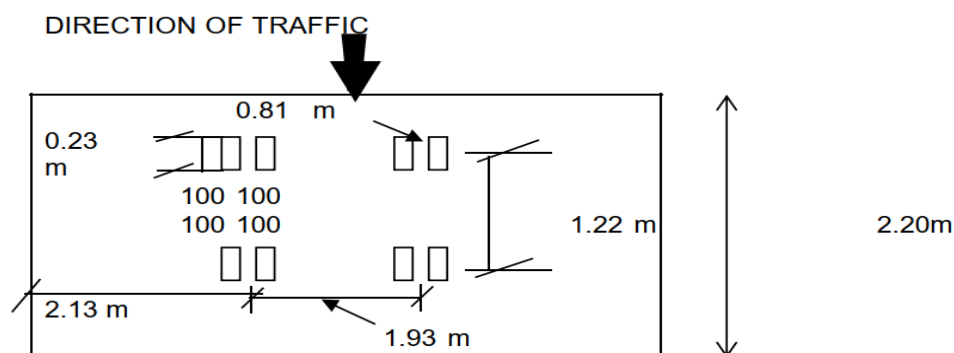
a	=	0.61 m
b1	=	4.96 m
b/lo	=	11.14
a	=	2.60
beff	=	6.11 m

$$1.93 < 6.11$$

Therefore overlapping due to load dispersion occurs

Effective width	=	7.12 m
Width along span	=	2.200 m
Load Intensity	=	25.55 kN/m ²
Impact factor	=	1.25
Increase due to impact	=	31.94 kN/m ²
Say		32.00 kN/m²

C) 40T Boggie Load at Mid Span



$$\text{Total Load} = 400\text{kN}$$

Effective width of Loading

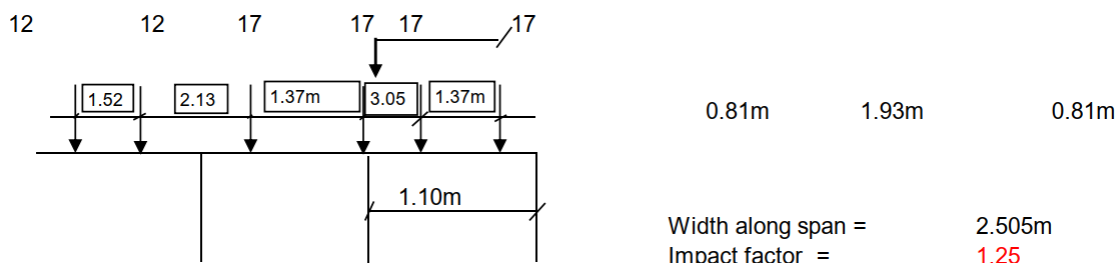
a	=	0.49 m
b1	=	4.96 m
b/lo	=	11.14
a	=	2.60
beff	=	5.95 m

$$1.93 < 5.95$$

Therefore overlapping due to load dispersion occurs

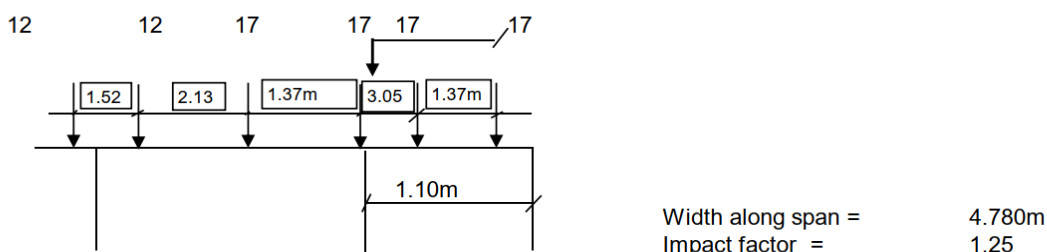
Effective width	=	7.04 m
Width along span	=	2.2 m
Load Intensity	=	25.84 kN/m ²
Impact factor	=	1.25
Increase due to impact	=	32.30 kN/m ²
Say		32.30 kN/m²

E) 70R Wheel Case 1 (at support)



S.No.	Load	a	a	beff	Overlap	Eff. Width	Load Int.	With Imp.
1	170	0.95m	2.60	6.36m	Yes	7.22m	9.4 kN/sqm	12 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.00m	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm

F) 70R Wheel Case 2 (at mid span)



S.No.	Load	a	a	beff	Overlap	Eff. Width	Load Int.	With Imp.
1	170	0.000	2.60	4.96m	Yes	6.52m	5.5 kN/sqm	7 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm
0	0	0.000	0.00	0.00m	No	0.00m	0.0 kN/sqm	0 kN/sqm

G) Braking load		20%	Av. Eff. Width	Load per meter
Load on the span 70R Wheel	0 kN	0 kN	7.22m	0 kN/m
Load on the span 40T Boggie	400 kN	80 kN	7.04m	11 kN/m
Load on the span ClassAA Track	0 kN	0 kN	7.39m	0 kN/m
Max. force		No braking load considered in case of earthfill.		11 kN/m

2.1.4. Collision Load

Nominal Vehicle collision load as per cl. 222.3 table 9 of IRC 6 2010

Point of application above Carriageway level	Direction of load	Load	Av. Eff. Width	Load per meter	
At crash barrier due to live load moving on bottom slab					
Main + Residual Load	1.0m	Normal to the carriageway	75 kN	1.00m	75 kN/m/m
Main + Residual Load	1.0m	Parallel to the carriageway	150 kN	1.00m	150 kN/m/m

2.1.5. Temperature load calculation

Effective Bridge Temperature

Maximum Air Shade temperature	=	47.5	°C (as per Fig 8 of IRC:6-2014)
Minimum Air Shade temperature	=	-2.5	°C (as per Fig 9 of IRC:6-2014)
Mean of max and min temperature	=	22.5	°C (as per clause 215.2 of IRC:6-2014)
Bridge temperature to be assumed	=	32.5	
TEMPERATURE RISE		32.5	
TEMPERATURE FALL		12.5	

Effect of temperature gradient

The box has been checked for temperature differential. As per IRC:6 - 2014, for this combination only 50% live load shall be considered.

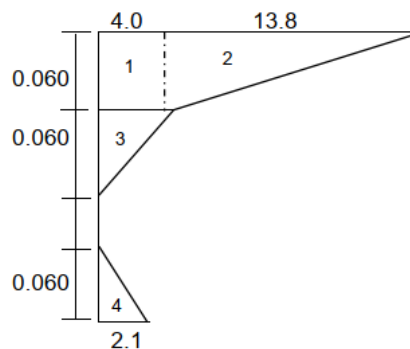
$$F = E_c aDt A$$

E_c = Modulus of Elasticity of Concrete	=	3.16E+06	t/m ²
a = Coefficient of Thermal expansion	=	1.20E-05	°C (as per IRC:6)
Dt = Temperature differential			
A = X sectional Area of section where temperature differential is Dt			

Average thickness of Deck slab = 200 mm

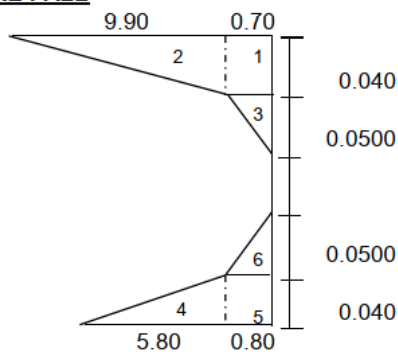
Table-3: 2 Temperature Stresses

EFFECT OF TEMPERATURE RISE



Sr. No.	Dt	b	t	A = b x t	F (force)	Acting at	Eccentricity e*
1	4.0	1.0	0.060	0.060	9.11	0.030 m from top	0.070
2	$\frac{13.8}{2}$	1.0	0.100	0.100	26.18	0.033 m from top	0.067
3	$\frac{4.0}{2}$	1.0	0.060	0.060	4.55	0.080 m from top	0.020
4	$\frac{2.1}{2}$	1.0	0.060	0.060	2.39	0.020 m from bottom	-0.080
					SF = 42.23	M = 2.283	

EFFECT OF TEMPERATURE FALL



Sr. No.	Dt	b	t	A = b x t	F (force)	Acting at	Eccentricity e*
1	0.70	1.0	0.040	0.040	1.06	0.020 m from top	0.080
2	$\frac{9.90}{2}$	1.0	0.040	0.040	7.51	0.013 m from top	0.087
3	$\frac{0.70}{2}$	1.0	0.0500	0.0500	0.66	0.057 m from top	0.043
4	$\frac{5.80}{2}$	1.0	0.040	0.040	4.40	0.013 m from bottom	-0.087
5	0.80	1.0	0.040	0.040	1.21	0.020 m from bottom	-0.080
6	$\frac{0.80}{2}$	1.0	0.0500	0.0500	0.76	0.057 m from bottom	-0.043
					SF = 15.61	M = 0.253	

2.1.6. Summary of factored moments

Table-3: 3 Summary of factored moments

Grade of Concrete = M30
Grade of Steel = Fe500

Summary of factored moments

Load Case	Top slab			Bottom slab			Outer wall			
	Moment in Mid-Span	Moment at End Support	Top slab shear at deff	Moment in Mid-Span	Moment at End Support	Bottom slab shear at deff	Moment at top	Moment at bottom	Span Moment	Wall shear at deff
	kN-m	kN-m	kN	kN-m	kN-m	kN	kN-m	kN-m	kN-m	
Structural Strength (Basic Combination) LC-100 To	45.836	24.069	114.583	51.297	32.501	136.204	25.173	25.173	5.759	47.478
Serviceability Check(Rare Combination) LC-172 To LC219	37.951	13.546	99.321	44.211	23.391	118.397	20.776	20.776	11.697	34.682
Serviceability Check(Quasi-Permanent Combination) LC-220 To LC223	19.162	12.61	50.783	22.604	18.071	64.174	12.537	12.537	1.205	35.067
Combination for Design of Foundation (Combination 1)LC-148 To	44.768	21.748	114.583	51.308	21.96	103.657	25.173	25.173	5.759	52.066

2.1.7. Partial Safety Factors

Material Parameters

Concrete

Refer Table 6.5, IRC:112-2019

Grade

Cube strength of concrete at 28 days f_{ck} = **M30** MPa

Design value of concrete compressive strength f_{cd} = $\alpha f_{ck} / \gamma_m$

Refer cl. 6.4.2.8 of IRC:112-2019

$a = 0.67$

$f_{ctm} = 2.5$ MPa

For Basic Combination $f_{cd} = 13.40$ MPa

For Accidental Combination $f_{cd} = 16.75$ MPa

For Seismic Combination $f_{cd} = 13.40$ MPa

Modulus of Elasticity $E_c = 31000$ MPa

Mean value of axial tensile strength of concrete $f_{ctm} = 2.5$ MPa

Density = **2.50** t/m³

Reinforcing Steel

Grade

=

Characteristics yield strength $f_{yk} = 500$ MPa

Design yield strength $f_{yd} = f_{yk} / \gamma_m$

For Basic Combination $f_{yd} = 434.78$ MPa

For Accidental Combination $f_{yd} = 500$ MPa

For Seismic Combination $f_{yd} = 434.78$ MPa

Modulus of Elasticity $E_s = 2.0E+05$ MPa

Density = **7.85** t/m³

Partial Safety Factor for Materials

Material	Partial Safety Factor γ_m		
	Basic Combination	Accidental Combination	Seismic Combination
Concrete	1.5	1.2	1.5
Steel	1.15	1	1.15

CI 6.4.2.8, IRC:112-2011

CI 6.2.2, IRC:112-2011

2.1.8. Partial Safety Factor for Loads

Table-3: 4 Partial safety factors

Ultimate Limit State

Partial Safety for Verification of Structural Strength Table 3.1, Annex B, IRC:6-2017

Loads	Partial Safety Factor					
	Basic Combination		Accidental Combination		Seismic Combination	
(1)	(2)	(3)	(4)	(5)	(4)	(3)
	Overturning or Sliding or Uplift Effect	Restoring or Resisting Effect	Overturning or Sliding or Uplift Effect	Restoring or Resisting Effect	Overturning or Sliding or Uplift Effect	Restoring or Resisting Effect
Permanent Loads:	1.10	0.90	1.00	1.00	1.10	0.90
Dead Load, SIDL except surfacing, Backfill Weight, Settlement, Creep and shrinkage effect						
Surfacing	1.35	1.00	1.00	1.00	1.35	1.00
Earth Pressure due to Backfill	1.50	1.00	1.00	0.00	1.00	1.00
Variable Loads:						
Carriageway Live Load and associated loads (braking, tractive and centrifugal forces) and pedestrian live load:						
a) Leading Load	1.50	0.00	0.75	0.00	0.00	0.00
b) Accompanying Load	1.15	0.00	0.20	0.00	0.20	0.00
c) Construction Live Load	1.35	0.00	1.00	0.00	1.00	0.00
Thermal Loads						
a) As Leading Load	1.50	0.00	0.00	0.00	0.00	0.00
b) As Accompanying Load	0.90	0.00	0.50	0.00	0.50	0.00
Wind						
a) As Leading Load	1.50	0.00	0.00	0.00	0.00	0.00
b) As Accompanying Load	0.90	0.00	0.00	0.00	0.00	0.00
Live Load Surcharge (as accompanying load)	1.20	0.00	0.00	0.00	0.00	0.00
Accidental Effects:						
i) Vehicle Collision	0.00	0.00	1.00	0.00	0.00	0.00
ii) Barge Impact	0.00	0.00	1.00	0.00	0.00	0.00
iii) Impact due to floating bodies	0.00	0.00	1.00	0.00	0.00	0.00
Seismic Effect						
a) During Service	0.00	0.00	0.00	0.00	1.50	0.00
b) During Construction	0.00	0.00	0.00	0.00	0.75	0.00
Construction Condition:						
Counter Weights:						
a) When density or self weight is well defined	0.00	0.90	0.00	1.00	0.00	1.00
b) When density or self weight is not well defined	0.00	0.80	0.00	1.00	0.00	1.00
c) Erection effects	1.05	0.95	0.00	0.00	0.00	0.00
Wind						
a) As Leading Load	1.50	0.00	0.00	0.00	0.00	0.00
b) As Accompanying Load	1.20	0.00	0.00	0.00	0.00	0.00
Hydraulic Loads:						
(Accompanying Load):						
Water Current Forces	1.00	0.00	1.00	0.00	1.00	0.00
Wave Pressure	1.00	0.00	1.00	0.00	1.00	0.00
Hydrodynamic Effect	0.00	0.00	0.00	0.00	1.00	0.00
Buoyancy	1.00	0.00	1.00	0.00	1.00	0.00

Partial Safety for Verification of Structural Strength Table 3.2, Annex B, IRC:6-2017

Loads	Partial Safety Factor		
	Basic Combination	Accidental Combination	Seismic Combination
(1)	(2)	(3)	(4)
Permanent Loads:			
Dead Load			
SIDL except surfacing			
a) Adding to the effect of variable loads	1.35	1.00	1.35
b) Relieving the effect of variable loads	1.00	1.00	1.00
Surfacing:			
a) Adding to the effect of variable loads	1.75	1.00	1.75
b) Relieving the effect of variable loads	1.00	1.00	1.00
Backfill Weight	1.50	1.00	1.00
Earth Pressure due to Backfill			
a) Leading Load	1.50	1.00	1.00
b) Accompanying Load	1.00	1.00	1.00
Variable Loads:			
Carriageway Live Load and associated loads (braking, tractive and centrifugal forces) and pedestrian live load:			
a) Leading Load	1.50	0.75	0.00
b) Accompanying Load	1.15	0.20	0.20
c) Construction Live Load	1.35	1.00	1.00
Wind during service and construction			
a) Leading Load	1.50	0.00	0.00
b) Accompanying Load	0.90	0.00	0.00
Live Load Surcharge (as accompanying load)	1.20	0.20	0.20
Erection effects	1.00	1.00	1.35
Accidental Effects:			
i) Vehicle Collision	0.00	1.00	0.00
ii) Barge Impact	0.00	1.00	0.00
iii) Impact due to floating bodies	0.00	1.00	0.00
Seismic Effect			
a) During Service	0.00	0.00	1.50
b) During Construction	0.00	0.00	0.75
Hydraulic Loads (Accompanying Load):			
Water Current Forces	1.00	1.00	1.00
Wave Pressure	1.00	1.00	1.00
Hydrodynamic Effect	0.00	0.00	1.00
Buoyancy	0.15	0.15	1.00

2.1.9. Serviceability Limit State

Partial Safety for Verification of Serviceability Limit S Table 3.3, Annex B, IRC:6-2017

Loads	Partial Safety Factor		
	Rare Combination	Frequent Combination	Quasi-permanent
(1)	(2)	(3)	(4)
Permanent Loads:			
Dead Load	1.00	1.00	1.00
SIDL including surfacing	1.20	1.20	1.20
Backfill Weight	1.00	1.00	1.00
Shrinkage and Creep Effects	1.00	1.00	1.00
Earth Pressure due to Backfill	1.00	1.00	1.00
Settlement Effects			
a) Adding to the permanent loads	1.00	1.00	1.00
b) Opposing the permanent loads	0.00	0.00	0.00
Variable Loads:			
Carriageway Live Load and associated loads (braking, tractive and centrifugal forces) and pedestrian live load:			
a) Leading Load	1.00	0.75	0.00
b) Accompanying Load	0.75	0.20	0.00
Thermal Loads:			
a) Leading Load	1.00	0.60	0.00
b) Accompanying Load	0.60	0.50	0.50
Wind			
a) Leading Load	1.00	0.60	0.00
b) Accompanying Load	0.60	0.50	0.00
Live Load Surcharge (Accompanying load)	0.80	0.00	0.00
Hydraulic Loads (Accompanying Load):			
Water Current Forces	1.00	1.00	0.00
Wave Pressure	1.00	1.00	0.00
Buoyancy	0.15	0.15	0.15

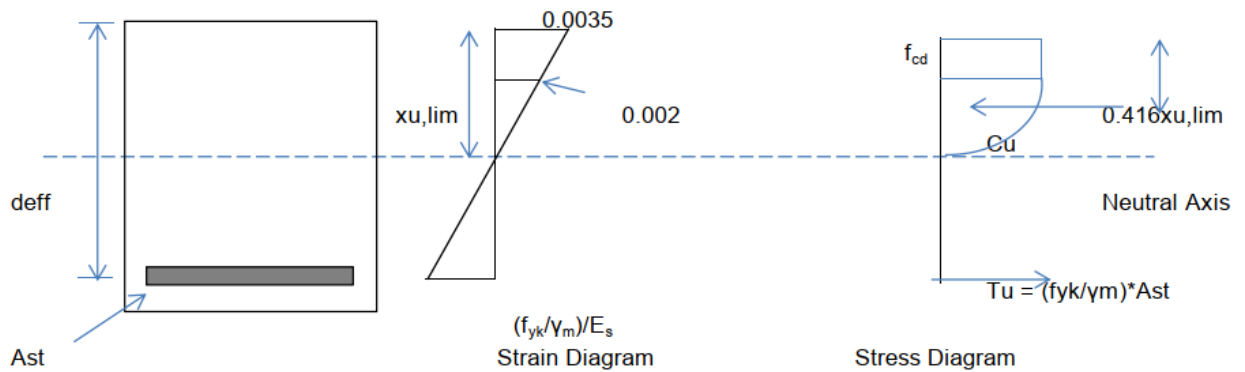
2.1.10. Combination for Base Pressure and Design of Foundation

Table-3: 5 Combination for Base Pressure and Design of Foundation

Table 3.4, Annex B, IRC:6-2014

Loads	Partial Safety Factor			
	Combination (1)	Combination (2)	Seismic Combination	Accidental Combination
(1)	(2)	(3)	(4a)	(4b)
Permanent Loads:				
Dead Load, SIDL except surfacing, Backfill earth filling	1.35	1.00	1.35	1.00
SIDL Surfacing	1.75	1.00	1.75	1.00
Settlement Effect	1.0 or 0	1.0 or 0	1.0 or 0	1.0 or 0
Earth Pressure due to Backfill				
a) Leading Load	1.50	1.30	1.00	1.00
b) Accompanying Load	1.00	0.85	1.00	1.00
Variable Loads:				
Carriageway Live Load and associated loads (braking, tractive and centrifugal forces) and pedestrian live load:				
	1.50	1.30	(0.75 if applicable) or 0	(0.75 if applicable) or 0
a) Leading Load				
b) Accompanying Load	1.15	1.00	0.20	0.20
Thermal Loads as accompanying load	0.90	0.80	0.50	0.50
Wind				
a) Leading Load	1.50	1.30	0.00	0.00
b) Accompanying Load	0.90	0.80	0.00	0.00
Live Load Surcharge (as accompanying load applicable)	1.20	1.00	0.20	0.20
Accidental Effects or Seismic Effect:				
a) During Service	0.00	0.00	1.50	1.00
b) During Construction	0.00	0.00	0.75	0.50
Erection effects	1.35	1.00	1.00	1.00
Hydraulic Loads:				
Water Current	1.0 or 0	1.0 or 0	1.0 or 0	1.0 or 0
Wave Pressure	1.0 or 0	1.0 or 0	1.0 or 0	1.0 or 0
Hydrodynamic Effect	0.00	0.00	1.0 or 0	1.0 or 0
Buoyancy:				
For Base Pressure	1.00	1.00	1.00	1.00
For Structural Design	0.15	0.15	0.15	0.15

2.1.11. Verification of structural strength for top slab



ULTIMATE LIMIT STATE

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 6.4.2.8, IRC:112-2011					
	f_{cd}	=	13.40	N/mm ²	For Basic Combination
	f_{cd}	=	16.75	N/mm ²	For Accidental Combination
	f_{cd}	=	13.40	N/mm ²	For Seismic Combination
	E_c	=	31000	MPa	
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	435	N/mm ²	For Basic Combination
	f_{yd}	=	500	N/mm ²	For Accidental Combination
	f_{yd}	=	435	N/mm ²	For Seismic Combination

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

Minimum strain in steel reinforcement = $0.87 f_y / E_s$

$E_s = 2.0E+05$ MPa

$C_u = f_{cd} \cdot b \cdot (3/7 x_{u,lim} + 2/3 \cdot 4/7 x_{u,lim})$

$= 17/21 \cdot f_{cd} \cdot b \cdot x_u$

$= 0.8095 \cdot f_{cd} \cdot b \cdot x_u$

cg of compression block from top = $0.416 x_u$

$T_u = f_{yd} \cdot A_{st}$

$R_{lim} = M_{u,lim} / b d^2 = 0.8095 f_{cd} \cdot (x_{u,lim} / d) \cdot (1 - 0.416 x_{u,lim} / d)$

	Basic Comb	Accidental Comb	Seismic Comb
$x_{u,lim} / d$	0.46	0.44	0.46
$R_{lim} = M_{u,lim} / b d^2$	4.01	4.85	4.01

Here R_{lim} is in MPa

Calculation of Reinforcement

Width of section $b = 1000$ mm

Depth of section $D = 200$ mm

Clear cover at top. = 40

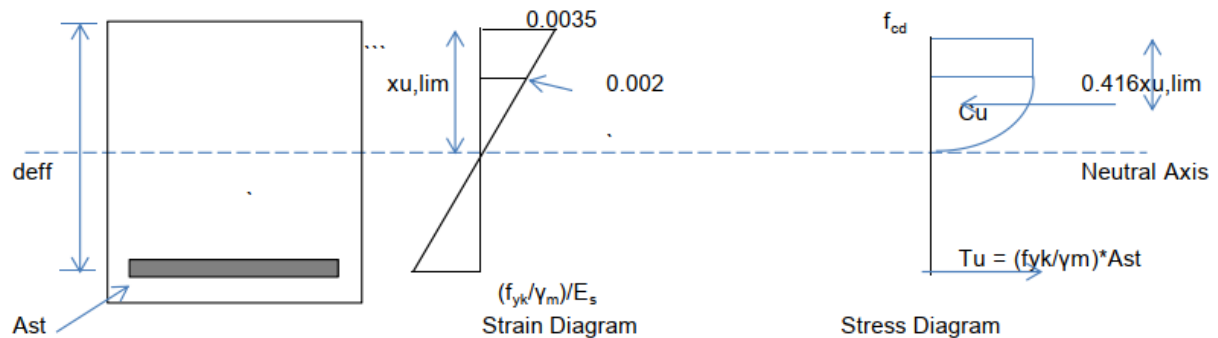
Clear cover at Bottom = 40

2.1.12. Verification of structural strength for top slab

Moment on the section	Top slab Top End support			Top slab Bottom Mid Span		
	Basic			Basic		
	Comb			Comb		
Actual moment (KNm)	24.1			45.8		
b	1000			1000		
D	200			200		
c	40			40		
d	155.0			146.0		
f_{cd}	13.40			13.40		
f_{yd}	435			435		
xu_{lim}/d	0.46			0.46		
$R_{sls} = M_{u,sls}/bd^2$	4.01			4.01		
$M_{u,Lim}$ (KNm)	96			85		
	OK			OK		
Ast Req.	372			794		
Dia of bar (main tension) (mm)	10			12		
Spacing (mm)	150			100		
+ dia of bar (main tension) (mm)	10			0		
Spacing (mm)	150			200		
Ast provided (sq mm)	1047			1131		
% Steel	0.68			0.73		
Dia of bar (main compresion) (mm)	0			10		
Spacing (mm)	200			150		
Area of main compresion (mm ²)	0			524		
f_{ctm}	2.5			2.5		
f_{yk}	500			500		
cl. 16.6.1 (2) of IRC :112-2011						
$A_{s,min} = 0.26 f_{ctm} b_t d / f_{yk} \geq 0.0013 b_t d$	202			190		
A_{ct}	158026			154668		
$f_{ct,eff}$	2.9			2.9		
$k_c = 0.4 \{ 1 - s_c / (k_1 f_{ct,eff} h/h') \} \leq 1$	0.4			0.4		
For Bending or bending combined with axial force						
k	1.000			1.0000		
s_s	500			500		
cl. 12.3.6 (4) of IRC :112-2011						
$A_{s,min} = k_c k f_{ct,eff} A_{ct} / s_s$	367			359		
	OK			OK		
$A_{s,max} = 0.025 A_c$ (main tension)	5000			5000		
cl. 16.5.1.1 (2) of IRC :112-2011	OK			OK		
$A_{s,max} = 0.04 A_c$ (tension + compresion)	8000			8000		
x (mm)	42			45		
x/d	0.271			0.310		
	OK			OK		
z (mm)	138			127		
MR (KNm)	63			63		
	OK			OK		
Calculation of Transverse Steel as per Clause 16.6.1.1						
$A_{ST,min} = 20\%$ of main reinforcement	74.4			158.8		
Dia of bar (Horizontal Bar) (mm)	10			10		
Spacing (mm)	200			200		
Area of distribution bar (mm ²)	392.7			392.7		
	OK			OK		

Min shear stress	0.480
cl. 10.3.2(5) Eq. 10.6 of IRC :112-2010 $n = 0.6 (1 - f_{ck} / 310)$	0.542
cl. 10.3.2(5) Eq. 10.5 of IRC :112-2011 $0.5 b_w d n f_{cd}$	563
	OK
Min shear force for providing reinf., V_E (N)	114583.0
No. of link for shear reinf.	4
Dia. of bar for shear reinf.	8
$S = A_{sw} \times 0.9 \times d \times \cot \theta \times f_y / V_E$	266
S (mm)	75
A_{SW}	201
cl. 16.5.2(7) Eq. 16.6 of IRC :112-2011 $S_{l,max} = 0.75 d$	116
Spacing Required in Long. Direction (mm)	116.3
Spacing provided in Long. Direction (mm)	100
	OK
cl. 16.5.2(9) Eq. 16.8 of IRC :112-2011 $S_{t,max} = 0.75 d \leq 600 \text{ mm}$	116
Spacing provided in Trans. Direction, S_t mm	100
	OK
z (mm)	138
f_{ywd}	400
cl. 10.3.3.3 Eq. 10.17 of IRC :112-2010 $V_{Ed} \leq A_{SW} f_{ywd}$ (KN)	80
cl. 10.3.3.3 (6) of IRC :112-2010 $M_{Ed} / z + 0.5 V_{Ed}$ (KN)	215
$M_{ed max} / z$ (KN)	455
	OK
cl. 10.3.3.2 Eq. 10.7 of IRC :112-2011 $V_{Rd,s} = A_{SW} z f_{ywd} / S$ (KN)	147
	OK
$a_{cw} = (s_{cp} = N_{Ed} / A_c = 0)$	1.0
n_1	0.6
cl. 10.3.3.2 Eq. 10.8 of IRC :112-2011 $V_{Rd,max} = a_{cw} b_w z n_1 f_{cd}$ (KN)	1106
	OK
cl. 10.3.3.2 Eq. 10.10 of IRC :112-2011 $A_{SW,max} \leq 0.5 a_{cw} n_1 f_{cd} b_w S / f_{ywd}$	754
	OK
cl. 10.3.1 of IRC :112-2011 $r_w = A_{SW} / (S b_w \sin \alpha)$	0.0027
cl. 10.3.3.5 of IRC :112-2011 $r_{w,min} = (0.072 f_{ck}^{0.5}) / f_{yk}$	0.0008
	OK

2.1.13. Verification for serviceability limit state for Top slab



SERVICEABILITY LIMIT STATE

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 12.2.1, IRC:112-2011	f_{cd}	=	14.40	N/mm ²	For Rare Combination
	f_{cd}	=	14.40	N/mm ²	For Frequent Combination
	f_{cd}	=	10.80	N/mm ²	For Quasi-Perma. Combination
As per clause 12.2.2, IRC:112-2011					
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	400	N/mm ²	For Rare Combination
	f_{yd}	=	400	N/mm ²	For Frequent Combination
	f_{yd}	=	400	N/mm ²	For Quasi-Perma. Combination

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

Minimum strain in steel reinforcement = $0.87 f_y / E_s$

$E_s = 2.0E+05 \text{ MPa}$

$E_c = 31000 \text{ MPa}$

$C_u = f_{cd} \cdot b \cdot (3/7 x_{u,lim} + 2/3 \cdot 4/7 x_{u,lim})$

$= 17/21 \cdot f_{cd} \cdot b \cdot x_u$

$= 0.8095 \cdot f_{cd} \cdot b \cdot x_u$

cg of compression block from top = $0.416 x_u$

$T_u = f_{yd} \cdot A_{st}$

$R_{sls} = M_{u,sls} / b d^2 = 0.8095 f_{cd} \cdot (x_u/d) \cdot (1 - 0.416 \cdot x_u/d)$

	Rare Comb	Frequent Comb	Quasi-Perma. Comb
$x_{u,sls}/d$	0.47	0.47	0.47
$R_{sls} = M_{u,sls} / b d^2$	4.38	4.38	3.29

Here R_{sls} is in MPa

Calculation of Reinforcement

Width of section $b = 1000 \text{ mm}$

Depth of section $d = 200 \text{ mm}$

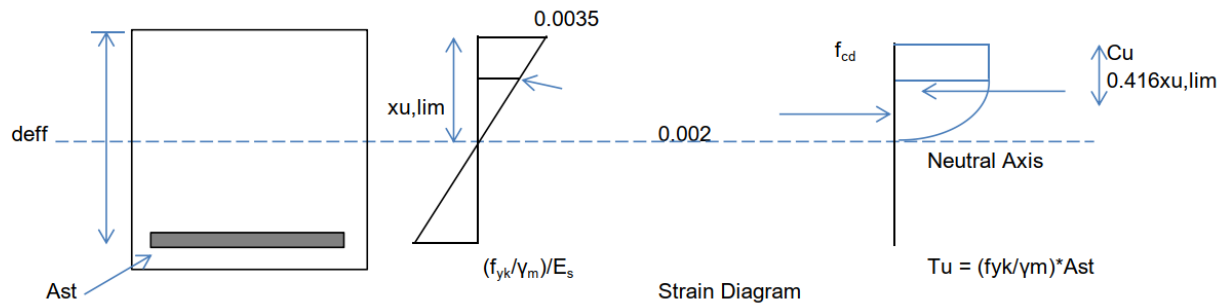
Clear cover at top. = **40**

Clear cover at Bottom = **40**

Moment on the section	Top slab Top End support			Top slab Bottom Mid Span		
	Rare Comb		Quasi-Perma. Comb	Rare Comb		Quasi-Perma. Comb
Actual moment (KNm)	13.5		12.6	37.951		19.162
b	1000		1000	1000		1000
D	200		200	200		200
c	40		40	40		40
d	147.0		147.0	146.0		146.0
f_{cd}	14.40		10.80	14.40		10.80
f_{yd}	400		400	400		400
$x_{u,sls}/d$	0.47		0.47	0.47		0.47
$R_{sls} = M_{u,sls}/bd^2$	4.38		3.29	4.38		3.29
$M_{u,sls}$ (KNm)	95		71	93		70
	OK		OK	OK		OK
Ast Req.	236		221	697		343
Dia of bar (main tension) (mm)	10		10	12		12
Spacing (mm)	150		150	100		100
+ dia of bar (main tension) (mm)	10		10	0		0
Spacing (mm)	150		150	200		200
Ast provided (sq mm)	1047		1047	1131		1131
Dia of bar (main compresion) (mm)	0		0	10		10
Spacing (mm)	200		200	150		150
Area of main compresion (mm ²)	0		0	524		524
f_{ctm}	2.5		2.5	2.5		2.5
x (mm)	35.9		47.9	38.8		51.7
x/d	0.244		0.326	0.266		0.354
	OK		OK	OK		OK
z (mm)	132		127	130		124
MR_{sls} (KNm)	55		53	59		56
	OK		OK	OK		OK
$s_{sc} = M/(A_s z)$	98		95	258		136
	OK		OK	OK		OK
$s_{ca} = M/(0.8095 z b x_u)$	3.53		2.56	9.30		3.68
	OK		OK	OK		OK

Calculation of crack width	Top slab Top End support			Top slab Bottom Mid Span		
n_1			7			10
n_2			7			5
$f_{eq} = (n_1 f_1^2 + n_2 f_2^2) / (n_1 f_1 + n_2 f_2)$			10			12
cl. 12.3.4 (3) of IRC :112-2011						
c			40			40
k_1			0.8			0.8
k_2			0.50			0.50
For skew slab refer eq. 12.10 of IRC :112-2011						
$r_{p,eff} = A_s / A_{c,eff}$			0.010			0.011
$S_{r,max} = \{ 3.4 c + (0.425 k_1 k_2 f) / r_{p,eff} \}$			298			316
cl. 12.3.4 (3) of IRC :112-2011						
k_t			0.5			0.5
$f_{ct,eff}$			2.90			2.90
E_s			200000			200000
E_{cm}			31000			31000
$a_e = E_s / E_{cm}$			6.45			6.45
$(e_{sm} - e_{cm}) = (s_{sc} - k_t f_{ct,eff} (1 + a_e r_{p,eff}) / r_{p,eff}) / E_s$ $\geq 0.6 s_{sc} / E_s$			0.0003			0.0004
cl. 12.3.4 (2) of IRC :112-2011						
$W_k = S_{r,max} (e_{sm} - e_{cm})$			0.08			0.13
cl. 12.3.4 (1) of IRC :112-2011						
			OK			OK
Calculation of deflection						
Span (mm)					2200	
span/800					2.8	
cl. 12.4.1 (2) of IRC :112-2011						
Short term elastic deflection from STAAD					0.5	
					OK	

2.1.14. Verification of structural strength for bottom slab



ULTIMATE LIMIT STATE

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 6.4.2.8, IRC:112-2011					
	f_{cd}	=	13.40	N/mm ²	Combination (1)
	f_{cd}	=	16.75	N/mm ²	Accidental Combi.
	f_{cd}	=	13.40	N/mm ²	Combination (2)
	E_c	=	31000	MPa	
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	435	N/mm ²	Combination (1)
	f_{yd}	=	500	N/mm ²	Accidental Combi.
	f_{yd}	=	435	N/mm ²	Combination (2)

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

Minimum strain in steel reinforcement = $0.87 f_y / E_s$

$E_s = 2.0E+05 \text{ MPa}$

$E_c = 31000 \text{ MPa}$

$C_u = f_{cd} \cdot b \cdot (3/7 x_{u,lim} + 2/3 \cdot 4/7 x_{u,lim})$

$= 17/21 \cdot f_{cd} \cdot b \cdot x_{u,lim}$

$= 0.8095 \cdot f_{cd} \cdot b \cdot x_{u,lim}$

cg of compression block from top = $0.416 x_{u,lim}$

$T_u = f_{yd} \cdot A_{st}$

$R_{lim} = M_{u,lim} / b d^2 = 0.8095 f_{cd} \cdot (x_{u,lim} / d) \cdot (1 - 0.416 \cdot x_{u,lim} / d)$

	Basic Comb	Accidental Comb	Seismic Comb
$x_{u,lim} / d$	0.46	0.44	0.46
$R_{lim} = M_{u,lim} / b d^2$	4.01	4.85	4.01

Here R_{lim} is in MPa

Calculation of Reinforcement

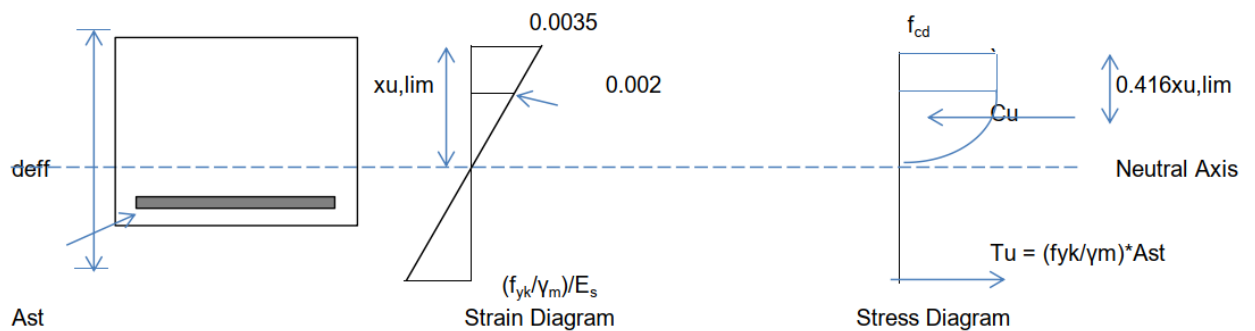
Width of section b	=	1000 mm		
Depth of section D	=	225 mm		
Clear cover at bott.	=	75	Clear cover at top	= 40

Moment on the section		Bottom End support		Top Mid Span	
		Combination (1)		Combination (1)	
Actual moment (KNm)		22.0		51.3	
b		1000		1000	
D		225		225	
c		75		40	
d		144.0		171.0	
f_{cd}		13.40		13.40	
f_{yd}		435		435	
xu_{lim}/d		0.46		0.46	
$R_{sls} = M_{u,sls}/bd^2$		4.01		4.01	
$M_{u,Lim}$ (KNm)		83		117	
		OK		OK	
Ast Req.		366		744	
Dia of bar (main tension) (mm)		12		12	
Spacing (mm)		200		100	
+ dia of bar (main tension) (mm)		10		0	
Spacing (mm)		150		200	
Ast provided (sq mm)		1089		1131	
% Steel		0.76		0.79	
Dia of bar (main compression) (mm)		0		10	
Spacing (mm)		200		150	
Area of main compression (mm ²)		0		524	
f_{ctm}		2.5		2.5	
f_{yk}		500		500	
cl. 16.6.1 (2) of IRC :112-2011					
$A_{s,min} = 0.26 f_{ctm} b_t d / f_{yk} \geq 0.0013 b_t d$		187		222	
A_{ct}		181347		179668	
$f_{ct,eff}$		2.9		2.9	
$k_c = 0.4 \{ 1 - s_c / (k_1 f_{ct,eff} h/h^*) \} \leq 1$		0.4		0.4	
For Bending or bending combined with axial force					
k		1.0000		1.0000	
s_s		500		500	
cl. 12.3.6 (4) of IRC :112-2011					
$A_{s,min} = k_c k f_{ct,eff} A_{ct} / s_s$		421		417	
		OK		OK	
$A_{s,max} = 0.025 A_c$ (main tension)		5625		5625	
cl. 16.5.1.1 (2) of IRC :112-2011		OK		OK	
$A_{s,max} = 0.04 A_c$ (tension + compression)		9000		9000	
x (mm)		44		45	
x/d		0.303		0.265	
		OK		OK	
z (mm)		126		152	
MR (KNm)		60		75	
		OK		OK	
Calculation of Transverse Steel as per Clause 16.6.1.1					
$A_{ST,min} = 20\%$ of main reinforcement		84.1		148.8	
Dia of bar (Horizontal Bar) (mm)		10		10	
Spacing (mm)		200		200	
Area of distribution bar (mm ²)		392.7		392.7	
		OK		OK	

Shear on the section		Bottom End support	
Actual shear V_{Ed} (KN)	103.7		
Actual shear stress (N/mm ²)	0.800		
Max shear capacity, $0.135 f_{ck}(1-f_{ck}/310)$	3.7		
	OK.		
Min shear capacity, $0.0924 f_{ck}(1-f_{ck}/310)$	2.5		
$\Theta = 0.5 \times \sin^{-1}$ (Applied shear stress / $0.135/f_{ck}/(1-f_{ck}/310)$)			
Min angle of inclination, Θ (deg)	21.8		
cl. 10.3.2(2) Eq. 10.2 of IRC :112-2010			
$K = 1 + \sqrt{200/d} \leq 2.0$	2.000		
cl. 10.3.2(2) Eq. 10.3 of IRC :112-2010			
$n_{min} = 0.031 K^{3/2} f_{ck}^{1/2}$	0.480		
cl. 10.3.1 of IRC :112-2011			
$r_1 = A_{sl}/(b_w d) \leq 0.02$	0.008		
	OK		
$0.12 K (80 r_1 f_{ck})^{0.33}$	0.625		
Axial compressive force N_{Ed} (KN)	0		
$s_{cp} = N_{Ed} / A_c \leq 0.2 f_{cd}$	0.0		
cl. 10.3.2(2) Eq. 10.1 of IRC :112-2010			
$V_{Rd,c} = [0.12K(80\rho_1 f_{ck})^{0.33} + 0.15\sigma_{cp}]b_w d \leq (n_{min} + 0.15 s_{cp}) b_w d$ (KN)	90.0		
Provide Shear Reinf.			
Min shear stress	0.625		
cl. 10.3.2(5) Eq. 10.6 of IRC :112-2010			
$n = 0.6 (1 - f_{ck} / 310)$	0.542		
cl. 10.3.2(5) Eq. 10.5 of IRC :112-2011			
$0.5 b_w d n f_{cd}$	523		
	OK		
Min shear force for providing reinf., V_E (N)	22699.6		
No. of link for shear reinf.	4		
Dia. of bar for shear reinf.	8		
$S = A_{sw} \times 0.9 \times d \times \cot \Theta \times f_y / V_E$	1248		
S (mm)	25		
A_{SW}	201		
cl. 16.5.2(7) Eq. 16.6 of IRC :112-2011			
$S_{l,max} = 0.75 d$	108		
Spacing Required in Long. Direction (mm)	108.0		
Spacing provided in Long. Direction (mm)	100		
	OK		
cl. 16.5.2(9) Eq. 16.8 of IRC :112-2011			
$S_{t,max} = 0.75 d \leq 600\text{mm}$	108		
Spacing provided in Trans. Direction, S_t mm	100		

	OK		
z (mm)	126		
f_{ywd}	400		
cl. 10.3.3.3 Eq. 10.17 of IRC :112-2010			
$V_{Ed} \leq A_{SW} f_{ywd}$ (KN)	80		
cl. 10.3.3.3 (6) of IRC :112-2010			
$M_{Ed} / z + 0.5 V_{Ed}$ (KN)	215		
$M_{ed\ max} / z$ (KN)	474		
	OK		
cl. 10.3.3.2 Eq. 10.7 of IRC :112-2011			
$V_{Rd.s} = A_{SW} z f_{ywd} / S$ (KN)	405		
	OK		
$a_{cw} =$ ($s_{cp} = N_{Ed} / A_c = 0$)	1.0		
n_1	0.6		
cl. 10.3.3.2 Eq. 10.8 of IRC :112-2011			
$V_{Rd.max} = a_{cw} b_w z n_1 f_{cd}$ (KN)	1012		
	OK		
cl. 10.3.3.2 Eq. 10.10 of IRC :112-2011			
$A_{SW.max} \leq 0.5 a_{cw} n_1 f_{cd} b_w S / f_{ywd}$	251		
	OK		
cl. 10.3.1 of IRC :112-2011			
$r_w = A_{SW} / (S b_w \sin \alpha)$	0.0080		
cl. 10.3.3.5 of IRC :112-2011			
$r_{w,min} = (0.072 f_{ck}^{0.5}) / f_{yk}$	0.0008		
	OK		

2.1.15. Verification for serviceability limit state for bottom slab



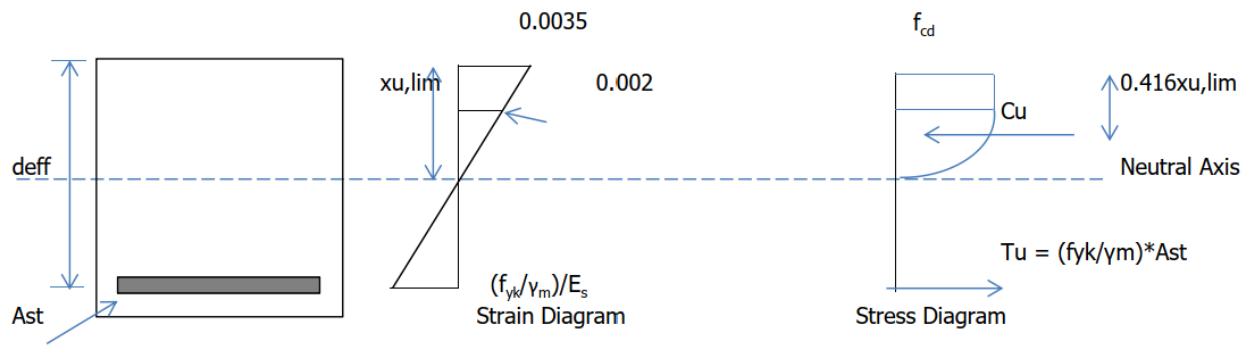
SERVICEABILITY LIMIT STATE

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 12.2.1, IRC:112-2011					
	f_{cd}	=	14.40	N/mm ²	For Rare Combination
	f_{cd}	=	14.40	N/mm ²	For Frequent Combination
	f_{cd}	=	10.80	N/mm ²	For Quasi-Perma. Combination
As per clause 12.2.2, IRC:112-2011					
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	400	N/mm ²	For Rare Combination
	f_{yd}	=	400	N/mm ²	For Frequent Combination
	f_{yd}	=	400	N/mm ²	For Quasi-Perma. Combination
Refer Fig. 6.2 of IRC:112-2011					
For steel reinforcement, simplified bilinear diagram is used					
Minimum strain in steel reinforcement		=	0.87 f_y / E_s		
	E_s	=	2.0E+05 MPa		
C_u		=	$f_{cd} \cdot b \cdot (3/7 x_{u,lim} + 2/3 \cdot 4/7 x_{u,lim})$		
		=	$17/21 \cdot f_{cd} \cdot b \cdot x_u$		
		=	$0.8095 \cdot f_{cd} \cdot b \cdot x_u$		
cg of compression block from top		=	0.416 x_u		
T_u		=	$f_{yd} \cdot A_{st}$		
$R_{sls} = M_{u,sls} / b d^2$		=	$0.8095 f_{cd} \cdot (x_u / d) \cdot (1 - 0.416 \cdot x_u / d)$		
	Rare Comb				
	Frequent Comb				
	Quasi-Perma. Comb				
$x_{u,sls} / d$	0.47		0.47		
$R_{sls} = M_{u,sls} / b d^2$	4.38		4.38		
Here R_{sls} is in MPa					
Calculation of Reinforcement					
Width of section b	=	1000	mm		
Depth of section d	=	225	mm		
Clear cover	=	75	mm	Clear cover at top	= 40

Moment on the section	Bottom End support			Top Mid Span		
	For Rare Combination		For Quasi-Perma. Combination	For Rare Combination		For Quasi-Perma. Combination
Actual moment (KNm)	23.4		18.1	44.211		22.604
b	1000		1000	1000		1000
D	225		225	225		225
c	75		75	40		40
d	136.0		136.0	171.0		171.0
f_{cd}	14.40		10.80	14.40		10.80
f_{yd}	400		400	400		400
$x_u, s/s/d$	0.47		0.47	0.47		0.47
$R_{sls} = M_{u,sls}/bd^2$	4.38		3.29	4.38		3.29
$M_{u,sls}$ (KNm)	81		61	128		96
	OK		OK	OK		OK
Ast Req.	451		349	686		344
Dia of bar (main tension) (mm)	12		12	12		12
Spacing (mm)	200		200	100		100
+ dia of bar (main tension) (mm)	10		10	0		0
Spacing (mm)	150		150	200		200
Ast provided (sq mm)	1089		1089	1131		1131
Dia of bar (main compresion) (mm)	0		0	10		10
Spacing (mm)	200		200	150		150
Area of main compresion (mm ²)	0		0	524		524
f_{ctm}	2.5		2.5	2.5		2.5
x (mm)	37.4		49.8	38.8		51.7
x/d	0.275		0.366	0.227		0.303
	OK		OK	OK		OK
z (mm)	120		115	155		149
MR_{sls} (KNm)	52		50	70		68
	OK		OK	OK		OK
$s_{sc} = M/(A_s z)$	178		144	252		134
	OK		OK	OK		OK
$s_{ca} = M/(0.8095 z b x_u)$	6.42		3.89	9.09		3.61
	OK		OK	OK		OK

Calculation of crack width	Bottom End support			Top Mid Span		
n_1			5			10
n_2			7			5
$f_{eq} = (n_1 f_1^2 + n_2 f_2^2) / (n_1 f_1 + n_2 f_2)$			11			12
cl. 12.3.4 (3) of IRC :112-2011						
c			75			40
k_1			0.8			0.8
k_2			0.50			0.50
For skew slab refer						
$r_{p,eff} = A_s / A_{c,eff}$			0.010			0.010
$S_{r,max} = \{ 3.4 c + (0.425 k_1 k_2 f) / r_{p,eff} \}$			447			339
cl. 12.3.4 (3) of IRC :112-2011						
k_t			0.5			0.5
$f_{ct,eff}$			2.90			2.90
E_s			200000			200000
E_{cm}			31000			31000
$a_e = E_s / E_{cm}$			6.45			6.45
$(e_{sm} - e_{cm}) = (s_{sc} - k_t f_{ct,eff} (1 + a_e r_{p,eff}) / r_{p,eff}) / E_s$ $\geq 0.6 s_{sc} / E_s$			0.0004			0.0004
cl. 12.3.4 (2) of IRC :112-2011						
$W_k = S_{r,max} (e_{sm} - e_{cm})$			0.19			0.14
cl. 12.3.4 (1) of IRC :112-2011						
			OK			OK

2.1.16. Verification of structural strength for outer wall



ULTIMATE LIMIT STATE

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 6.4.2.8, IRC:112-2011					
	f_{cd}	=	13.40	N/mm ²	For Basic Combination
	f_{rd}	=	16.75	N/mm ²	For Accidental Combination
	f_{cd}	=	13.40	N/mm ²	For Seismic Combination
	E_c	=	31000	MPa	
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	435	N/mm ²	For Basic Combination
	f_{yd}	=	500	N/mm ²	For Accidental Combination
	f_{yd}	=	435	N/mm ²	For Seismic Combination

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

$$\text{Minimum strain in steel reinforcement} = \frac{0.87 f_y}{E_s} = \frac{2.0E+05 \text{ MPa}}{31000 \text{ MPa}}$$

$$\begin{aligned} Cu &= f_{cd} * b * (3/7 x_{u,lim} + 2/3 * 4/7 x_{u,lim}) \\ &= 17/21 * f_{cd} * b * x_{u,lim} \\ &= 0.8095 * f_{cd} * b * x_{u,lim} \end{aligned}$$

$$\text{cg of compression block from top} = 0.416 x_{u,lim}$$

$$T_u = f_{yd} * A_{st}$$

$$R_{lim} = M_{u,lim} / b d^2 = 0.8095 f_{cd} * (x_{u,lim} / d) * (1 - 0.416 * x_{u,lim} / d)$$

	Basic Comb	Accidental Comb	Seismic Comb
$x_{u,lim} / d$	0.46	0.44	0.46
$R_{lim} = M_{u,lim} / b d^2$	4.01	4.85	4.01

Here R_{lim} is in MPa

Calculation of Reinforcement

$$\text{Width of section } b = 1000 \text{ mm}$$

$$\text{Depth of section } D = 200 \text{ mm}$$

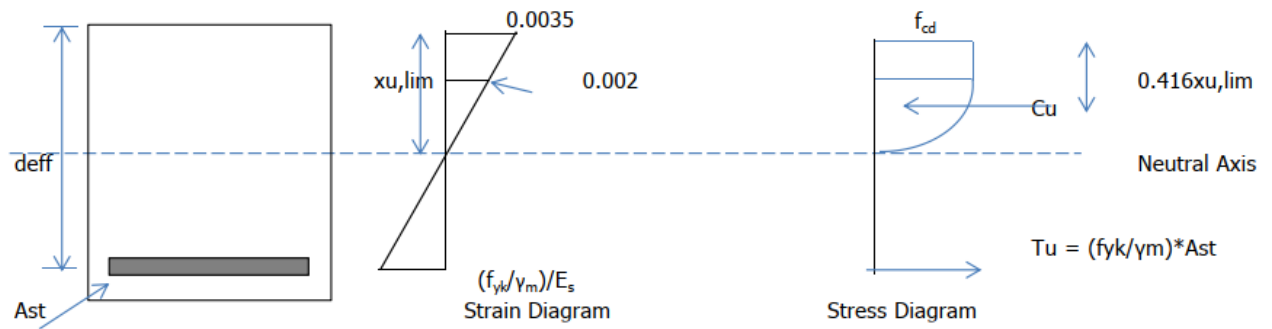
$$\text{Clear cover at Earther} = 75$$

$$\text{Clear cover at open side} = 50$$

Moment on the section		Bottom End support		Top End support	
		Basic Comb		Basic Comb	Mid Span
Actual moment (KNm)		25.2		25.2	5.8
b		1000		1000	1000
D		200		200	200
c		75		75	50
d		109.0		110.0	145.0
f_{cd}		13.40		13.40	13.40
f_{yd}		435		435	435
xu_{lim}/d		0.46		0.46	0.46
$R_{sls} = M_{u,sls}/bd^2$		4.01		4.01	4.01
$M_{u,Lim}$ (KNm)		48		49	84
		OK		OK	OK
Ast Req.		583		577	92
Dia of bar (main tension) (mm)		10		10	10
Spacing (mm)		150		150	150
+ dia of bar (main tension) (mm)		12		10	0
Spacing (mm)		200		150	150
Ast provided (sq mm)		1089		1047	524
% Steel		1.00		0.96	0.36
Dia of bar (main compression) (mm)		10		12	10
Spacing (mm)		150		200	150
Area of main compression (mm ²)		524		565	524
f_{ctm}		2.5		2.5	2.5
f_{yk}		500		500	500
cl. 16.6.1 (2) of IRC :112-2011					
$A_{s,min} = 0.26 f_{ctm} b_t d / f_{yk} \geq 0.0013 b_t d$		142		143	189
A_{ct}		156347		158026	179013
$f_{ct,eff}$		2.9		2.9	2.9
$k_c = 0.4 \{ 1 - \sigma_c / (k_1 f_{ct,eff} h/h^*) \} \leq 1$		0.4		0.4	0.4
For Bending or bending combined with axial force					
k		1.0000		1.0000	1.0000
σ_s		500		500	500
cl. 12.3.6 (4) of IRC :112-2011					
$A_{s,min} = k_c k f_{ct,eff} A_{ct} / \sigma_s$		363		367	415
		OK		OK	OK
$A_{s,max} = 0.025 A_c$ (main tension)		5000		5000	5000
cl. 16.5.1.1 (2) of IRC :112-2011		OK		OK	OK
$A_{s,max} = 0.04 A_c$ (tension + compression)		8000		8000	8000
x (mm)		44		42	21
x/d		0.400		0.382	0.145
		OK		OK	OK
z (mm)		91		93	136
MR (KNm)		43		42	31
		OK		OK	OK
Calculation of Transverse Steel as per Clause 16.3.1					
$A_{ST min} = 25\%$ of main reinforcement in each side or 0.001Ac in each side whichever greater		145.8		144.2	103.8
Dia of bar (Horizontal Bar) (mm)		10	OK	10	OK
Spacing (mm)		200		200	200
Area of distribution bar (mm ²)		392.7		392.7	392.7
		OK		OK	OK

Shear on the section		Bottom End support
Actual shear V_{Ed} (KN)	47.5	
Actual shear stress (N/mm ²)	0.484	
Max shear capacity, $0.135 f_{ck}(1-f_{ck}/310)$	3.7	
	OK.	
Min shear capacity, $0.0924 f_{ck}(1-f_{ck}/310)$	2.5	
$\theta = 0.5 \times \sin^{-1} (\text{Applied shear stress} / 0.135/f_{ck}/(1-f_{ck}/310))$		
Min angle of inclination, θ (deg)	21.8	
cl. 10.3.2(2) Eq. 10.2 of IRC :112-2010		
$K = 1 + \sqrt{200/d} \leq 2.0$	2.000	
cl. 10.3.2(2) Eq. 10.3 of IRC :112-2010		
$v_{min} = 0.031 K^{3/2} f_{ck}^{1/2}$	0.480	
cl. 10.3.1 of IRC :112-2011		
$\rho_1 = A_{sl}/(b_w d) \leq 0.02$	0.010	
	OK	
$0.12 K (80 \rho_1 f_{ck})^{0.33}$	0.685	
Axial compressive force N_{Ed} (KN)	0	
$\sigma_{cp} = N_{Ed} / A_c \leq 0.2 f_{cd}$	0.0	
cl. 10.3.2(2) Eq. 10.1 of IRC :112-2010		
$V_{Rd,c} = [0.12K(80\rho_1 f_{ck})^{0.33} + 0.15\sigma_{cp}] b_w d \leq (v_{min} + 0.15 \sigma_{cp}) b_w d$ (KN)	75	
hence, no reqd to provide reinforcement		

2.1.17. Verification for serviceability limit state for Outer Wall



SERVICEABILITY LIMIT STATE

Grade of Concrete	f_{ck}	=	30	N/mm ²	
As per clause 12.2.1, IRC:112-2011					
	f_{cd}	=	14.40	N/mm ²	For Rare Combination
	f_{rtd}	=	14.40	N/mm ²	For Frequent Combination
	f_{cd}	=	10.80	N/mm ²	For Quasi-Perma. Combination
As per clause 12.2.2, IRC:112-2011					
Grade of steel	f_y	=	500	N/mm ²	
	f_{yd}	=	400	N/mm ²	For Rare Combination
	f_{yd}	=	400	N/mm ²	For Frequent Combination
	f_{yd}	=	400	N/mm ²	For Quasi-Perma. Combination

Refer Fig. 6.2 of IRC:112-2011

For steel reinforcement, simplified bilinear diagram is used

Minimum strain in steel reinforcement = $0.87 f_y / E_s$

$E_s = 2.0 \times 10^5$ MPa $E_c = 31000$ MPa

$$\begin{aligned} Cu &= f_{cd} \cdot b \cdot (3/7 x_{u,lim} + 2/3 \cdot 4/7 x_{u,lim}) \\ &= 17/21 \cdot f_{cd} \cdot b \cdot x_u \\ &= 0.8095 \cdot f_{cd} \cdot b \cdot x_u \end{aligned}$$

cg of compression block from top = $0.416 x_u$

$T_u = f_{yd} \cdot A_{st}$

$$R_{sls} = M_{u,sls} / b d^2 = 0.8095 f_{cd} \cdot (x_u / d) \cdot (1 - 0.416 x_u / d)$$

	Basic Comb	Accidental Comb	Seismic Comb
$x_{u,sls} / d$	0.47	0.47	0.47
$R_{sls} = M_{u,sls} / b d^2$	4.38	4.38	3.29

Here R_{sls} is in MPa

Calculation of Reinforcement

Width of section b	=	1000 mm
Depth of section d	=	200 mm
Clear cover	=	75

Moment on the section	Bottom End support		Top End support		Mid SPAN	
	Rare Comb	Quasi-Perma. Comb	Rare Comb	Quasi-Perma. Comb	Rare Comb	Quasi-Perma. Comb
Actual moment (KNm)	20.8	12.5	20.776	12.537	11.7	1.2
b	1000	1000	1000	1000	1000	1000
D	200	200	200	200	200	200
c	75	75	75	75	75	75
d	109.0	109.0	110.0	110.0	110.0	110.0
f_{cd}	14.40	10.80	14.40	10.80	14.40	10.80
f_{yd}	400	400	400	400	400	400
$x_{u,sls}/d$	0.47	0.47	0.47	0.47	0.47	0.47
$R_{sls} = M_{u,sls}/bd^2$	4.38	3.29	4.38	3.29	4.38	3.29
$M_{u,sls}$ (KNm)	52	39	53	40	53	40
	OK	OK	OK	OK	OK	OK
Ast Req.	511	304	505	301	276	28
Dia of bar (main tension) (mm)	10	10	10	10	10	10
Spacing (mm)	150	150	150	150	150	150
+ dia of bar (main tension) (mm)	12	12	10	10	0	0
Spacing (mm)	200	200	150	150	150	150
Ast provided (sq mm)	1089	1089	1047	1047	524	524
Dia of bar (main compression) (mm)	10	10	12	10	10	10
Spacing (mm)	150	150	200	150	150	150
Area of main compression (mm ²)	524	524	565	524	524	524
f_{ctm}	2.5	2.5	2.5	2.5	2.5	2.5
x (mm)	37.4	49.8	35.9	47.9	18.0	24.0
x/d	0.343	0.457	0.327	0.436	0.163	0.218
	OK	OK	OK	OK	OK	OK
z (mm)	93	88	95	90	103	100
MR_{sls} (KNm)	41	38	40	38	21	21
	OK	OK	OK	OK	OK	OK
$\sigma_{sc} = M/(A_s z)$	204	130	209	133	218	23
	OK	OK	OK	OK	OK	OK
$\sigma_{ca} = M/(0.8095 z b x_u)$	7.35	3.52	7.51	3.59	7.84	0.62
	OK	OK	OK	OK	OK	OK

Calculation of crack width	Bottom End support	Top End support	Span
n_1	7	7	7
n_2	5	7	7
$\phi_{eq} = (n_1 \phi_1^2 + n_2 \phi_2^2) / (n_1 \phi_1 + n_2 \phi_2)$	11	10	10
d. 12.3.4 (3) of IRC :112-2011			
c	75	75	75
k1	0.8	0.8	0.8
k2	0.50	0.50	0.50
For skew slab refer eq. 12.10 of IRC :112-2011			
$\rho_{p,eff} = A_s / A_{c,eff}$	0.011	0.010	0.005
$S_{r,max} = \{ 3.4 c + (0.425 k_1 k_2 \phi) / \rho_{p,eff} \}$	426	417	580
d. 12.3.4 (3) of IRC :112-2011			
k_t	0.5	0.5	0.5
$f_{ct,eff}$	2.90	2.90	2.90
E_s	200000	200000	200000
E_{cm}	31000	31000	31000
$\alpha_e = E_s / E_{cm}$	6.45	6.45	6.45
$(\epsilon_{sm} - \epsilon_{cm}) = (\sigma_{sc} - k_t f_{ct,eff} (1 + \alpha_e \rho_{p,eff}) / \rho_{p,eff}) / E_s$ >= 0.6 σ_{sc} / E_s	0.0004	0.0004	0.0001
d. 12.3.4 (2) of IRC :112-2011			
$W_k = S_{r,max} (\epsilon_{sm} - \epsilon_{cm})$	0.17	0.17	0.04
d. 12.3.4 (1) of IRC :112-2011			
	OK	OK	OK

ANNEXTURES

ANNEXURE

MSA CALCULATIONS

Carriageway			Mand atory Input →	Enter the Input Load Unit (either Kg or T)		kg	Mandatory Input →	Enter Whether Input Load is for Wheel or Axle (W or A)				w	Individual Axle Load (KN)						Gross Vehicle Weight GVW (KN)	Equivalency Factor (EF) or VDF							
Chainage		Mand atory Input	Origin	Destination	Mandat ory Input↓ Axle Config. (See Note above)	Commod ity Type	Individual Wheel Load (kg)																				
Sl. No.	Direction	Vehicle Type					1 st Wheel Load	2 nd Wheel Load	3 rd Wheel Load	4 th Wheel Load	5 th Wheel Load	6 th Wheel Load	1 st Axle Load (KN)	2 nd Axle Load (KN)	3 rd Axle Load (KN)	4 th Axle Load (KN)	5 th Axle Load (KN)	6 th Axle Load (KN)		Steering Single Axle	2 nd	3 rd	4 th	5 th	6 th	Total EF per Vehicle	
1	LHS	3AT	Kandla	Rajasthan	1.22	CORN	1900	8090	8120	0	0	0	37.3	158.7	159.3	0.0	0.0	0.0	355.3	0.108	-	21.32					21.43
2	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2300	2230	2200	1760	2080	0	45.1	43.8	43.2	34.5	40.8	0.0	207.4	0.232	0.089	-	-	0.08			0.40
3	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2100	2150	2130	0	0	0	41.2	42.2	41.8	0.0	0.0	0.0	125.2	0.161	-	0.10					0.26
4	LHS	MAV	Kandla	Shantilaal	1.1.22	EMPTY	2400	1700	1800	2200	0	0	47.1	33.4	35.3	43.2	0.0	0.0	158.9	0.275	0.069	-	0.08				0.42
5	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1830	1920	1995	1430	0	0	35.9	37.7	39.1	28.1	0.0	0.0	140.8	0.093	0.049	-	0.04				0.18
6	LHS	MAV	Kandla	Anjaar	1.2.222	CAR	2830	2470	4020	3710	4255	0	55.5	48.5	78.9	72.8	83.5	0.0	339.1	0.532	0.135	-	-	1.21			1.88
7	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	4870	5660	7800	8240	0	0	95.5	111.0	153.0	161.7	0.0	0.0	521.3	4.669	8.519	-	20.44				33.63
8	LHS	3AT	Kandla	Shantilaal	1.22	SALT	3000	7850	8050	0	0	0	58.9	154.0	157.9	0.0	0.0	0.0	370.8	0.672	-	19.74					20.41
9	LHS	MAV	Kandla	Pune	1.2.22	RICE	2050	5705	7800	7700	0	0	40.2	111.9	153.0	151.1	0.0	0.0	456.3	0.147	3.832	-	17.83				21.81
10	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1710	2210	2470	0	0	0	33.6	43.4	48.5	0.0	0.0	0.0	125.4	0.071	-	0.15					0.22
11	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1900	2000	2200	0	0	0	37.3	39.2	43.2	0.0	0.0	0.0	119.7	0.108	-	0.10					0.20
12	LHS	MAV	Kandla	RuchSoya Comp.	1.22.222	CLOTHES	2130	1960	3420	5400	5045	5525	41.8	38.5	67.1	105.9	99.0	108.4	460.7	0.171	-	0.26	-	-	3.83		4.26
13	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2610	4890	5950	6350	0	0	51.2	95.9	116.7	124.6	0.0	0.0	388.5	0.385	2.069	-	7.07				9.52
14	LHS	MAV	Kandla	Mundra	1.2.22	GAS	3200	3250	4700	6700	0	0	62.8	63.8	92.2	131.5	0.0	0.0	350.2	0.870	0.404	-	5.22				6.49
15	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1870	2250	2190	0	0	0	36.7	44.1	43.0	0.0	0.0	0.0	123.8	0.102	-	0.12					0.22
16	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1870	1920	2140	0	0	0	36.7	37.7	42.0	0.0	0.0	0.0	116.3	0.102	-	0.08					0.19
17	LHS	MAV	Kandla	Rajasthan	1.2.22	EMPTY	1730	1580	2395	2000	0	0	33.9	31.0	47.0	39.2	0.0	0.0	151.2	0.074	0.023	-	0.12				0.21
18	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2145	4805	5550	5420	0	0	42.1	94.3	108.9	106.3	0.0	0.0	351.6	0.176	1.928	-	4.47				6.58
19	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2110	1940	0	1880	1720	0	41.4	38.1	0.0	36.9	33.7	0.0	150.1	0.165	0.051	-	-	0.01			0.23
20	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	2515	7310	0	5630	4820	0	49.3	143.4	0.0	110.5	94.6	0.0	397.8	0.332	#####	-	-	0.70			11.36
21	LHS	MAV	Kandla	Shantilaal	1.1.22	SALT	2640	7030	6470	6040	0	0	51.8	137.9	126.9	118.5	0.0	0.0	435.2	0.403	#####	-	7.56				28.24
22	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1820	1435	1840	1345	0	0	35.7	28.2	36.1	26.4	0.0	0.0	126.4	0.091	0.015	-	0.03				0.14
23	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2760	2250	2505	0	0	0	54.2	44.1	49.1	0.0	0.0	0.0	147.4	0.482	-	0.16					0.64
24	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2480	6670	6090	5860	0	0	48.7	130.9	119.5	115.0	0.0	0.0	414.0	0.314	7.160	-	6.30				13.77
25	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1710	1610	0	1710	1640	0	33.6	31.6	0.0	33.6	32.2	0.0	130.9	0.071	0.024	-	-	0.01			0.10
26	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1900	2000	1900	0	0	0	37.3	39.2	37.3	0.0	0.0	0.0	113.8	0.108	-	0.07					0.18
27	LHS	MAV	Kandla	Gandhidh am	1.1.22	Petroleum	2800	4400	5500	6700	0	0	54.9	86.3	107.9	131.5	0.0	0.0	380.6	0.510	3.111	-	6.84				10.46
28	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2250	4550	5770	4090	0	0	44.1	89.3	113.2	80.2	0.0	0.0	326.9	0.213	1.551	-	2.92				4.68
29	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	3265	4710	5825	5440	0	0	64.1	92.4	114.3	106.7	0.0	0.0	377.5	0.943	1.780	-	4.97				7.70
30	LHS	MAV	Kandla	Shantilaal	1.2.22	Petroleum	2450	6800	6700	6400	0	0	48.1	133.4	131.5	125.6	0.0	0.0	438.5	0.299	7.735	-	9.10				17.13
31	LHS	MAV	Kandla	Shantilaal	1.22.22	EMPTY	2960	3140	3260	3870	3910	0	58.1	61.6	64.0	75.9	76.7	0.0	336.3	0.637	-	0.52	-	1.13			2.29
32	LHS	MAV	Kandla	Shantilaal	1.2.22	CHEMICAL	3105	5505	5900	7800	0	0	60.9	108.0	115.8	153.0	0.0	0.0	437.7	0.772	3.323	-	10.88				14.97

33	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1770	2315	2020	1790	1830	0	34.7	45.4	39.6	35.1	35.9	0.0	190.8	0.081	0.104	-	-	0.06		0.24
34	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	2120	1980	2030	2170	0	0	41.6	38.8	39.8	42.6	0.0	0.0	162.8	0.168	0.056	-	0.10			0.32
35	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1950	2170	2050	0	0	0	38.3	42.6	40.2	0.0	0.0	0.0	121.1	0.120	-	0.10				0.22
36	LHS	MAV	Kandla	Shantilaal	1.22.222	EMPTY	2410	2040	1870	0	1925	1830	47.3	40.0	36.7	0.0	37.8	35.9	197.7	0.280	-	0.07	-	-	0.01	0.36
37	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2130	1910	2050	2190	0	0	41.8	37.5	40.2	43.0	0.0	0.0	162.5	0.171	0.048	-	0.10			0.32
38	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1800	1950	1900	0	0	0	35.3	38.3	37.3	0.0	0.0	0.0	110.9	0.087	-	0.07				0.15
39	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	1935	5610	0	6330	6135	0	38.0	110.1	0.0	124.2	120.4	0.0	392.6	0.116	3.583	-	-	1.42		5.12
40	LHS	MAV	Kandla	Anjaar	1.1.22	TILES	3550	0	4130	4260	0	0	69.7	0.0	81.0	83.6	0.0	0.0	234.3	1.318	0.000	-	1.53			2.85
41	LHS	MAV	Kandla	Shantilaal	1.22.222	EMPTY	2110	1980	1760	0	1810	1740	41.4	38.8	34.5	0.0	35.5	34.1	184.4	0.165	-	0.06	-	-	0.01	0.23
42	LHS	3AT	Kandla	Mithi	1.22	EMPTY	2200	2400	2450	0	0	0	43.2	47.1	48.1	0.0	0.0	0.0	138.3	0.194	-	0.17				0.36
43	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	1965	5650	5965	5810	0	0	38.6	110.9	117.0	114.0	0.0	0.0	380.4	0.124	3.687	-	5.94			9.75
44	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1820	1660	1910	1510	0	0	35.7	32.6	37.5	29.6	0.0	0.0	135.4	0.091	0.027	-	0.04			0.16
45	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	3610	0	5970	6010	0	0	70.8	0.0	117.1	117.9	0.0	0.0	305.9	1.410	0.000	-	6.36			7.77
46	LHS	MAV	Kandla	Shantilaal	1.2.222	CLOTHES	3310	6510	0	4115	4630	0	64.9	127.7	0.0	80.7	90.8	0.0	364.2	0.996	6.498	-	-	0.34		7.84
47	LHS	MAV	Kandla	Mithi	1.22.222	CLOTHES	2560	3970	3770	5830	5070	4830	50.2	77.9	74.0	114.4	99.5	94.8	510.7	0.357	-	1.11	-	-	3.60	5.07
48	LHS	MAV	Kandla	Shantilaal	1.22.22	EMPTY	2210	1930	1870	1605	1575	0	43.4	37.9	36.7	31.5	30.9	0.0	180.3	0.198	-	0.06	-	0.03		0.29
49	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1850	2270	2100	0	0	0	36.3	44.5	41.2	0.0	0.0	0.0	122.0	0.097	-	0.11				0.21
50	LHS	MAV	Kandla	RuchSoya Comp.	1.22.22	Petroleum	2760	3640	6700	7200	9600	0	54.2	71.4	131.5	141.3	188.4	0.0	586.6	0.482	-	3.53	-	24.60		28.62
51	LHS	MAV	Kandla	Shantilaal	1.22.222	CLOTHES	2330	3290	3380	5340	5005	4610	45.7	64.5	66.3	104.8	98.2	90.4	470.0	0.245	-	0.61	-	-	2.94	3.80
52	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1900	1950	2200	0	0	0	37.3	38.3	43.2	0.0	0.0	0.0	118.7	0.108	-	0.09				0.20
53	LHS	MAV	Kandla	Ahmedab	1.1.22	CORN	2100	6705	6500	7800	0	0	41.2	131.6	127.5	153.0	0.0	0.0	453.3	0.161	#####	-	12.91			29.85
54	LHS	MAV	Kandla	Shantilaal	1.1.22	TILES	3390	0	4640	5100	0	0	66.5	0.0	91.0	100.1	0.0	0.0	257.6	1.096	0.000	-	2.78			3.88
55	LHS	MAV	Kandla	Mithi	1.22.22	GAS	3300	6700	6900	7700	8800	0	64.7	131.5	135.4	151.1	172.7	0.0	655.3	0.984	-	10.57	-	22.89		34.44
56	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1850	1910	2170	0	0	0	36.3	37.5	42.6	0.0	0.0	0.0	116.3	0.097	-	0.09				0.18
57	LHS	MAV	Kandla	Anjaar	1.2.222	POWDER	3240	4560	4850	5970	5330	0	63.6	89.5	95.2	117.1	104.6	0.0	469.9	0.915	1.564	-	-	4.00		6.48
58	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1980	2240	2700	0	0	0	38.8	43.9	53.0	0.0	0.0	0.0	135.8	0.128	-	0.18				0.31
59	LHS	MAV	Kandla	Ahmedab	1.22.222	POWDER	2670	4370	4130	0	6205	6270	52.4	85.7	81.0	0.0	121.7	123.0	463.9	0.422	-	1.61	-	-	1.43	3.46
60	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2150	1960	2180	2540	0	0	42.2	38.5	42.8	49.8	0.0	0.0	173.2	0.177	0.053	-	0.15			0.38
61	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1670	1925	1775	1950	0	0	32.8	37.8	34.8	38.3	0.0	0.0	143.6	0.065	0.050	-	0.06			0.17
62	LHS	MAV	Kandla	GT Rd	1.2.22	Petroleum	3200	6700	6800	7200	0	0	62.8	131.5	133.4	141.3	0.0	0.0	468.9	0.870	7.290	-	11.86			20.02
63	LHS	MAV	Kandla	Mithi	1.22.22	Petroleum	2405	4870	5900	6700	6800	0	47.2	95.5	115.8	131.5	133.4	0.0	523.4	0.278	-	4.16	-	10.26		14.69
64	LHS	MAV	Kandla	Shantilaal	1.2.22	WOOD	2350	3270	6070	7200	0	0	46.1	64.2	119.1	141.3	0.0	0.0	370.6	0.253	0.414	-	9.58			10.24
65	LHS	MAV	Kandla	Mundra	1.2.22	SALT	2580	5490	6290	4200	0	0	50.6	107.7	123.4	82.4	0.0	0.0	364.1	0.368	3.286	-	3.74			7.39
66	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1785	1825	0	2175	1970	0	35.0	35.8	0.0	42.7	38.7	0.0	152.2	0.084	0.040	-	-	0.02		0.14
67	LHS	MAV	Kandla	Shantilaal	1.1.22	EMPTY	1750	0	1860	1840	0	0	34.3	0.0	36.5	36.1	0.0	0.0	106.9	0.078	0.000	-	0.06			0.14
68	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1870	1950	2140	0	0	0	36.7	38.3	42.0	0.0	0.0	0.0	116.9	0.102	-	0.09				0.19
69	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1820	1430	1840	1340	0	0	35.7	28.1	36.1	26.3	0.0	0.0	126.2	0.091	0.015	-	0.03			0.14
70	LHS	MAV	Kandla	Mundra	1.2.22	GAS	2760	5500	6700	7800	0	0	54.2	107.9	131.5	153.0	0.0	0.0	446.6	0.482	3.310	-	13.65			17.45
71	LHS	MAV	Kandla	Anjaar	1.2.222	TILES	1980	4550	0	4670	4925	0	38.8	89.3	0.0	91.6	96.6	0.0	316.4	0.128	1.551	-	-	0.50		2.18
72	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	1560	1800	6750	5900	0	0	30.6	35.3	132.4	115.8	0.0	0.0	314.1	0.049	0.038	-	7.91			8.00
73	LHS	MAV	Kandla	Anjaar	1.2.222	SALT	2080	3050	2930	3210	3560	0	40.8	59.8	57.5	63.0	69.8	0.0	291.0	0.155	0.313	-	-	0.52		0.99
74	LHS	MAV	Kandla	GT Rd	1.2.22	D.O.C	3460	4935	6670	5830	0	0	67.9	96.8	130.9	114.4	0.0	0.0	410.0	1.190	2.146	-	7.54			10.88
75	LHS	MAV	Kandla	Gandhida am	1.2.22	TILES	1980	5025	5135	5025	0	0	38.8	98.6	100.7	98.6	0.0	0.0	336.8	0.128	2.307	-	3.29			5.73
76	LHS	MAV	Kandla	Mundra	1.22.2.22	RICE	2830	4690	5130	5230	7655	7835	55.5	92.0	100.7	102.6	150.2	153.7	654.7	0.532	-	2.87	2.71	-	17.78	23.89
77	LHS	MAV	Kandla	Shantilaal	1.22.22	GCB	2200	8800	8850	7700	9070	0	43.2	172.7	173.6	151.1	178.0	0.0	718.5	0.194	-	29.97	-	24.43		54.59

78	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	2785	3875	5640	5700	0	0	54.6	76.0	110.7	111.8	0.0	0.0	353.2	0.499	0.816	-	5.11			6.42
79	LHS	3AT	Kandla	Gandhidham	1.22	EMPTY	2050	2270	2370	0	0	0	40.2	44.5	46.5	0.0	0.0	0.0	131.3	0.147	-	0.14				0.29
80	LHS	MAV	Kandla	Mundra	1.2.22	GAS	2970	3100	4750	4200	0	0	58.3	60.8	93.2	82.4	0.0	0.0	294.7	0.646	0.334	-	1.98			2.96
81	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1860	2240	2170	0	0	0	36.5	43.9	42.6	0.0	0.0	0.0	123.0	0.099	-	0.12				0.22
82	LHS	MAV	Kandla	Shantilaal	1.1.22	CLOTHES	2575	0	3058	3870	0	0	50.5	0.0	60.0	75.9	0.0	0.0	186.4	0.365	0.000	-	0.71			1.08
83	LHS	MAV	Kandla	IOCL	1.1.22	TILES	2150	4670	5615	5260	0	0	42.2	91.6	110.2	103.2	0.0	0.0	347.2	0.177	3.948	-	4.32			8.45
84	LHS	MAV	Kandla	Shantilaal	1.2.222	Handcraft	2160	3200	0	3520	3710	0	42.4	62.8	0.0	69.1	72.8	0.0	247.0	0.181	0.379	-	-	0.16		0.72
85	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2010	1730	1635	1540	0	0	39.4	33.9	32.1	30.2	0.0	0.0	135.7	0.135	0.032	-	0.03			0.20
86	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1970	1670	2145	1980	0	0	38.7	32.8	42.1	38.8	0.0	0.0	152.3	0.125	0.028	-	0.09			0.24
87	LHS	MAV	Kandla	Haryana	1.2.222	EMPTY	2300	2080	0	1990	2540	0	45.1	40.8	0.0	39.0	49.8	0.0	174.8	0.232	0.068	-	-	0.02		0.32
88	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2230	2450	2300	0	0	0	43.8	48.1	45.1	0.0	0.0	0.0	136.9	0.205	-	0.16				0.36
89	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1250	2840	2530	2310	2680	0	24.5	55.7	49.6	45.3	52.6	0.0	227.8	0.020	0.235	-	-	0.19		0.44
90	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	2880	3810	5130	5630	0	0	56.5	74.8	100.7	110.5	0.0	0.0	342.4	0.571	1.749	-	4.14			6.46
91	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2550	7020	6720	5870	0	0	50.0	137.7	131.8	115.2	0.0	0.0	434.8	0.351	8.786	-	7.76			16.90
92	LHS	MAV	Kandla	Anjaar	1.2.22	GAS	3200	6700	6800	6905	0	0	62.8	131.5	133.4	135.5	0.0	0.0	463.1	0.870	7.290	-	10.90			19.06
93	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1760	2230	2450	0	0	0	34.5	43.8	48.1	0.0	0.0	0.0	126.4	0.080	-	0.15				0.23
94	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2380	5240	7290	6810	0	0	46.7	102.8	143.0	133.6	0.0	0.0	426.1	0.266	2.727	-	12.21			15.20
95	LHS	2AT	Kandla	Shantilaal	1.2	EMPTY	2200	2150	0	0	0	0	43.2	42.2	0.0	0.0	0.0	0.0	85.3	0.194	0.077					0.27
96	LHS	MAV	Kandla	Mundra	1.2.22	D.O.C	3460	4935	6670	5840	0	0	67.9	96.8	130.9	114.6	0.0	0.0	410.2	1.190	2.146	-	7.56			10.90
97	LHS	3AT	Kandla	Shantilaal	1.22	GAS	3260	5740	6700	0	0	0	64.0	112.6	131.5	0.0	0.0	0.0	308.0	0.938	-	7.40				8.33
98	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	2085	1210	1390	1460	0	0	40.9	23.7	27.3	28.6	0.0	0.0	120.6	0.157	0.008	-	0.02			0.19
99	LHS	MAV	Kandla	Shantilaal	1.1.22	TILES	2280	0	5310	5840	0	0	44.7	0.0	104.2	114.6	0.0	0.0	263.5	0.224	0.000	-	4.77			5.00
100	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2005	1900	2360	0	0	0	39.3	37.3	46.3	0.0	0.0	0.0	122.9	0.134	-	0.10				0.24
101	LHS	3AT	Kandla	Mithi	1.22	EMPTY	2270	3200	3100	0	0	0	44.5	62.8	60.8	0.0	0.0	0.0	168.1	0.220	-	0.49				0.71
102	LHS	MAV	Kandla	RuchSoya Comp.	1.2.222	RICE	2750	4730	5620	5840	5630	0	54.0	92.8	110.3	114.6	110.5	0.0	482.1	0.475	1.811	-	-	5.02		7.31
103	LHS	MAV	Kandla	Shantilaal	1.1.22	GAS	3505	4050	5760	7240	0	0	68.8	79.5	113.0	142.0	0.0	0.0	403.3	1.253	2.233	-	8.82			12.31
104	LHS	MAV	Kandla	Mithi	1.2.222	RICE	2970	6640	0	7110	6840	0	58.3	130.3	0.0	139.5	134.2	0.0	462.2	0.646	7.032	-	-	2.23		9.91
105	LHS	MAV	Kandla	Mithi	1.22.222	SALT	2140	2980	4300	4820	4635	5615	42.0	58.5	84.4	94.6	90.9	110.2	480.5	0.174	-	0.87	-	-	3.04	4.08
106	LHS	MAV	Kandla	Punjab	1.22.22	GAS	9200	6970	7200	7800	7900	0	180.5	136.8	141.3	153.0	155.0	0.0	766.6	59.469	-	12.45	-	18.76		90.69
107	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1710	1830	1610	1530	0	0	33.6	35.9	31.6	30.0	0.0	0.0	131.1	0.071	0.041	-	0.03			0.14
108	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2180	1960	2140	2310	0	0	42.8	38.5	42.0	45.3	0.0	0.0	168.5	0.187	0.053	-	0.12			0.36
109	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1750	1900	2105	0	0	0	34.3	37.3	41.3	0.0	0.0	0.0	112.9	0.078	-	0.08				0.16
110	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1550	1340	1530	1480	0	0	30.4	26.3	30.0	29.0	0.0	0.0	115.8	0.048	0.012	-	0.03			0.09
111	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2185	2560	2470	0	0	0	42.9	50.2	48.5	0.0	0.0	0.0	141.6	0.189	-	0.20				0.39
112	LHS	MAV	Kandla	Shantilaal	1.1.22	STONE	3205	2990	7070	7860	0	0	62.9	58.7	138.7	154.2	0.0	0.0	414.5	0.876	0.663	-	15.35			16.89
113	LHS	2AT	Kandla	Shantilaal	1.2	EMPTY	2300	2150	0	0	0	0	45.1	42.2	0.0	0.0	0.0	0.0	87.3	0.232	0.077					0.31
114	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2170	2400	2570	0	0	0	42.6	47.1	50.4	0.0	0.0	0.0	140.1	0.184	-	0.19				0.37
115	LHS	MAV	Kandla	Ahmedab	1.2.22	EMPTY	1820	1660	1910	1510	0	0	35.7	32.6	37.5	29.6	0.0	0.0	135.4	0.091	0.027	-	0.04			0.16
116	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	2485	6675	6130	5615	0	0	48.8	131.0	120.3	110.2	0.0	0.0	410.2	0.317	7.182	-	5.88			13.38
117	LHS	MAV	Kandla	Mundra	1.2.22	IRON	2600	2700	3900	4250	0	0	51.0	53.0	76.5	83.4	0.0	0.0	263.9	0.379	0.192	-	1.36			1.93
118	LHS	3AT	Kandla	Shantilaal	1.22	GAS	2705	4800	4805	0	0	0	53.1	94.2	94.3	0.0	0.0	0.0	241.5	0.444	-	2.63				3.07
119	LHS	MAV	Kandla	Punjab	1.22.22	RICE	3540	7610	7700	9000	7770	0	69.5	149.3	151.1	176.6	152.4	0.0	698.9	1.304	-	16.97	-	24.43		42.70
120	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1900	2300	2400	0	0	0	37.3	45.1	47.1	0.0	0.0	0.0	129.5	0.108	-	0.15				0.26
121	LHS	MAV	Kandla	GT Rd	1.2.222	TILES	2515	7310	0	5630	4820	0	49.3	143.4	0.0	110.5	94.6	0.0	397.8	0.332	#####	-	-	0.70		11.36
122	LHS	MAV	Kandla	Ahmedab	1.2.22	RICE	2160	4050	5750	7805	0	0	42.4	79.5	112.8	153.1	0.0	0.0	387.8	0.181	0.973	-	10.43			11.58

123	LHS	MAV	Kandla	Shantilaal	1.1.22	EMPTY	3160	3260	3310	3300	0	0	62.0	64.0	64.9	64.7	0.0	0.0	255.6	0.828	0.938	-	0.59			2.36
124	LHS	MAV	Kandla	Mundra	1.2.22	TILES	1910	4765	4710	4500	0	0	37.5	93.5	92.4	88.3	0.0	0.0	311.7	0.110	1.865	-	2.22			4.20
125	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	4045	4600	0	6140	5575	0	79.4	90.3	0.0	120.5	109.4	0.0	399.5	2.222	1.620	-	-	1.11		4.95
126	LHS	MAV	Kandla	Shantilaal	1.1.22	Furnitures	2155	1515	4890	3990	0	0	42.3	29.7	95.9	78.3	0.0	0.0	246.2	0.179	0.044	-	1.92			2.14
127	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2140	5240	5670	5280	0	0	42.0	102.8	111.2	103.6	0.0	0.0	359.6	0.174	2.727	-	4.44			7.34
128	LHS	2AT	Kandla	Shantilaal	1.2	EMPTY	1900	1700	0	0	0	0	37.3	33.4	0.0	0.0	0.0	0.0	70.6	0.108	0.030					0.14
129	LHS	MAV	Kandla	Gandhida am	1.1.22	TILES	2160	4775	5515	5460	0	0	42.4	93.7	108.2	107.1	0.0	0.0	351.4	0.181	4.316	-	4.48			8.98
130	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	3140	5610	6430	6045	0	0	61.6	110.1	126.2	118.6	0.0	0.0	416.4	0.807	3.583	-	7.48			11.87
131	LHS	MAV	Kandla	Badona	1.2.22	EMPTY	1270	2190	2550	2015	0	0	24.9	43.0	50.0	39.5	0.0	0.0	157.5	0.022	0.083	-	0.13			0.24
132	LHS	MAV	Kandla	Mithi	1.2.222	EMPTY	2530	2840	0	2080	2730	0	49.6	55.7	0.0	40.8	53.6	0.0	199.7	0.340	0.235	-	-	0.03		0.61
133	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1970	1940	1980	1510	0	0	38.7	38.1	38.8	29.6	0.0	0.0	145.2	0.125	0.051	-	0.05			0.22
134	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1760	2140	2210	0	0	0	34.5	42.0	43.4	0.0	0.0	0.0	119.9	0.080	-	0.11				0.19
135	LHS	MAV	Kandla	Shantilaal	1.2.22	Petroleum	2700	4005	4200	4800	0	0	53.0	78.6	82.4	94.2	0.0	0.0	308.1	0.441	0.931	-	2.03			3.40
136	LHS	MAV	Kandla	Mundra	1.2.22	EMPTY	3150	4800	4700	5550	0	0	61.8	94.2	92.2	108.9	0.0	0.0	357.1	0.817	1.920	-	3.41			6.15
137	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2120	2360	2210	0	0	0	41.6	46.3	43.4	0.0	0.0	0.0	131.3	0.168	-	0.13				0.30
138	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1840	1730	2045	1870	0	0	36.1	33.9	40.1	36.7	0.0	0.0	146.9	0.095	0.032	-	0.07			0.20
139	LHS	MAV	Kandla	Anjaar	1.1.22	EMPTY	3750	4205	7745	8050	0	0	73.6	82.5	152.0	157.9	0.0	0.0	466.0	1.642	2.595	-	19.22			23.46
140	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1970	2010	2170	0	0	0	38.7	39.4	42.6	0.0	0.0	0.0	120.7	0.125	-	0.09				0.22
141	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1850	1910	2140	0	0	0	36.3	37.5	42.0	0.0	0.0	0.0	115.8	0.097	-	0.08				0.18
142	LHS	MAV	Kandla	Shantilaal	1.2.22	COAL	3350	7850	9450	9400	0	0	65.7	154.0	185.4	184.4	0.0	0.0	589.6	1.045	#####	-	38.99			53.78
143	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	2340	5920	0	6045	6180	0	45.9	116.2	0.0	118.6	121.3	0.0	401.9	0.249	4.443	-	-	1.31		6.01
144	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	1430	1735	1430	1130	0	0	28.1	34.0	28.1	22.2	0.0	0.0	112.3	0.035	0.033	-	0.01			0.08
145	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	2185	1930	2090	2240	0	0	42.9	37.9	41.0	43.9	0.0	0.0	165.7	0.189	0.050	-	0.11			0.35
146	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	1510	1855	1730	1340	0	0	29.6	36.4	33.9	26.3	0.0	0.0	126.3	0.043	0.043	-	0.03			0.11
147	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1930	1880	1630	1690	0	0	37.9	36.9	32.0	33.2	0.0	0.0	139.9	0.115	0.045	-	0.04			0.20
148	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1900	2240	2310	0	0	0	37.3	43.9	45.3	0.0	0.0	0.0	126.5	0.108	-	0.13				0.24
149	LHS	MAV	Kandla	Shantilaal	1.2.222	Furnitures	2200	3275	0	3515	3640	0	43.2	64.3	0.0	69.0	71.4	0.0	247.8	0.194	0.416	-	-	0.15		0.76
150	LHS	3AT	Kandla	Rajasthan	1.22	EMPTY	2300	1700	1900	0	0	0	45.1	33.4	37.3	0.0	0.0	0.0	115.8	0.232	-	0.05				0.28
151	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1870	2260	2340	0	0	0	36.7	44.3	45.9	0.0	0.0	0.0	126.9	0.102	-	0.14				0.24
152	LHS	MAV	Kandla	Badona	1.2.22	ZEERA	2025	3440	7130	7270	0	0	39.7	67.5	139.9	142.6	0.0	0.0	389.8	0.140	0.507	-	13.28			13.93
153	LHS	MAV	Kandla	Anjaar	1.2.22	SALT	2870	6700	6280	5600	0	0	56.3	131.5	123.2	109.9	0.0	0.0	420.8	0.563	7.290	-	6.15			14.01
154	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	3170	4470	6230	6430	0	0	62.2	87.7	122.2	126.2	0.0	0.0	398.3	0.838	3.314	-	7.93			12.09
155	LHS	MAV	Kandla	Shantilaal	1.2.22	PARCEL	2250	3950	4350	3970	0	0	44.1	77.5	85.3	77.9	0.0	0.0	284.9	0.213	0.881	-	1.48			2.57
156	LHS	MAV	Kandla	Mithi	1.2.22	COAL	3705	5000	7000	8200	0	0	72.7	98.1	137.3	160.9	0.0	0.0	469.0	1.564	2.261	-	16.49			20.31
157	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	1800	4230	5740	5360	0	0	35.3	83.0	112.6	105.2	0.0	0.0	336.1	0.087	1.158	-	4.69			5.93
158	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2005	1800	1700	1670	0	0	39.3	35.3	33.4	32.8	0.0	0.0	140.8	0.134	0.038	-	0.04			0.21
159	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1710	1610	0	1710	1640	0	33.6	31.6	0.0	33.6	32.2	0.0	130.9	0.071	0.024	-	-	0.01		0.10
160	LHS	MAV	Kandla	Anjaar	1.2.222	TILES	2210	5240	0	5740	4805	0	43.4	102.8	0.0	112.6	94.3	0.0	353.1	0.198	2.727	-	-	0.73		3.65
161	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2570	1930	2030	2130	0	0	50.4	37.9	39.8	41.8	0.0	0.0	169.9	0.362	0.050	-	0.09			0.50
162	LHS	MAV	Kandla	Anjaar	1.22.22	WOOD	2470	5560	6970	7850	8150	0	48.5	109.1	136.8	154.0	159.9	0.0	608.2	0.309	-	7.61	-	20.24		28.16
163	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2730	6830	6715	6540	0	0	53.6	134.0	131.7	128.3	0.0	0.0	447.6	0.461	7.873	-	9.53			17.87
164	LHS	MAV	Kandla	Shantilaal	1.1.222	SALT	2640	3250	4280	3480	4160	0	51.8	63.8	84.0	68.3	81.6	0.0	349.4	0.403	0.926	-	-	1.19		2.52
165	LHS	3AT	Kandla	Anjaar	1.22	RICE	3240	5760	6780	0	0	0	63.6	113.0	133.0	0.0	0.0	0.0	309.6	0.915	-	7.64				8.55
166	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1900	1700	2100	0	0	0	37.3	33.4	41.2	0.0	0.0	0.0	111.8	0.108	-	0.06				0.17
167	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1740	2190	1850	0	0	0	34.1	43.0	36.3	0.0	0.0	0.0	113.4	0.076	-	0.08				0.16
168	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1790	1850	2150	0	0	0	35.1	36.3	42.2	0.0	0.0	0.0	113.6	0.085	-	0.08				0.16

169	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1905	1800	1700	0	0	0	37.4	35.3	33.4	0.0	0.0	0.0	106.0	0.109	-	0.05				0.16
170	LHS	MAV	Kandla	Mithi	1.1.22	SALT	2840	0	4960	5340	0	0	55.7	0.0	97.3	104.8	0.0	0.0	257.8	0.540	0.000	-	3.48			4.02
171	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1760	2200	2450	0	0	0	34.5	43.2	48.1	0.0	0.0	0.0	125.8	0.080	-	0.14				0.22
172	LHS	MAV	Kandla	Mithi	1.1.22	EMPTY	1700	1800	1700	1600	0	0	33.4	35.3	33.4	31.4	0.0	0.0	133.4	0.069	0.087	-	0.04			0.19
173	LHS	MAV	Kandla	Shantilaal	1.2.22	CAR	2230	2930	4260	3730	0	0	43.8	57.5	83.6	73.2	0.0	0.0	258.0	0.205	0.267	-	1.26			1.73
174	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1870	1970	2105	0	0	0	36.7	38.7	41.3	0.0	0.0	0.0	116.6	0.102	-	0.09				0.19
175	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	2380	5610	0	5710	6245	0	46.7	110.1	0.0	112.0	122.5	0.0	391.3	0.266	3.583	-	-	1.20		5.05
176	LHS	MAV	Kandla	Pune	1.2.22	EMPTY	3090	2560	2720	2050	0	0	60.6	50.2	53.4	40.2	0.0	0.0	204.4	0.757	0.155	-	0.16			1.07
177	LHS	3AT	Kandla	Shantilaal	1.22	GAS	3140	6870	8010	0	0	0	61.6	134.8	157.2	0.0	0.0	0.0	353.6	0.807	-	15.14				15.95
178	LHS	MAV	Kandla	Mithi	1.2.22	Petroleum	2450	3450	7670	7800	0	0	48.1	67.7	150.5	153.0	0.0	0.0	419.3	0.299	0.513	-	17.69			18.50
179	LHS	MAV	Kandla	Anjaar	1.1.22	EMPTY	2160	2260	2115	2270	0	0	42.4	44.3	41.5	44.5	0.0	0.0	172.8	0.181	0.217	-	0.11			0.51
180	LHS	MAV	Kandla	Shantilaal	1.2.222	Furnitures	2160	3525	0	3045	3610	0	42.4	69.2	0.0	59.7	70.8	0.0	242.1	0.181	0.559	-	-	0.12		0.86
181	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1470	2270	1960	0	0	0	28.8	44.5	38.5	0.0	0.0	0.0	111.8	0.039	-	0.10				0.14
182	LHS	MAV	Kandla	Gandhida am	1.2.22	EMPTY	2140	1860	2070	2250	0	0	42.0	36.5	40.6	44.1	0.0	0.0	163.2	0.174	0.043	-	0.11			0.32
183	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1760	2260	2515	0	0	0	34.5	44.3	49.3	0.0	0.0	0.0	128.2	0.080	-	0.16				0.24
184	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1980	1730	1540	1710	0	0	38.8	33.9	30.2	33.6	0.0	0.0	136.6	0.128	0.032	-	0.03			0.19
185	LHS	MAV	Kandla	Mundra	1.2.22	GAS	3200	6770	7700	7950	0	0	62.8	132.8	151.1	156.0	0.0	0.0	502.7	0.870	7.600	-	18.53			27.00
186	LHS	2AT	Kandla	IOCL	1.2	EMPTY	2040	1840	0	0	0	0	40.0	36.1	0.0	0.0	0.0	0.0	76.1	0.144	0.041					0.19
187	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1790	2190	2230	0	0	0	35.1	43.0	43.8	0.0	0.0	0.0	121.8	0.085	-	0.12				0.20
188	LHS	MAV	Kandla	Shantilaal	1.2.22	Petroleum	2700	4800	5400	6700	0	0	53.0	94.2	105.9	131.5	0.0	0.0	384.6	0.441	1.920	-	6.62			8.98
189	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	1930	3180	2560	1640	0	0	37.9	62.4	50.2	32.2	0.0	0.0	182.7	0.115	0.370	-	0.10			0.58
190	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2160	6840	7080	6930	0	0	42.4	134.2	138.9	136.0	0.0	0.0	451.5	0.181	7.919	-	11.90			20.00
191	LHS	MAV	Kandla	Shantilaal	1.22.22	GOC	3250	6700	6500	9700	9800	0	63.8	131.5	127.5	190.3	192.3	0.0	705.3	0.926	-	9.38	-	44.66		54.96
192	LHS	2AT	Kandla	Hari Rd	1.2	EMPTY	2340	1950	0	0	0	0	45.9	38.3	0.0	0.0	0.0	0.0	84.2	0.249	0.052					0.30
193	LHS	MAV	Kandla	Shantilaal	1.2.222	CLOTHES	1950	3650	4130	4140	6070	0	38.3	71.6	81.0	81.2	119.1	0.0	391.2	0.120	0.642	-	-	2.49		3.25
194	LHS	MAV	Kandla	Anjaar	1.2.2.22	ROLL	2260	3740	0	4860	5010	0	44.3	73.4	0.0	95.4	98.3	0.0	311.4	0.217	0.708	0.00	-	2.93		3.86
195	LHS	MAV	Kandla	Mundra	1.2.222	GEL	1990	3940	0	3710	4190	0	39.0	77.3	0.0	72.8	82.2	0.0	271.3	0.130	0.872	-	-	0.23		1.23
196	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2700	2900	3250	0	0	0	53.0	56.9	63.8	0.0	0.0	0.0	173.6	0.441	-	0.44				0.88
197	LHS	MAV	Kandla	Anjaar	1.2.22	GAS	3300	7200	8700	9000	0	0	64.7	141.3	170.7	176.6	0.0	0.0	553.3	0.984	9.722	-	30.31			41.02
198	LHS	MAV	Kandla	Anjaar	1.2.222	EMPTY	1760	1640	1820	1925	1810	0	34.5	32.2	35.7	37.8	35.5	0.0	175.7	0.080	0.026	-	-	0.06		0.16
199	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2040	2100	2240	0	0	0	40.0	41.2	43.9	0.0	0.0	0.0	125.2	0.144	-	0.11				0.25
200	LHS	3AT	Kandla	Mithi	1.22	EMPTY	1970	2240	2230	0	0	0	38.7	43.9	43.8	0.0	0.0	0.0	126.4	0.125	-	0.12				0.25
201	LHS	MAV	Kandla	Mithi	1.2.222	EMPTY	2110	1940	0	1880	1710	0	41.4	38.1	0.0	36.9	33.6	0.0	149.9	0.165	0.051	-	-	0.01		0.23
202	LHS	3AT	Kandla	Shantilaal	1.22	RICE	3210	5940	6870	0	0	0	63.0	116.5	134.8	0.0	0.0	0.0	314.3	0.881	-	8.32				9.20
203	LHS	MAV	Kandla	Mithi	1.2.222	EMPTY	2110	2060	0	1710	1610	0	41.4	40.4	0.0	33.6	31.6	0.0	147.0	0.165	0.065	-	-	0.01		0.24
204	LHS	MAV	Kandla	Shantilaal	1.2.22	hiding Mate	2610	4275	6510	6345	0	0	51.2	83.9	127.7	124.5	0.0	0.0	387.3	0.385	1.208	-	8.43			10.03
205	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1810	2210	0	2740	2130	0	35.5	43.4	0.0	53.8	41.8	0.0	174.4	0.089	0.086	-	-	0.03		0.21
206	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1800	2100	2300	0	0	0	35.3	41.2	45.1	0.0	0.0	0.0	121.6	0.087	-	0.12				0.20
207	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	4010	0	6830	6645	0	0	78.7	0.0	134.0	130.4	0.0	0.0	343.1	2.146	0.000	-	10.18			12.33
208	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2190	1895	0	1610	2215	0	43.0	37.2	0.0	31.6	43.5	0.0	155.2	0.191	0.047	-	-	0.01		0.25
209	LHS	3AT	Kandla	RuchSoya Comp.	1.22	EMPTY	2200	2300	2200	0	0	0	43.2	45.1	43.2	0.0	0.0	0.0	131.5	0.194	-	0.13				0.32
210	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1940	2240	2310	0	0	0	38.1	43.9	45.3	0.0	0.0	0.0	127.3	0.118	-	0.13				0.25
211	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2060	1820	1760	1940	0	0	40.4	35.7	34.5	38.1	0.0	0.0	148.7	0.149	0.040	-	0.06			0.25
212	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2200	2170	0	1880	2840	0	43.2	42.6	0.0	36.9	55.7	0.0	178.3	0.194	0.080	-	-	0.03		0.30
213	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	2150	1970	2270	0	0	0	42.2	38.7	44.5	0.0	0.0	0.0	125.4	0.177	-	0.10				0.28

214	LHS	MAV	Kandla	Hari Rd	1.2.222	SALT	1980	5630	5970	5850	5030	0	38.8	110.5	117.1	114.8	98.7	0.0	479.9	0.128	3.635	-	-	4.74		8.51
215	LHS	MAV	Kandla	Mundra	1.2.2.22	TILES	3380	1940	720	4660	4280	0	66.3	38.1	14.1	91.4	84.0	0.0	293.9	1.083	0.051	0.00	-	1.97		3.11
216	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2150	2270	2970	0	0	0	42.2	44.5	58.3	0.0	0.0	0.0	145.0	0.177	-	0.23				0.41
217	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	2150	2760	1900	1800	0	0	42.2	54.2	37.3	35.3	0.0	0.0	168.9	0.177	0.210	-	0.06			0.44
218	LHS	MAV	Kandla	Shantilaal	1.2.22	PIPE	1850	4690	5940	5820	0	0	36.3	92.0	116.5	114.2	0.0	0.0	359.0	0.097	1.750	-	5.91			7.75
219	LHS	MAV	Kandla	Shantilaal	1.2.22	Petroleum	2800	3700	3950	4250	0	0	54.9	72.6	77.5	83.4	0.0	0.0	288.4	0.510	0.678	-	1.40			2.58
220	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	2340	2970	2910	2410	2450	0	45.9	58.3	57.1	47.3	48.1	0.0	256.6	0.249	0.281	-	-	0.21		0.75
221	LHS	MAV	Kandla	Anjaar	1.2.22	PIPE	2110	4680	5985	5770	0	0	41.4	91.8	117.4	113.2	0.0	0.0	363.9	0.165	1.735	-	5.90			7.80
222	LHS	MAV	Kandla	Anjaar	1.2.22	Petroleum	2905	3760	5140	6700	0	0	57.0	73.8	100.8	131.5	0.0	0.0	363.1	0.591	0.723	-	6.07			7.38
223	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2900	3200	4400	0	0	0	56.9	62.8	86.3	0.0	0.0	0.0	206.0	0.587	-	1.03				1.62
224	LHS	MAV	Kandla	Anjaar	1.22.22	WOOD	2500	5560	6870	7800	8200	0	49.1	109.1	134.8	153.0	160.9	0.0	606.8	0.324	-	7.37	-	20.24		27.94
225	LHS	MAV	Kandla	Mithi	1.2.222	TABACOO	1650	4430	0	4815	4765	0	32.4	86.9	0.0	94.5	93.5	0.0	307.2	0.062	1.393	-	-	0.50		1.95
226	LHS	MAV	Kandla	Shantilaal	1.1.22	RICE	3580	0	5975	6610	0	0	70.2	0.0	117.2	129.7	0.0	0.0	317.2	1.364	0.000	-	7.75			9.11
227	LHS	MAV	Kandla	Shantilaal	1.22.22	CORN	2000	2890	3250	3900	4070	0	39.2	56.7	63.8	76.5	79.9	0.0	316.1	0.133	-	0.44	-	1.25		1.82
228	LHS	3AT	Kandla	Anjaar	1.22	EMPTY	1905	2170	2190	0	0	0	37.4	42.6	43.0	0.0	0.0	0.0	122.9	0.109	-	0.11				0.22
229	LHS	3AT	Kandla	RuchSoya Comp.	1.22	Petroleum	2600	5700	5950	0	0	0	51.0	111.8	116.7	0.0	0.0	0.0	279.6	0.379	-	5.69				6.07
230	LHS	MAV	Kandla	Mithi	1.2.22	EMPTY	1810	1610	1540	1620	0	0	35.5	31.6	30.2	31.8	0.0	0.0	129.1	0.089	0.024	-	0.03			0.14
231	LHS	MAV	Kandla	Haryana	1.2.222	Petroleum	3400	10340	11400	11790	12070	0	66.7	202.9	223.7	231.3	236.8	0.0	961.4	1.109	#####	-	-	90.98		133.44
232	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2230	2370	2450	0	0	0	43.8	46.5	48.1	0.0	0.0	0.0	138.3	0.205	-	0.17				0.37
233	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2040	1780	1630	1550	0	0	40.0	34.9	32.0	30.4	0.0	0.0	137.3	0.144	0.036	-	0.03			0.21
234	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1900	2100	2500	0	0	0	37.3	41.2	49.1	0.0	0.0	0.0	127.5	0.108	-	0.14				0.25
235	LHS	3AT	Kandla	Mithi	1.22	Petroleum	2200	2900	4400	0	0	0	43.2	56.9	86.3	0.0	0.0	0.0	186.4	0.194	-	0.88				1.07
236	LHS	MAV	Kandla	Ahmedab	1.2.22	Petroleum	2370	6270	7550	8600	0	0	46.5	123.0	148.1	168.7	0.0	0.0	486.4	0.262	5.591	-	21.01			26.86
237	LHS	MAV	Kandla	Anjaar	1.2.22	EMPTY	1950	1630	1250	1150	0	0	38.3	32.0	24.5	22.6	0.0	0.0	117.3	0.120	0.026	-	0.01			0.16
238	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1630	1850	1300	1440	1810	0	32.0	36.3	25.5	28.3	35.5	0.0	157.5	0.059	0.042	-	-	0.03		0.13
239	LHS	MAV	Kandla	Shantilaal	1.2.22	DIESEL	3620	4600	5625	5970	0	0	71.0	90.3	110.4	117.1	0.0	0.0	388.8	1.426	1.620	-	5.58			8.63
240	LHS	MAV	Kandla	Mithi	1.2.222	EMPTY	2190	1895	0	1610	2215	0	43.0	37.2	0.0	31.6	43.5	0.0	155.2	0.191	0.047	-	-	0.01		0.25
241	LHS	MAV	Kandla	Shantilaal	1.22.222	CLOTHES	2390	3720	3510	5320	4325	4580	46.9	73.0	68.9	104.4	84.9	89.9	467.8	0.271	-	0.84	-	-	2.41	3.52
242	LHS	3AT	Kandla	Gandhidh am	1.22	EMPTY	2050	2170	2290	0	0	0	40.2	42.6	44.9	0.0	0.0	0.0	127.7	0.147	-	0.12				0.27
243	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	2250	1900	2300	0	0	0	44.1	37.3	45.1	0.0	0.0	0.0	126.5	0.213	-	0.10				0.31
244	LHS	MAV	Kandla	Shantilaal	1.2.22	TILES	2240	5530	7380	6360	0	0	43.9	108.5	144.8	124.8	0.0	0.0	422.0	0.209	3.383	-	11.01			14.60
245	LHS	3AT	Kandla	Badona	1.22	Petroleum	3600	7800	8200	0	0	0	70.6	153.0	160.9	0.0	0.0	0.0	384.6	1.394	-	20.24				21.63
246	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1960	2240	2310	0	0	0	38.5	43.9	45.3	0.0	0.0	0.0	127.7	0.123	-	0.13				0.26
247	LHS	MAV	Kandla	Shantilaal	1.2.222	POWDER	2530	3995	4245	4360	5740	0	49.6	78.4	83.3	85.5	112.6	0.0	409.5	0.340	0.922	-	-	2.49		3.75
248	LHS	MAV	Kandla	Shantilaal	1.1.22	EMPTY	1705	2160	2540	2220	0	0	33.5	42.4	49.8	43.6	0.0	0.0	169.2	0.070	0.181	-	0.16			0.41
249	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2680	5540	6315	5480	0	0	52.6	108.7	123.9	107.5	0.0	0.0	392.7	0.428	3.408	-	5.98			9.81
250	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2130	1850	2180	1940	0	0	41.8	36.3	42.8	38.1	0.0	0.0	158.9	0.171	0.042	-	0.09			0.30
251	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1280	2640	2360	2030	0	0	25.1	51.8	46.3	39.8	0.0	0.0	163.0	0.022	0.176	-	0.11			0.31
252	LHS	MAV	Kandla	Shantilaal	1.2.222	SOIL	3430	3820	0	6810	6125	0	67.3	74.9	0.0	133.6	120.2	0.0	396.0	1.149	0.770	-	-	1.65		3.57
253	LHS	MAV	Kandla	RuchSoya Comp.	1.1.22	POWDER	2510	4460	5870	6040	0	0	49.2	87.5	115.2	118.5	0.0	0.0	370.4	0.329	3.285	-	6.21			9.83
254	LHS	MAV	Kandla	Shantilaal	1.2.222	EMPTY	1630	1850	1300	1440	1810	0	32.0	36.3	25.5	28.3	35.5	0.0	157.5	0.059	0.042	-	-	0.03		0.13
255	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2060	1810	1760	1940	0	0	40.4	35.5	34.5	38.1	0.0	0.0	148.5	0.149	0.039	-	0.06			0.25
256	LHS	MAV	Kandla	Punjab	1.2.222	OOD GRAIN	2260	4815	0	5265	4920	0	44.3	94.5	0.0	103.3	96.5	0.0	338.6	0.217	1.945	-	-	0.63		2.79
257	LHS	MAV	Kandla	Shantilaal	1.22.222	Petroleum	3500	7700	7670	5600	5970	5540	68.7	151.1	150.5	109.9	117.1	108.7	705.9	1.246	-	17.24	-	-	5.04	23.53

258	LHS	MAV	Kandla	Shantilaal	1.1.22	SALT	2460	7090	5768	5970	0	0	48.3	139.1	113.2	117.1	0.0	0.0	417.7	0.304	#####	-	5.86			27.14
259	LHS	MAV	Kandla	Mundra	1.2.22	GAS	2870	3190	6700	5900	0	0	56.3	62.6	131.5	115.8	0.0	0.0	366.1	0.563	0.375	-	7.78			8.72
260	LHS	MAV	Kandla	Shantilaal	1.2.222	POWDER	2350	6030	0	5065	6435	0	46.1	118.3	0.0	99.4	126.3	0.0	390.0	0.253	4.783	-	-	1.03		6.07
261	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	2200	2730	2330	2020	0	0	43.2	53.6	45.7	39.6	0.0	0.0	182.1	0.194	0.201	-	0.11			0.51
262	LHS	MAV	Kandla	Anjaar	1.1.22	LEMON	3210	0	5565	4845	0	0	63.0	0.0	109.2	95.1	0.0	0.0	267.2	0.881	0.000	-	3.63			4.51
263	LHS	MAV	Kandla	Shantilaal	1.2.22	SUGAR	5160	5050	7500	7800	0	0	101.2	99.1	147.2	153.0	0.0	0.0	500.5	5.885	2.353	-	16.92			25.16
264	LHS	2AT	Kandla	Anjaar	1.2	EMPTY	2250	1920	0	0	0	0	44.1	37.7	0.0	0.0	0.0	0.0	81.8	0.213	0.049					0.26
265	LHS	MAV	Kandla	Shantilaal	1.2.222	TILES	2040	4075	0	6310	5740	0	40.0	80.0	0.0	123.8	112.6	0.0	356.4	0.144	0.998	-	-	1.24		2.38
266	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1240	2130	2060	1930	0	0	24.3	41.8	40.4	37.9	0.0	0.0	144.4	0.020	0.074	-	0.08			0.17
267	LHS	MAV	Kandla	Shantilaal	1.1.22	CLOTHES	3370	0	4320	4220	0	0	66.1	0.0	84.8	82.8	0.0	0.0	233.7	1.071	0.000	-	1.64			2.71
268	LHS	MAV	Kandla	Shantilaal	1.2.22	SALT	2120	4850	5590	5630	0	0	41.6	95.2	109.7	110.5	0.0	0.0	356.9	0.168	2.002	-	4.89			7.06
269	LHS	MAV	Kandla	Shantilaal	1.2.22	COAL	2800	7800	6900	9800	0	0	54.9	153.0	135.4	192.3	0.0	0.0	535.6	0.510	#####	-	24.02			37.92
270	LHS	MAV	Kandla	Shantilaal	1.2.22	EMPTY	1780	1830	2150	1815	0	0	34.9	35.9	42.2	35.6	0.0	0.0	148.6	0.083	0.041	-	0.08			0.20
271	LHS	MAV	Kandla	Mundra	1.22.222	BOX	2810	6140	6470	0	6740	6415	55.1	120.5	126.9	0.0	132.2	125.9	560.6	0.518	-	7.81	-	-	1.76	10.09
272	LHS	MAV	Kandla	Ahmedab	1.2.22	TILES	3295	4765	5110	5190	0	0	64.6	93.5	100.3	101.8	0.0	0.0	360.2	0.979	1.865	-	3.48			6.32
273	LHS	MAV	Kandla	Shantilaal	1.2.22	COAL	2950	4780	6700	7800	0	0	57.9	93.8	131.5	153.0	0.0	0.0	436.2	0.629	1.889	-	13.65			16.17
274	LHS	MAV	Kandla	Anjaar	1.2.22	CAR	2150	2870	4110	3870	0	0	42.2	56.3	80.6	75.9	0.0	0.0	255.1	0.177	0.245	-	1.25			1.67
275	LHS	MAV	Kandla	Shantilaal	1.2.22	ZEERA	2025	3440	7380	7270	0	0	39.7	67.5	144.8	142.6	0.0	0.0	394.7	0.140	0.507	-	14.23			14.87
276	LHS	3AT	Kandla	Shantilaal	1.22	EMPTY	1860	2210	2310	0	0	0	36.5	43.4	45.3	0.0	0.0	0.0	125.2	0.099	-	0.13				0.23
277	LHS	3AT	Kandla	Anjaar	1.22	WATER	2200	3700	4100	0	0	0	43.2	72.6	80.4	0.0	0.0	0.0	196.2	0.194	-	1.14				1.34
278	LHS	MAV	Kandla	Punjab	1.2.2.22	EMPTY	1045	2035	2180	1345	1180	0	20.5	39.9	42.8	26.4	23.2	0.0	152.7	0.010	0.062	0.08	-	0.01		0.17
279	LHS	MAV	Kandla	Anjaar	1.2.222	BOX	2160	3525	0	3045	3630	0	42.4	69.2	0.0	59.7	71.2	0.0	242.5	0.181	0.559	-	-	0.12		0.86
280	LHS	3AT	Kandla	Shantilaal	1.22	PARCEL	1900	10700	11700	0	0	0	37.3	209.9	229.6	0.0	0.0	0.0	476.8	0.108	-	77.76				77.87

Carriageway			Mandatory Input →	Enter the Input Load		Kg	Mandatory Input →	Enter Whether Input Load is for Wheel or Axle				w	Individual Axle Load (KN)						Gross Vehicle Weight GVW (KN)	Equivalency Factor (EF) or VDF						
Chainage		Man dator	Origin	Destination	Man dato ry	Commo dity Type	Individual Wheel Load (Kg)																			
Sl. No.	Direction	Vehicle Type			Axle Config. (See Note above)				1 st Wheel Load	2 nd Wheel Load	3 rd Wheel Load	4 th Wheel Load	5 th Wheel Load	6 th Wheel Load	1 st Axle Load (KN)	2 nd Axle Load (KN)	3 rd Axle Load (KN)	4 th Axle Load (KN)		5 th Axle Load (KN)	6 th Axle Load (KN)	Steering Single Axle	2 nd	3 rd	4 th	5 th
1	RHS	MAV	Mandunagar	Kandla	1.2.22	EMPTY	1815	2220	2010	1985	0	0	35.6	43.6	39.4	38.9	0.0	0.0	157.5	0.090	0.088	-	0.08			0.26
2	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1970	2210	1950	1730	0	0	38.7	43.4	38.3	33.9	0.0	0.0	154.2	0.125	0.086	-	0.06			0.27
3	RHS	MAV	ANJAR	Kandla	1.2.222	POWDE	2210	5570	0	4710	6725	0	43.4	109.3	0.0	92.4	131.9	0.0	377.0	0.198	3.482	-	-	1.01		4.69
4	RHS	3AT	HPCL	Kandla	1.22	EMPTY	1910	1970	1650	0	0	0	37.5	38.7	32.4	0.0	0.0	0.0	108.5	0.110	-	0.05				0.16
5	RHS	MAV	ManchuNaga	Kandla	1.2.222	EMPTY	2010	2270	0	2110	2000	0	39.4	44.5	0.0	41.4	39.2	0.0	164.6	0.135	0.096	-	-	0.02		0.25
6	RHS	MAV	Shantilaal	Kandla	1.2.22	EMPTY	1795	1500	1270	1380	0	0	35.2	29.4	24.9	27.1	0.0	0.0	116.6	0.086	0.018	-	0.02			0.12
7	RHS	3AT	HPCL	Kandla	1.22	EMPTY	2840	2750	2910	0	0	0	55.7	54.0	57.1	0.0	0.0	0.0	166.8	0.540	-	0.32				0.86
8	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1810	1360	1420	1150	0	0	35.5	26.7	27.9	22.6	0.0	0.0	112.6	0.089	0.012	-	0.01			0.11
9	RHS	MAV	Gandhidham	Kandla	1.2.222	Chemica	3250	9210	0	7570	7090	0	63.8	180.7	0.0	148.5	139.1	0.0	532.1	0.926	26.030	-	-	2.72		29.67
10	RHS	MAV	Gandhidham	Kandla	1.1.22	EMPTY	1740	2120	1620	1700	0	0	34.1	41.6	31.8	33.4	0.0	0.0	140.9	0.076	0.168	-	0.04			0.28
11	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1870	1845	2055	2060	0	0	36.7	36.2	40.3	40.4	0.0	0.0	153.6	0.102	0.042	-	0.09			0.23
12	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2110	2290	2410	2170	2010	0	41.4	44.9	47.3	42.6	39.4	0.0	215.6	0.165	0.099	-	-	0.11		0.38
13	RHS	MAV	Gandhidham	Kandla	1.2.22	Patriliu	2985	3710	7910	7750	0	0	58.6	72.8	155.2	152.1	0.0	0.0	438.6	0.659	0.685	-	18.57			19.92
14	RHS	3AT	Shantilaal	Kandla	1.22	ANAJ	2660	6010	6770	0	0	0	52.2	117.9	132.8	0.0	0.0	0.0	302.9	0.416	-	8.24				8.65
15	RHS	MAV	MADNA	Kandla	1.2.222	EMPTY	1710	1730	1170	1800	2430	0	33.6	33.9	23.0	35.3	47.7	0.0	173.4	0.071	0.032	-	-	0.05		0.15
16	RHS	MAV	RADARPUR	Kandla	1.2.22	TILES	1970	4970	5430	5845	0	0	38.7	97.5	106.5	114.7	0.0	0.0	357.4	0.125	2.207	-	4.99			7.32
17	RHS	3AT	Shantilaal	Kandla	1.22	RICE	4250	6880	6910	0	0	0	83.4	135.0	135.6	0.0	0.0	0.0	353.9	2.708	-	11.17				13.88
18	RHS	MAV	Shantilaal	Kandla	1.2.222	RICE	2935	7430	0	7635	6975	0	57.6	145.8	0.0	149.8	136.8	0.0	490.0	0.616	11.025	-	-	2.68		14.32
19	RHS	3AT	Shantilaal	Kandla	1.22	ANAJ	2815	6770	6045	0	0	0	55.2	132.8	118.6	0.0	0.0	0.0	306.7	0.521	-	8.33				8.85
20	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2210	3510	3140	3015	0	0	43.4	68.9	61.6	59.2	0.0	0.0	233.0	0.198	0.549	-	0.44			1.19
21	RHS	MAV	BIHAR	Kandla	1.2.222	EMPTY	1950	2350	0	1730	1910	0	38.3	46.1	0.0	33.9	37.5	0.0	155.8	0.120	0.110	-	-	0.01		0.24
22	RHS	MAV	Gandhidham	Kandla	1.2.22	TILES	3610	4225	5115	5190	0	0	70.8	82.9	100.4	101.8	0.0	0.0	355.9	1.410	1.153	-	3.48			6.05
23	RHS	MAV	HPCL	Kandla	1.2.222	EMPTY	1450	1730	0	1310	1180	0	28.4	33.9	0.0	25.7	23.2	0.0	111.2	0.037	0.032	-	-	0.00		0.07
24	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2350	2390	1910	1790	0	0	46.1	46.9	37.5	35.1	0.0	0.0	165.6	0.253	0.118	-	0.06			0.43
25	RHS	MAV	Gandhidham	Kandla	1.22.222	ZINK	3250	5230	5425	0	5680	5360	63.8	102.6	106.4	0.0	111.4	105.2	489.4	0.926	-	3.98	-	-	0.87	5.78
26	RHS	MAV	IOCL	Kandla	1.1.22	Chemica	3830	0	6990	6335	0	0	75.1	0.0	137.1	124.3	0.0	0.0	336.6	1.786	0.000	-	9.74			11.52
27	RHS	MAV	Gandhidham	Kandla	1.1.22	Patriliu	2210	0	5110	6250	0	0	43.4	0.0	100.3	122.6	0.0	0.0	266.2	0.198	0.000	-	5.14			5.34
28	RHS	MAV	BHAVNAGAR	Kandla	1.1.222	GUM	4135	3910	3380	7850	6940	0	81.1	76.7	66.3	154.0	136.2	0.0	514.3	2.427	1.940	-	-	6.42		10.78
29	RHS	MAV	Shantilaal	Kandla	1.2.22	EMPTY	2190	2110	1680	1990	0	0	43.0	41.4	33.0	39.0	0.0	0.0	156.4	0.191	0.072	-	0.06			0.32
30	RHS	MAV	BACHAU	Kandla	1.2.222	EMPTY	2275	2665	0	2560	2015	0	44.6	52.3	0.0	50.2	39.5	0.0	186.7	0.222	0.182	-	-	0.03		0.43
31	RHS	3AT	RADARPUR	Kandla	1.22	EMPTY	1910	1890	1710	0	0	0	37.5	37.1	33.6	0.0	0.0	0.0	108.1	0.110	-	0.05				0.16
32	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1995	2350	0	2450	2110	0	39.1	46.1	0.0	48.1	41.4	0.0	174.7	0.131	0.110	-	-	0.03		0.27
33	RHS	3AT	ManchuNaga	Kandla	1.22	EMPTY	2260	1950	1800	0	0	0	44.3	38.3	35.3	0.0	0.0	0.0	117.9	0.217	-	0.06				0.28
34	RHS	MAV	Gandhidham	Kandla	1.1.22	TILES	3390	0	4600	4830	0	0	66.5	0.0	90.3	94.8	0.0	0.0	251.5	1.096	0.000	-	2.44			3.54
35	RHS	MAV	MP	Kandla	1.2.22	GAS	2550	3250	3430	3730	0	0	50.0	63.8	67.3	73.2	0.0	0.0	254.3	0.351	0.404	-	0.81			1.57
36	RHS	MAV	IOCL	Kandla	1.22.222	SALT	2130	2985	4300	4820	4635	5615	41.8	58.6	84.4	94.6	90.9	110.2	480.4	0.171	-	0.87	-	-	3.04	4.08

37	RHS	MAV	ANJAR	Kandla	1.22.222	Chemical	3455	7440	6880	0	8535	7670	67.8	146.0	135.0	0.0	167.5	150.5	666.7	1.183	-	12.99	-	-	4.06	18.23
38	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1720	1480	1625	1360	0	0	33.7	29.0	31.9	26.7	0.0	0.0	121.3	0.073	0.017	-	0.02			0.11
39	RHS	MAV	IOCL	Kandla	1.2.222	EMPTY	1775	2180	0	2610	2240	0	34.8	42.8	0.0	51.2	43.9	0.0	172.8	0.082	0.082	-	-	0.03		0.20
40	RHS	MAV	MORBI	Kandla	1.1.22	POWDE	2490	4130	5845	5960	0	0	48.9	81.0	114.7	116.9	0.0	0.0	361.5	0.319	2.415	-	6.00			8.73
41	RHS	3AT	Shantilaal	Kandla	1.22	RICE	4020	5340	6860	0	0	0	78.9	104.8	134.6	0.0	0.0	0.0	318.2	2.168	-	6.84				9.01
42	RHS	MAV	Gandhidham	Kandla	1.22.222	EMPTY	2735	1810	1950	0	2250	2010	53.7	35.5	38.3	0.0	44.1	39.4	211.0	0.464	-	0.06	-	-	0.02	0.55
43	RHS	MAV	Mithi Rd	Kandla	1.2.22	EMPTY	2210	2000	1880	2310	0	0	43.4	39.2	36.9	45.3	0.0	0.0	164.8	0.198	0.058	-	0.10			0.35
44	RHS	MAV	Mithi Rd	Kandla	1.1.22	RICE	5230	0	6630	7550	0	0	102.6	0.0	130.1	148.1	0.0	0.0	380.8	6.211	0.000	-	12.49			18.70
45	RHS	MAV	Bhatinda	Kandla	1.1.22	EMPTY	2340	0	1745	1640	0	0	45.9	0.0	34.2	32.2	0.0	0.0	112.3	0.249	0.000	-	0.04			0.29
46	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	1690	2070	0	2160	2650	0	33.2	40.6	0.0	42.4	52.0	0.0	168.1	0.068	0.066	-	-	0.03		0.17
47	RHS	MAV	Kandla	Kandla	1.2.22	EMPTY	1970	1940	1970	1610	0	0	38.7	38.1	38.7	31.6	0.0	0.0	147.0	0.125	0.051	-	0.05			0.23
48	RHS	MAV	Gandhidham	Kandla	1.1.22	EMPTY	1980	1830	1590	1730	0	0	38.8	35.9	31.2	33.9	0.0	0.0	139.9	0.128	0.093	-	0.04			0.26
49	RHS	MAV	Mithi Rd	Kandla	1.2.222	Chemical	3210	3950	0	7990	7850	0	63.0	77.5	0.0	156.8	154.0	0.0	451.3	0.881	0.881	-	-	3.71		5.47
50	RHS	3AT	Mithi Rd	Kandla	1.22	ANAJ	3940	6810	6230	0	0	0	77.3	133.6	122.2	0.0	0.0	0.0	333.1	2.000	-	8.93				10.93
51	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1580	1795	0	1940	1755	0	31.0	35.2	0.0	38.1	34.4	0.0	138.7	0.052	0.038	-	-	0.01		0.10
52	RHS	MAV	Mithi Rd	Kandla	1.22.222	BOX	2915	5160	6130	0	5800	5930	57.2	101.2	120.3	0.0	113.8	116.3	508.8	0.599	-	5.02	-	-	1.11	6.73
53	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1695	2195	2078	1995	0	0	33.3	43.1	40.8	39.1	0.0	0.0	156.2	0.069	0.084	-	0.08			0.24
54	RHS	MAV	GT ROAD	Kandla	1.2.22	EMPTY	1250	2850	2475	2220	0	0	24.5	55.9	48.6	43.6	0.0	0.0	172.6	0.020	0.239	-	0.15			0.41
55	RHS	MAV	Gandhidham	Kandla	1.22.22	EMPTY	2330	2250	2410	2210	2190	0	45.7	44.1	47.3	43.4	43.0	0.0	223.5	0.245	-	0.15	-	0.12		0.51
56	RHS	MAV	ManchuNagar	Kandla	1.2.22	Building Material	2130	4130	6100	4840	0	0	41.8	81.0	119.7	95.0	0.0	0.0	337.5	0.171	1.053	-	4.42			5.65
57	RHS	3AT	Rajashthan	Kandla	1.22	RICE	4810	7010	6560	0	0	0	94.4	137.5	128.7	0.0	0.0	0.0	360.6	4.443	-	10.47				14.92
58	RHS	MAV	IOCL	Kandla	1.2.222	Chemical	2910	8830	0	7850	7290	0	57.1	173.2	0.0	154.0	143.0	0.0	527.4	0.595	21.993	-	-	3.09		25.68
59	RHS	3AT	MORBI	Kandla	1.22	RICE	4415	7930	6895	0	0	0	86.6	155.6	135.3	0.0	0.0	0.0	377.5	3.154	-	14.92				18.07
60	RHS	MAV	IOCL	Kandla	1.1.22	SALT	2610	0	3930	3805	0	0	51.2	0.0	77.1	74.7	0.0	0.0	203.0	0.385	0.000	-	1.11			1.49
61	RHS	MAV	Shantilaal	Kandla	1.1.22	RICE	3510	4110	5150	5540	0	0	68.9	80.6	101.0	108.7	0.0	0.0	359.2	1.260	2.369	-	4.03			7.66
62	RHS	MAV	Shantilaal	Kandla	1.2.22	DIESEL	3280	5130	5825	6130	0	0	64.4	100.7	114.3	120.3	0.0	0.0	399.6	0.961	2.506	-	6.31			9.78
63	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2030	2330	2535	2175	2090	0	39.8	45.7	49.7	42.7	41.0	0.0	219.0	0.141	0.107	-	-	0.13		0.37
64	RHS	MAV	Rajashthan	Kandla	1.2.222	TILES	1980	4915	0	4690	5215	0	38.8	96.4	0.0	92.0	102.3	0.0	329.6	0.128	2.111	-	-	0.57		2.81
65	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2140	1940	2090	2250	0	0	42.0	38.1	41.0	44.1	0.0	0.0	165.2	0.174	0.051	-	0.11			0.33
66	RHS	MAV	HPCL	Kandla	1.2.222	EMPTY	1765	2300	0	1470	1545	0	34.6	45.1	0.0	28.8	30.3	0.0	138.9	0.081	0.101	-	-	0.00		0.19
67	RHS	MAV	Rajashthan	Kandla	1.2.222	EMPTY	2040	2380	1470	1110	1770	0	40.0	46.7	28.8	21.8	34.7	0.0	172.1	0.144	0.116	-	-	0.02		0.28
68	RHS	MAV	Gandhidham	Kandla	1.2.22	PARCEL	2830	6860	6570	8010	0	0	55.5	134.6	128.9	157.2	0.0	0.0	476.2	0.532	8.012	-	13.96			22.50
69	RHS	3AT	Mithi Rd	Kandla	1.22	SALT	5670	6440	6190	0	0	0	111.2	126.4	121.4	0.0	0.0	0.0	359.0	8.580	-	7.86				16.44
70	RHS	MAV	Gandhidham	Kandla	1.2.222	TILES	3265	4710	5825	5710	5235	0	64.1	92.4	114.3	112.0	102.7	0.0	485.5	0.943	1.780	-	-	4.66		7.38
71	RHS	MAV	Gandhidham	Kandla	1.2.22	Chemical	2485	7010	7850	6830	0	0	48.8	137.5	154.0	134.0	0.0	0.0	474.3	0.317	8.736	-	14.34			23.40
72	RHS	2AT	Gandhidham	Kandla	1.2	EMPTY	2310	1910	0	0	0	0	45.3	37.5	0.0	0.0	0.0	0.0	82.8	0.236	0.048					0.28
73	RHS	MAV	Shantilaal	Kandla	1.22.222	EMPTY	2135	2090	1835	1910	1830	1670	41.9	41.0	36.0	37.5	35.9	32.8	225.0	0.172	-	0.07	-	-	0.05	0.30
74	RHS	3AT	HPCL	Kandla	1.22	Patrilu	1910	2050	1910	0	0	0	37.5	40.2	37.5	0.0	0.0	0.0	115.2	0.110	-	0.08				0.19
75	RHS	MAV	Mithi Rd	Kandla	1.2.222	EMPTY	2250	2150	0	2310	1790	0	44.1	42.2	0.0	45.3	35.1	0.0	166.8	0.213	0.077	-	-	0.02		0.31
76	RHS	MAV	Mandunagar	Kandla	1.1.22	Building Material	3940	4360	6780	6940	0	0	77.3	85.5	133.0	136.2	0.0	0.0	432.0	2.000	3.000	-	10.94			15.94
77	RHS	MAV	ANJAR	Kandla	1.2.222	EMPTY	2020	2435	0	2010	2000	0	39.6	47.8	0.0	39.4	39.2	0.0	166.1	0.138	0.127	-	-	0.02		0.28
78	RHS	MAV	Mandunagar	Kandla	1.2.22	TILES	2150	4670	5615	5270	0	0	42.2	91.6	110.2	103.4	0.0	0.0	347.4	0.177	1.721	-	4.34			6.23

79	RHS	MAV	JAIPUR	Kandla	1.1.22	RICE	2950	3410	5740	5210	0	0	57.9	66.9	112.6	102.2	0.0	0.0	339.6	0.629	1.122	-	4.44			6.19
80	RHS	3AT	Shantilaal	Kandla	1.22	RICE	3240	6850	7410	0	0	0	63.6	134.4	145.4	0.0	0.0	0.0	343.4	0.915	-	12.77				13.69
81	RHS	3AT	Gandhidham	Kandla	1.22	WHEAT	4520	8650	7220	0	0	0	88.7	169.7	141.7	0.0	0.0	0.0	400.1	3.465	-	19.59				23.06
82	RHS	3AT	Shantilaal	Kandla	1.22	RICE	2710	6880	7235	0	0	0	53.2	135.0	142.0	0.0	0.0	0.0	330.1	0.448	-	12.26				12.71
83	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2275	2250	1510	1630	0	0	44.6	44.1	29.6	32.0	0.0	0.0	150.4	0.222	0.093	-	0.03			0.34
84	RHS	MAV	Gandhidham	Kandla	1.1.22	EMPTY	2235	0	2010	1935	0	0	43.9	0.0	39.4	38.0	0.0	0.0	121.3	0.207	0.000	-	0.07			0.28
85	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1555	1690	0	760	1410	0	30.5	33.2	0.0	14.9	27.7	0.0	106.2	0.049	0.030	-	-	0.00		0.08
86	RHS	3AT	Shantilaal	Kandla	1.22	ANAJ	4440	6795	6810	0	0	0	87.1	133.3	133.6	0.0	0.0	0.0	354.0	3.226	-	10.58				13.81
87	RHS	MAV	GIDC	Kandla	1.2.22	EMPTY	1935	3015	2915	1520	0	0	38.0	59.2	57.2	29.8	0.0	0.0	184.1	0.116	0.299	-	0.12			0.53
88	RHS	MAV	GT ROAD	Kandla	1.1.22	#N/A	5250	0	7910	7660	0	0	103.0	0.0	155.2	150.3	0.0	0.0	408.5	6.306	0.000	-	18.15			24.46
89	RHS	MAV	Gandhidham	Kandla	1.2.222	Chemica	2550	3850	0	5170	5580	0	50.0	75.5	0.0	101.4	109.5	0.0	336.5	0.351	0.795	-	-	0.79		1.93
90	RHS	3AT	Mithi Rd	Kandla	1.22	RICE	3990	7495	7875	0	0	0	78.3	147.1	154.5	0.0	0.0	0.0	379.8	2.104	-	17.24				19.34
91	RHS	3AT	KATI	Kandla	1.22	ANAJ	3820	6170	7550	0	0	0	74.9	121.1	148.1	0.0	0.0	0.0	344.1	1.768	-	10.94				12.71
92	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1670	1820	1440	1710	0	0	32.8	35.7	28.3	33.6	0.0	0.0	130.3	0.065	0.040	-	0.03			0.14
93	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2115	2575	1995	1910	0	0	41.5	50.5	39.1	37.5	0.0	0.0	168.6	0.166	0.159	-	0.07			0.40
94	RHS	3AT	Gandhidham	Kandla	1.22	WHEAT	4510	6850	6370	0	0	0	88.5	134.4	125.0	0.0	0.0	0.0	347.9	3.434	-	9.43				12.87
95	RHS	MAV	Mithi Rd	Kandla	1.2.222	EMPTY	2170	2390	0	3140	2885	0	42.6	46.9	0.0	61.6	56.6	0.0	207.7	0.184	0.118	-	-	0.08		0.38
96	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1630	1500	0	1440	1405	0	32.0	29.4	0.0	28.3	27.6	0.0	117.2	0.059	0.018	-	-	0.00		0.08
97	RHS	3AT	ManchuNaga	Kandla	1.22	SALT	3015	5560	5010	0	0	0	59.2	109.1	98.3	0.0	0.0	0.0	266.5	0.686	-	3.86				4.54
98	RHS	MAV	MORBI	Kandla	1.2.222	EMPTY	2650	2650	0	2510	2010	0	52.0	52.0	0.0	49.2	39.4	0.0	192.7	0.409	0.178	-	-	0.02		0.61
99	RHS	MAV	Shantilaal	Kandla	1.1.22	RICE	5150	6750	7410	6835	0	0	101.0	132.4	145.4	134.1	0.0	0.0	513.0	5.839	17.233	-	12.72			35.79
100	RHS	3AT	Shantilaal	Kandla	1.22	RICE	5555	6290	6010	0	0	0	109.0	123.4	117.9	0.0	0.0	0.0	350.3	7.905	-	7.07				14.97
101	RHS	3AT	BPCL	Kandla	1.22	EMPTY	2375	2535	2285	0	0	0	46.6	49.7	44.8	0.0	0.0	0.0	141.2	0.264	-	0.17				0.43
102	RHS	MAV	Gandhidham	Kandla	1.2.222	CLOTHE	3210	6460	0	4010	4305	0	63.0	126.7	0.0	78.7	84.5	0.0	352.9	0.881	6.300	-	-	0.28		7.46
103	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2810	2150	0	1970	2110	0	55.1	42.2	0.0	38.7	41.4	0.0	177.4	0.518	0.077	-	-	0.02		0.61
104	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	1525	1500	0	1250	1300	0	29.9	29.4	0.0	24.5	25.5	0.0	109.4	0.045	0.018	-	-	0.00		0.07
105	RHS	MAV	MADNA	Kandla	1.2.222	EMPTY	2010	2510	2010	1990	1850	0	39.4	49.2	39.4	39.0	36.3	0.0	203.5	0.135	0.144	-	-	0.07		0.35
106	RHS	MAV	GIDC	Kandla	1.2.222	EMPTY	2150	1850	1910	2270	1950	0	42.2	36.3	37.5	44.5	38.3	0.0	198.8	0.177	0.042	-	-	0.08		0.30
107	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2575	4010	3235	3645	0	0	50.5	78.7	63.5	71.5	0.0	0.0	264.2	0.365	0.935	-	0.69			1.99
108	RHS	MAV	BAJRANGI	Kandla	1.2.222	RICE	2480	6330	0	7010	6855	0	48.7	124.2	0.0	137.5	134.5	0.0	444.9	0.314	5.808	-	-	2.18		8.30
109	RHS	MAV	Rajashthan	Kandla	1.2.222	TILES	2090	4020	0	4710	6065	0	41.0	78.9	0.0	92.4	119.0	0.0	331.3	0.158	0.945	-	-	0.79		1.90
110	RHS	MAV	Gandhidham	Kandla	1.1.222	TILES	2080	4510	0	6590	5010	0	40.8	88.5	0.0	129.3	98.3	0.0	356.9	0.155	3.434	-	-	1.07		4.66
111	RHS	MAV	Gandhidham	MOTHI BAR	1.22.222	ZINK	2250	4630	3630	5450	5725	5840	44.1	90.8	71.2	106.9	112.3	114.6	540.0	0.213	-	1.44	-	-	4.93	6.58
112	RHS	MAV	IOCL	Kandla	1.2.222	EMPTY	1890	1870	0	2640	1870	0	37.1	36.7	0.0	51.8	36.7	0.0	162.3	0.106	0.044	-	-	0.02		0.17
113	RHS	MAV	Bhatinda	Kandla	1.2.22	TILES	1785	3250	3110	2995	0	0	35.0	63.8	61.0	58.8	0.0	0.0	218.6	0.084	0.404	-	0.43			0.92
114	RHS	MAV	Gandhidham	Kandla	1.22.222	POWDE R	2550	4260	3870	0	6175	5940	50.0	83.6	75.9	0.0	121.2	116.5	447.2	0.351	-	1.35	-	-	1.27	2.97
115	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2150	1935	2050	2250	0	0	42.2	38.0	40.2	44.1	0.0	0.0	164.5	0.177	0.051	-	0.11			0.33
116	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	1930	1870	0	1710	1485	0	37.9	36.7	0.0	33.6	29.1	0.0	137.2	0.115	0.044	-	-	0.01		0.17
117	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	1560	1710	1820	1660	0	0	30.6	33.6	35.7	32.6	0.0	0.0	132.4	0.049	0.031	-	0.05			0.13
118	RHS	MAV	IOCL	Kandla	1.2.22	EMPTY	1550	1890	2160	1900	0	0	30.4	37.1	42.4	37.3	0.0	0.0	147.2	0.048	0.046	-	0.08			0.18
119	RHS	MAV	Gandhidham	Kandla	1.1.22	D.O.C	3290	4270	6100	5210	0	0	64.5	83.8	119.7	102.2	0.0	0.0	370.2	0.973	2.760	-	5.05			8.79
120	RHS	MAV	MORBI	Kandla	1.2.222	EMPTY	1935	2010	0	2275	2465	0	38.0	39.4	0.0	44.6	48.4	0.0	170.4	0.116	0.059	-	-	0.03		0.20
121	RHS	MAV	ManchuNaga	Kandla	1.2.22	EMPTY	2340	3830	2810	3200	0	0	45.9	75.1	55.1	62.8	0.0	0.0	239.0	0.249	0.778	-	0.40			1.43
122	RHS	3AT	Shantilaal	Kandla	1.22	RICE	4440	7610	7475	0	0	0	87.1	149.3	146.7	0.0	0.0	0.0	383.1	3.226	-	15.99				19.22
123	RHS	MAV	ANJAR	Kandla	1.2.22	EMPTY	1840	1910	2035	1990	0	0	36.1	37.5	39.9	39.0	0.0	0.0	152.5	0.095	0.048	-	0.08			0.22

124	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2150	3810	3900	3510	0	0	42.2	74.8	76.5	68.9	0.0	0.0	262.3	0.177	0.762	-	0.93			1.87
125	RHS	3AT	Gandhidham	Kandla	1.22	EMPTY	1860	2410	2230	0	0	0	36.5	47.3	43.8	0.0	0.0	0.0	127.5	0.099	-	0.14				0.24
126	RHS	2AT	IOCL	Kandla	1.2	EMPTY	1920	2430	0	0	0	0	37.7	47.7	0.0	0.0	0.0	0.0	85.3	0.113	0.126					0.24
127	RHS	3AT	IOCL	Kandla	1.22	RICE	2955	5650	5560	0	0	0	58.0	110.9	109.1	0.0	0.0	0.0	277.9	0.633	-	4.88				5.51
128	RHS	3AT	HPCL	Kandla	1.22	Patriluu	2150	1930	1780	0	0	0	42.2	37.9	34.9	0.0	0.0	0.0	115.0	0.177	-	0.06				0.24
129	RHS	MAV	Gandhidham	Kandla	1.22.222	EMPTY	1460	1470	1140	0	1760	1555	28.6	28.8	22.4	0.0	34.5	30.5	144.9	0.038	-	0.01	-	-	0.01	0.06
130	RHS	MAV	HPCL	Kandla	1.22.222	CLOTHERS	2330	3290	3380	5340	4600	4610	45.7	64.5	66.3	104.8	90.3	90.4	462.1	0.245	-	0.61	-	-	2.64	3.49
131	RHS	MAV	ANJAR	Kandla	1.2.22	EMPTY	1280	2830	2470	2210	0	0	25.1	55.5	48.5	43.4	0.0	0.0	172.5	0.022	0.232	-	0.15			0.40
132	RHS	MAV	ANJAR	Kandla	1.2.222	POWDER	3870	4110	5020	5150	5030	0	75.9	80.6	98.5	101.0	98.7	0.0	454.8	1.862	1.032	-	-	3.14		6.04
133	RHS	MAV	HPCL	Kandla	1.1.22	RICE	2860	3110	4960	4440	0	0	56.1	61.0	97.3	87.1	0.0	0.0	301.6	0.555	0.777	-	2.41			3.74
134	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1555	1360	1260	1130	1300	0	30.5	26.7	24.7	22.2	25.5	0.0	129.6	0.049	0.012	-	-	0.01		0.07
135	RHS	MAV	ManchuNaga	Kandla	1.2.22	SALT	2480	6670	6090	5860	0	0	48.7	130.9	119.5	115.0	0.0	0.0	414.0	0.314	7.160	-	6.30			13.77
136	RHS	3AT	MORBI	Kandla	1.22	RICE	3435	6935	5850	0	0	0	67.4	136.1	114.8	0.0	0.0	0.0	318.2	1.156	-	8.25				9.41
137	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2120	2010	2540	1810	0	0	41.6	39.4	49.8	35.5	0.0	0.0	166.4	0.168	0.059	-	0.11			0.34
138	RHS	3AT	Kandla	Kandla	1.22	EMPTY	1950	1670	1750	0	0	0	38.3	32.8	34.3	0.0	0.0	0.0	105.4	0.120	-	0.04				0.16
139	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	1980	2210	0	1920	1710	0	38.8	43.4	0.0	37.7	33.6	0.0	153.4	0.128	0.086	-	-	0.01		0.22
140	RHS	MAV	Gandhidham	MOTHIBAR	1.2.222	EMPTY	1950	2190	0	1790	1530	0	38.3	43.0	0.0	35.1	30.0	0.0	146.4	0.120	0.083	-	-	0.01		0.21
141	RHS	MAV	Gandhidham	Kandla	1.2.22	GEL	2380	4660	5870	5860	0	0	46.7	91.4	115.2	115.0	0.0	0.0	368.3	0.266	1.706	-	5.85			7.82
142	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	2375	2320	4110	4560	0	0	46.6	45.5	80.6	89.5	0.0	0.0	262.2	0.264	0.240	-	1.75			2.25
143	RHS	MAV	RKT	Kandla	1.2.222	EMPTY	1510	1580	0	1380	1520	0	29.6	31.0	0.0	27.1	29.8	0.0	117.5	0.043	0.023	-	-	0.00		0.07
144	RHS	MAV	RKT	Kandla	1.22.22	EMPTY	2570	0	2210	1950	1650	0	50.4	0.0	43.4	38.3	32.4	0.0	164.4	0.362	-	0.01	-	0.05		0.42
145	RHS	MAV	KARGO	Kandla	1.1.22	EMPTY	2130	0	3135	3010	0	0	41.8	0.0	61.5	59.1	0.0	0.0	162.4	0.171	0.000	-	0.44			0.61
146	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2290	3190	3050	2910	0	0	44.9	62.6	59.8	57.1	0.0	0.0	224.5	0.228	0.375	-	0.39			0.99
147	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2050	2930	0	1990	2140	0	40.2	57.5	0.0	39.0	42.0	0.0	178.7	0.147	0.267	-	-	0.02		0.43
148	RHS	MAV	VINAYAK	Kandla	1.22.222	EMPTY	2130	2010	1905	0	1730	1915	41.8	39.4	37.4	0.0	33.9	37.6	190.1	0.171	-	0.07	-	-	0.01	0.25
149	RHS	MAV	IOCL	Kandla	1.2.222	Chemical	3220	8350	0	7750	7810	0	63.2	163.8	0.0	152.1	153.2	0.0	532.3	0.892	17.587	-	-	3.45		21.93
150	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	5310	0	7790	6950	0	0	104.2	0.0	152.8	136.4	0.0	0.0	393.4	6.600	0.000	-	14.58			21.18
151	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	2810	3360	5645	6110	0	0	55.1	65.9	110.8	119.9	0.0	0.0	351.7	0.518	1.058	-	5.90			7.47
152	RHS	MAV	IOCL	Kandla	1.1.22	RICE	3585	0	5870	5640	0	0	70.3	0.0	115.2	110.7	0.0	0.0	296.2	1.371	0.000	-	5.42			6.79
153	RHS	3AT	Shantilaal	Kandla	1.22	RICE	4250	7490	7570	0	0	0	83.4	147.0	148.5	0.0	0.0	0.0	378.9	2.708	-	15.89				18.60
154	RHS	3AT	Shantilaal	Kandla	1.22	ANAJ	3660	6940	5335	0	0	0	71.8	136.2	104.7	0.0	0.0	0.0	312.6	1.490	-	7.01				8.50
155	RHS	3AT	Gandhidham	Kandla	1.22	Patriluu	2740	5600	5350	0	0	0	53.8	109.9	105.0	0.0	0.0	0.0	268.6	0.468	-	4.44				4.91
156	RHS	MAV	SiriramFood	Kandla	1.2.22	EMPTY	2010	2255	1995	1910	0	0	39.4	44.2	39.1	37.5	0.0	0.0	160.3	0.135	0.094	-	0.07			0.30
157	RHS	3AT	Gandhidham	Kandla	1.22	EMPTY	2150	2310	1975	0	0	0	42.2	45.3	38.7	0.0	0.0	0.0	126.3	0.177	-	0.10				0.28
158	RHS	MAV	IOCL	Kandla	1.2.22	Chemical	3270	3540	8210	7490	0	0	64.2	69.5	161.1	147.0	0.0	0.0	441.6	0.949	0.568	-	18.76			20.28
159	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	1480	1670	1460	1480	0	0	29.0	32.8	28.6	29.0	0.0	0.0	119.5	0.040	0.028	-	0.02			0.09
160	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	4270	0	6380	5870	0	0	83.8	0.0	125.2	115.2	0.0	0.0	324.1	2.760	0.000	-	6.95			9.71
161	RHS	MAV	IOCL	Kandla	1.1.22	BLACK PAPER	3920	0	5555	6035	0	0	76.9	0.0	109.0	118.4	0.0	0.0	304.3	1.960	0.000	-	5.57			7.53
162	RHS	MAV	IOCL	Kandla	1.1.22	Building Material	3380	6130	7780	7140	0	0	66.3	120.3	152.6	140.1	0.0	0.0	479.3	1.083	11.722	-	15.30			28.11
163	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2180	4010	3090	2950	0	0	42.8	78.7	60.6	57.9	0.0	0.0	240.0	0.187	0.935	-	0.41			1.53
164	RHS	MAV	Mithi Rd	Kandla	1.2.22	EMPTY	1690	2330	2490	1910	0	0	33.2	45.7	48.9	37.5	0.0	0.0	165.2	0.068	0.107	-	0.12			0.29
165	RHS	MAV	Mithi Rd	Kandla	1.1.22	EMPTY	2110	2250	2090	1975	0	0	41.4	44.1	41.0	38.7	0.0	0.0	165.3	0.165	0.213	-	0.08			0.46

166	RHS	MAV	GIDC	Kandla	1.1.22	EMPTY	2635	0	2390	2030	0	0	51.7	0.0	46.9	39.8	0.0	0.0	138.4	0.400	0.000	-	0.12			0.52
167	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2110	2650	0	2410	2090	0	41.4	52.0	0.0	47.3	41.0	0.0	181.7	0.165	0.178	-	-	0.02		0.37
168	RHS	MAV	BIHAR	Kandla	1.2.22	EMPTY	1670	1925	1775	1945	0	0	32.8	37.8	34.8	38.2	0.0	0.0	143.5	0.065	0.050	-	0.06			0.17
169	RHS	MAV	Shantilaal	Kandla	1.1.22	Patriluu	1980	2810	4190	7010	0	0	38.8	55.1	82.2	137.5	0.0	0.0	313.7	0.128	0.518	-	4.86			5.51
170	RHS	MAV	Gandhidham	Kandla	1.2.222	RICE	2150	4810	4915	5010	5810	0	42.2	94.4	96.4	98.3	114.0	0.0	445.3	0.177	1.936	-	-	3.61		5.72
171	RHS	MAV	Shantilaal	Kandla	1.1.22	CLOTHE	3280	0	4110	3870	0	0	64.4	0.0	80.6	75.9	0.0	0.0	220.9	0.961	0.000	-	1.25			2.21
172	RHS	3AT	BAJRANGI	Kandla	1.22	WHEAT	4450	5910	6270	0	0	0	87.3	116.0	123.0	0.0	0.0	0.0	326.3	3.255	-	6.80				10.05
173	RHS	3AT	Shantilaal	Kandla	1.22	WHEAT	3440	7010	6860	0	0	0	67.5	137.5	134.6	0.0	0.0	0.0	339.6	1.162	-	11.43				12.59
174	RHS	3AT	Shantilaal	Kandla	1.22	RICE	3910	5260	6810	0	0	0	76.7	103.2	133.6	0.0	0.0	0.0	313.5	1.940	-	6.56				8.50
175	RHS	3AT	Gandhidham	Kandla	1.22	SALT	4150	8270	7950	0	0	0	81.4	162.3	156.0	0.0	0.0	0.0	399.7	2.462	-	21.38				23.84
176	RHS	MAV	Shantilaal	Kandla	1.22.222	EMPTY	2255	2150	2090	0	1975	1950	44.2	42.2	41.0	0.0	38.7	38.3	204.4	0.215	-	0.10	-	-	0.01	0.33
177	RHS	MAV	Gandhidham	Kandla	1.1.22	SALT	4490	0	5185	4105	0	0	88.1	0.0	101.7	80.5	0.0	0.0	270.4	3.374	0.000	-	2.30			5.67
178	RHS	MAV	Gandhidham	Kandla	1.2.222	Chemica	2430	4460	4900	6870	7010	0	47.7	87.5	96.1	134.8	137.5	0.0	503.6	0.289	1.431	-	-	7.32		9.04
179	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	2130	1540	0	1130	1010	0	41.8	30.2	0.0	22.2	19.8	0.0	114.0	0.171	0.020	-	-	0.00		0.19
180	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2335	3450	2870	3010	0	0	45.8	67.7	56.3	59.1	0.0	0.0	228.9	0.247	0.513	-	0.37			1.13
181	RHS	3AT	Shantilaal	Kandla	1.22	EMPTY	1975	1810	2170	0	0	0	38.7	35.5	42.6	0.0	0.0	0.0	116.8	0.126	-	0.08				0.20
182	RHS	MAV	PALI	Kandla	1.2.222	MEDICI	1795	2930	0	2780	3110	0	35.2	57.5	0.0	54.5	61.0	0.0	208.3	0.086	0.267	-	-	0.07		0.42
183	RHS	3AT	Shantilaal	Kandla	1.22	PAPAD	3780	6070	5920	0	0	0	74.2	119.1	116.2	0.0	0.0	0.0	309.4	1.695	-	6.38				8.08
184	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2185	1935	2090	2240	0	0	42.9	38.0	41.0	43.9	0.0	0.0	165.8	0.189	0.051	-	0.11			0.35
185	RHS	MAV	GT ROAD	Kandla	1.2.222	EMPTY	1310	1510	0	1970	1055	0	25.7	29.6	0.0	38.7	20.7	0.0	114.7	0.024	0.019	-	-	0.00		0.05
186	RHS	3AT	Gandhidham	Kandla	1.22	EMPTY	2530	3540	3410	0	0	0	49.6	69.5	66.9	0.0	0.0	0.0	186.0	0.340	-	0.72				1.06
187	RHS	MAV	Mithi Rd	Kandla	1.1.22	EMPTY	2260	2200	2210	0	0	0	44.3	43.2	43.4	0.0	0.0	0.0	130.9	0.217	0.194	-	0.01			0.42
188	RHS	MAV	IOCL	Kandla	1.2.222	EMPTY	1860	2080	0	2110	1710	0	36.5	40.8	0.0	41.4	33.6	0.0	152.3	0.099	0.068	-	-	0.01		0.18
189	RHS	MAV	Gandhidham	Kandla	1.2.222	EMPTY	1870	2110	0	2550	1890	0	36.7	41.4	0.0	50.0	37.1	0.0	165.2	0.102	0.072	-	-	0.02		0.20
190	RHS	MAV	PALI	Kandla	1.2.222	EMPTY	2220	2430	0	2440	2160	0	43.6	47.7	0.0	47.9	42.4	0.0	181.5	0.202	0.126	-	-	0.03		0.35
191	RHS	MAV	Gandhidham	Kandla	1.1.22	Chemica	2530	0	2875	3215	0	0	49.6	0.0	56.4	63.1	0.0	0.0	169.1	0.340	0.000	-	0.42			0.76
192	RHS	MAV	RKT	Kandla	1.2.222	EMPTY	2630	1970	0	1770	1550	0	51.6	38.7	0.0	34.7	30.4	0.0	155.4	0.397	0.054	-	-	0.01		0.46
193	RHS	MAV	Gandhidham	Kandla	1.2.22	RICE	2590	5670	7935	7675	0	0	50.8	111.2	155.7	150.6	0.0	0.0	468.3	0.374	3.739	-	18.34			22.45
194	RHS	3AT	Shantilaal	Kandla	1.22	RICE	5190	6940	6530	0	0	0	101.8	136.2	128.1	0.0	0.0	0.0	366.1	6.023	-	10.17				16.19
195	RHS	3AT	Shantilaal	Kandla	1.22	KOYLA	4040	5690	8010	0	0	0	79.3	111.6	157.2	0.0	0.0	0.0	348.1	2.211	-	10.88				13.09
196	RHS	MAV	IOCL	Kandla	1.2.22	DIESEL	2180	4560	5245	4865	0	0	42.8	89.5	102.9	95.5	0.0	0.0	330.6	0.187	1.564	-	3.23			4.98
197	RHS	MAV	JAIPUR	Kandla	1.1.22	EMPTY	2110	0	2690	2250	0	0	41.4	0.0	52.8	44.1	0.0	0.0	138.3	0.165	0.000	-	0.18			0.35
198	RHS	MAV	IOCL	Kandla	1.1.22	Chemica	3730	0	7445	6990	0	0	73.2	0.0	146.1	137.1	0.0	0.0	356.4	1.607	0.000	-	13.41			15.02
199	RHS	MAV	MORBI	Kandla	1.2.22	EMPTY	2330	3130	2940	2775	0	0	45.7	61.4	57.7	54.4	0.0	0.0	219.3	0.245	0.347	-	0.33			0.92
200	RHS	MAV	Shantilaal	Kandla	1.2.222	EMPTY	2510	2290	0	2190	1995	0	49.2	44.9	0.0	43.0	39.1	0.0	176.3	0.329	0.099	-	-	0.02		0.45
201	RHS	MAV	Shantilaal	Kandla	1.1.22	EMPTY	1910	0	1810	1750	0	0	37.5	0.0	35.5	34.3	0.0	0.0	107.3	0.110	0.000	-	0.05			0.16
202	RHS	MAV	Shantilaal	Kandla	1.2.22	EMPTY	2155	2335	2110	1910	0	0	42.3	45.8	41.4	37.5	0.0	0.0	167.0	0.179	0.108	-	0.08			0.37
203	RHS	MAV	Mandunagar	Kandla	1.2.222	EMPTY	1990	2270	0	1970	2050	0	39.0	44.5	0.0	38.7	40.2	0.0	162.5	0.130	0.096	-	-	0.02		0.24
204	RHS	MAV	Gandhidham	Kandla	1.1.22	RICE	5010	0	6890	7450	0	0	98.3	0.0	135.2	146.2	0.0	0.0	379.6	5.230	0.000	-	13.06			18.29
205	RHS	3AT	Shantilaal	Kandla	1.22	RICE	3785	7935	7245	0	0	0	74.3	155.7	142.1	0.0	0.0	0.0	372.1	1.704	-	16.40				18.10
206	RHS	MAV	GT ROAD	Kandla	1.2.22	EMPTY	1340	1990	1850	1925	0	0	26.3	39.0	36.3	37.8	0.0	0.0	139.4	0.027	0.057	-	0.06			0.15
207	RHS	MAV	Gandhidham	Kandla	1.2.22	EMPTY	2070	2210	2035	1905	0	0	40.6	43.4	39.9	37.4	0.0	0.0	161.3	0.152	0.086	-	0.07			0.31
208	RHS	3AT	Shantilaal	Kandla	1.22	EMPTY	2150	2240	2370	0	0	0	42.2	43.9	46.5	0.0	0.0	0.0	132.6	0.177	-	0.14				0.32
209	RHS	MAV	Shantilaal	Kandla	1.1.22	RICE	2380	2770	4140	5210	0	0	46.7	54.3	81.2	102.2	0.0	0.0	284.5	0.266	0.489	-	2.36			3.12
210	RHS	3AT	Mithi Rd	Kandla	1.22	RICE	4115	7075	7550	0	0	0	80.7	138.8	148.1	0.0	0.0	0.0	367.7	2.380	-	14.13				16.51

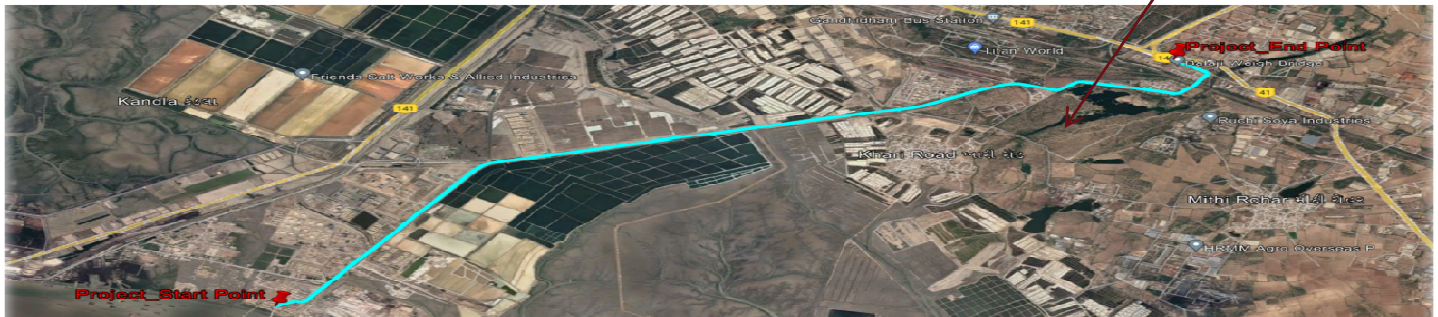
Indian Roads Congress Guidelines IRC:37-2012													
Calculation of Cumulative Nos of Two Way Commercial Vehicles for the Entire Design Period						and		Design MSA					
Carriageway Configuration and Design Life													
Carriageway Configuration (Single-Lane / Undivided 2-lane / Undivided 4-lane / Divided 4-Lane / Divided 6-lane / Divided 8-lane)						Mandatory Input →		Divided 6-Lane					
Design Period (Years), n						Mandatory Input →		15					
Number of years between the Last Classified Traffic Volume Count and the Year of Completion of Construction, x						Mandatory Input →		1.5					
Lane width (m)						Optional Input		3.5					
Paved Shoulder Width (m)						Optional Input		yes					
Design Traffic (MSA) Estimation													
Base Year CVPD, Two-Way CV Wise as per Last Classified Traffic Volume Count, P (Important Note ! If Any of the CV Wise CVPD is Zero, Enter 0 there)						LCV (CVPD)	M.BUS (CVPD)	BUS (CVPD)	2AT (CVPD)	3AT (CVPD)	MAV (CVPD)	Total CVPD	
						258	1	14	19	574	1333	2199	
Initial CVPD, Two-Way (CV Wise) at the Start when the Road is Opened, A						263	1	14	20	614	1490	2401	
Annual Growth Rate of Commercial Vehicles. (Important Note ! If Any of the CV Wise CVPD is Zero, Enter Corresponding Growth Rate % as Any Non-Zero Value. Don't Put 0 or Don't Leave it Blank)						LCV (Growth %)	M.BUS (Growth %)	BUS (Growth %)	2AT (Growth %)	3AT (Growth %)	MAV (Growth %)	Average Growth % (If Growth Rate Assumed Uniform for all CV)	
Growth Rate (%) During the Period 1.5 Years for Design, Project Preparation &		Period in Years →				1	1.2%	0.0%	0.0%	1.9%	4.6%	7.7%	
		Period in Years →				0.5	1.2%	0.0%	0.0%	1.9%	4.6%	7.7%	
Growth Rate % for the First 'Time		Year	0	To	Year	5	1.1%	0.0%	0.0%	1.8%	5.3%	8.9%	
Growth Rate % for the Second 'Time		Year	5	To	Year	10	0.9%	0.0%	0.0%	1.5%	4.6%	7.8%	
Growth Rate % for the Third 'Time		Year	10	To	Year	15	0.7%	0.0%	0.0%	1.2%	3.9%	6.7%	
Growth Rate % for the Fourth 'Time		Year	15	To	Year	20	0.6%	0.0%	0.0%	1.0%	3.2%	5.8%	
Growth Rate % for the Fifth 'Time		Year	20	To	Year	25	0.5%	0.0%	0.0%	0.9%	2.7%	5.1%	
Growth Rate % for the Sixth 'Time		Year	25	To	Year	50	0.5%	0.0%	0.0%	0.8%	2.4%	4.9%	

Design Two-Way Cumulative Number of Commercial Vehicles (CV) for the Entire Design Period, C		C _{LCV}	C _{M.BUS}	C _{BUS}	C _{2AT}	C _{3AT}	C _{MAV}	C = $\Sigma(C_{LCV}+C_{M.BUS}+C_{BUS}+C_{2AT}+C_{3AT}+C_{MAV})$
		1539742			120064	4809490	15012400	21481696
Whether like to Use Design VDF as CV Wise or Average or by User Input (CV Wise / Average / User Input)							Mandatory Input for VDF	User Input
Design VDF (To be determined from Axle Load Survey, if not, then Enter Value as Per Cl. 4.4.6 of IRC:37-2012), F		LCV (VDF)	M.BUS (VDF)	BUS (VDF)	2AT (VDF)	3AT (VDF)	MAV (VDF)	Average VDF (If VDF Assumed Uniform for
	VDF by User Input →	0	0	0	0.25	6.27	6.6	
Directional Distribution Factor (For Undivided Road 100%, For Divided Road 50%)							B	50%
Lane Distribution Factor (Refer Clause 4.5.1 of IRC:37-2012)							D	0.60
Design MSA							msa	39
Proportion of Front single (steering) Axles,							Not Considered in Fatigue Damage Analysis for Design of Cementitious Flexible	
Proportion of Rear single Axles,							K1	34.5%
Proportion of tandem Axles,							K2	49.4%
Proportion of Tridem Axles, K3 = (1-K1-K2)							K3	16.1%
Total							K1+K2+K3	100.0%



DEENDAYAL PORT AUTHORITY
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Consultancy Service for Preparation of Details Project Report for widening & Improvement of Existing 2/4-lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)



FINAL DETAILED PROJECT REPORT

TECHNICAL SPECIFICATIONS [VOLUME - IV]



MONARCH

SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.

Technical Specifications

The modifications proposed in this section are intended for improvement, removing ambiguity and to make the specification more users friendly.

TECHNICAL SPECIFICATIONS

INTRODUCTION

The Works shall be executed in accordance with these Specifications which comprises the following Sections:

- Section A - General Specifications
- Section B - Technical Specifications

- Part 1 - General Technical Specifications
- Part 2 - Particular Technical Specifications

SPECIFICATIONS SECTION A GENERAL SPECIFICATIONS

General

In the first 3 months from the date of signing of agreement, the contractor shall complete the following actions

1. Establish his office in complete manner including installing Telephone and Fax.
2. The contractor shall furnish, in advance, a detailed Work programme containing all activities upto the completion of Works. Supporting resources schedule shall also be submitted.
3. Complete construction, installation and commissioning of “Field Laboratory”.
4. Mobilize all required Key Staff, Technicians, Labourers,
5. Mobilize all required equipment/ machinery including commissioning and trial run of all the Plant/ Machinery. Some of the major plants/ equipment to be mobilized are listed below.
 - a) Wet Mix Plant
 - b) Aggregate Crushing Plant having secondary crusher of ‘Cone Type’
 - c) Sensor Pavers and other Paving finishers.
 - d) Vibratory Rollers and other compaction equipments.
 - e) Excavators, Bull Dozers and Graders
 - f) Tippers/ Dumpers and Water Bowsers (Tankers).
6. Complete Setting out activities as per MoRT&H Specifications.
7. Complete the identification of Quarries and quality of available material.
8. Complete the crushing of Aggregates required for the Section of work taken initially.

This Section Replaces Technical Specification Clause 111

A1. Protection of the Environment

[As stipulated under some of the major laws that are applicable, but not limited to, are as under:

1. The Water (Prevention and Control of Pollution) Act, 1974
2. The Air (Prevention and Control of Pollution) Act, 1981
3. The Environment (Protection) Act, 1986
4. The Public Liability Insurance Act, 1991]

(a) General

The Contractor shall take all precautions for safeguarding the environment during the course of the construction of works. He shall abide by all rules, regulations and laws in force governing pollution and environmental protection that are applicable to the area where the works are situated.

NOISE:

The Contractor shall mitigate against any sustained increase in base line ambient Noise levels at sensitive receptors during construction of work.

All construction operations shall be performed in a manner to minimize noise and vibration. The parameters for noise are detailed below.

- 70 dB (A) for day and night;
- 50 dB (A) for day and 45 dB (A) for night for sensitive receptors

If the noise levels are found to be above these standards and it is determined by the Engineer that these levels are due to the equipment or plant being deployed by the Contractor, he shall undertake, at his own cost measures as approved by the Engineer, to bring these levels down to the specified levels. Blasting should be done as per Indian Explosive Act. People living near such blasting sites shall have prior information of operational hazards. Blasting will not be undertaken at night. Workers at blasting sites will be provided with earplugs. Material haulage roads will be properly regulated.

Labour shall be warned against the hunting of wild life, if any. No archaeological site shall be disturbed.

(b) Borrow-pits for Embankment Construction

Borrow pits shall not be dug within the Right-of-Way of the road. Arable lands will not be used for earth borrowing. The Contractor will ensure that proper excavation techniques are used to improve stability and safety of the borrow area. The excavation shall be carried out in such a way that the area does not inundate during monsoons or generate cesspools of water to become mosquito-breeding sites. The borrow pits shall not be left in a condition likely to cause hazard to human or animal life. The stipulations in Clause – 305.2.2 shall govern.

(c) Quarry Operations

The Contractor shall obtain material from licensed quarries only after the consent of the Mining Department or other concerned authorities. The quarry operation shall be undertaken within the purview of the rules and regulations in force. The Contractor shall ensure scheduling the movement of transport carrying material to and from the site during non-peak hours. The trucks carrying all the dusty material, red earth, moorum and fly ash/ pond, ash shall be covered with a tarpaulin and

provided with adequate free board to prevent spillage. End boards shall be provided in loaders to prevent spillage.

Stockpiling of material shall be properly planned so as to ensure that no traffic jam takes place on the highway.

(d) Soil Erosion and Sedimentation Control

The Contractor shall carry out the works in such a manner that soil erosion is fully controlled, and sedimentation and pollution of natural water courses, ponds, tanks and reservoirs is avoided. The stipulations in clause 306 of the technical specification shall govern.

(e) Precautions against Dust

The Contractor shall take all reasonable steps to minimize dust nuisance during the construction of the works. All existing highways and roads used by vehicles of the Contractor or any of his sub-Contractors or suppliers of materials or plant, and similarly any new roads which are part of the works and which are being used by traffic shall be kept clean and clear of all dust / mud or other extraneous material dropped by the said vehicles or their tyres. Similarly, all dust / or mud or other extraneous material from the works spreading on these highways shall be immediately cleared by the Contractor. Clearance shall be effected immediately by manual sweeping and removal of debris, or, if so directed by the Engineer, by mechanical sweeping and clearing equipment, and all dust, mud and other debris shall be removed entirely from the road surface. Additionally, the road surface including haul road from Quarries and Plants shall be hosed or watered using suitable equipment to avoid dust pollution. Special care shall be taken to combat dust problem originating from use of fly ash/pond ash.

(f) Pollution from Hot Mix Plant, WMM Plant, Batching Plant & Crusher and Other Construction Machinery

The Contractor shall ensure the use of a relatively new, well maintained hot mix plant (batch type) so that any emission conforms to the CPCB norms and be fitted with a dust extraction unit to avoid prolonged engine powered equipment illness. Hot Mix Plant, WMM plant, Batching Plant & Crusher shall be located more than 500 m from any community or residence. The Contractor has to obtain necessary consent/clearance from State Pollution Control Board to operate Hot Mix Plant, WMM plant, Batching Plant, DG Set & Crusher before commencement of works.

All vehicles, equipment and machinery needed for construction will be regularly maintained to ensure that pollution emission levels conform to CPCB norms. All vehicles should be fitted with silencers.

Construction vehicles, machinery & equipment will move or be stationed in designated areas to avoid compaction of soil to ensure the preservation of the top soil for agriculture.

(g) Road Safety

The Contractor shall provide adequate circuit for traffic flow around construction areas, control speed of construction vehicles through road safety and training of drivers, provide adequate signage, barriers and flag persons for traffic control. If there are traffic jams during construction,

measures shall be taken to relieve the congestion with the assistance of local traffic police. Safety of workers undertaking various operations during construction will be ensured by providing helmets, masks, safety goggles, etc. One Qualified Safety Officer and one Safety Supervisor must be available in the Contractor's working team for the entire construction period.

(h) Sanitation & Waste Disposal in Construction Camp

The Contractor shall ensure that construction camps are located at a distance of minimum 200m from water sources. Special attention shall be paid to the sanitary conditions of the camps. The Contractor shall ensure that sufficient measures are taken i.e. provision of garbage tanks and sanitation facilities. Waste in septic tanks shall be cleaned periodically. Garbage shall be collected in four empty drums at each construction site and disposed of daily. The Contractor shall provide adequate measures for the health care of workers and arrange their regular medical check-up to ensure that they do not suffer from any communicable disease. At every workplace, good & sufficient water supply will be maintained to avoid waterborne / water related diseases. If any pits are dug at construction / camp sites which are not filled and then may turn into mosquito breeding sites during monsoons shall be filled up properly so that no water accumulates.

(i) Substance Hazardous to Health

The Contractor shall not use or generate any material in the works, which is hazardous to the health of persons, animals or vegetation. Where it is necessary to use some such substance which can cause injury to the health of the workers, the Contractor shall provide suitable protective clothing or appliances to his workers, viz. earplugs, helmets or dust masks.

(k) Damage to Existing road/CD Structures

Any structural damage caused to the existing roads/structures by the Contractor's construction equipment shall be made good without any extra cost.

(l) Use of Nuclear Gauges

Nuclear gauges shall be used only where permitted by the Engineer. The Contractor shall provide the Engineer with a copy of the regulations governing the safe use of nuclear gauges he intends to employ and shall abide by such regulations. Without written approval, no such equipment shall be used at any level of the work.

(m) Environmental Monitoring

In order to carry out periodic checks, environmental monitoring will be carried out by the Engineer as per schedule and if any parameter is found above the acceptable standards, mitigation measures / control measures as decided by the Engineer shall be complied with by the Contractor.

(n) Protection of Existing Trees

Some of the existing trees within the right of way are likely to be cut down by the Employer prior to handing over of the site to the Contractor. The Contractor shall take all necessary measures to ensure safety and protection of the remaining trees from any action whatsoever relating to his construction operations in the adjoining areas.

Giant neighbourhood trees recognized locally as important shall be preserved and engineering designs modified to accommodate these wherever possible depending on Engineer's directions.

(o) Disposal of Materials outside Work Site

Notwithstanding other relevant provisions in the contract, the excess material generated by dismantling, excavation, waste material and lubricants, used oil, gasoline and other such substance etc., shall be removed from site outside the right of way at regular intervals and site shall kept clean from all such disposable materials. Grease, cotton and other waste construction materials shall be disposed off in shallow pits and periodically burnt in a incinerator constructed at each construction site. Such intervals shall not exceed one month under any circumstances. The selection of the disposal site shall be the responsibility of the Contractor and he shall ensure that the selected site does not result in any claim for damages to the Employer or violation of any existing laws.

This section of Technical Specifications sets out instructions, recommended standards and technical specifications for the design and implementation of EMP mitigation works associated with construction of roads.

Environmental Management Plan has been prepared for the Project road, which needs to be followed during the implementation of the civil works. The key responsibility of the contractor/sub-contractor will be the successful implementation of the EMP. In addition, he will update MoRT&H on the progress of environmental protection and / or enhancement works as envisaged in the EMP. Execution of environmental mitigation measures meeting the requirement of Technical Specifications in conformity with applicable legislation will be the responsibility of the contractor. It shall also be accompanied with relevant documents (statements of compliance, certificates of compliance, test reports, etc.), evidencing their conformity with the statutory regulations.

DISPOSAL OF UNSERVICEABLE MATERIALS:

The locations of Disposal sites have to be selected such that:

- Locating the disposal sites is the sole responsibility of the contractor with the approval of Engineer.
- Joint inspection of all disposal sites shall be done by Engineer and Contractor prior to approval.
- No residential area are located downwind side of these locations,
- Disposal sites are located at least 1000 m away from sensitive locations like
- Settlements, Water body notified forest areas, Sanctuaries or any other sensitive locations.
- Disposal sites do not contaminate any water sources, rivers etc. for this site should be located away from water body and disposal site should be lined properly to prevent infiltration of water.
- Public perception about the location of debris disposal site has to be obtained before finalizing the location.
- Permission from the Village/local community is to be obtained for the Disposal site selected.

- Contractor will resolve all claims arising out of waste disposal at his own cost.
- Contractor shall utilize the suitable borrow areas, abandoned quarries and other waste land for the debris disposal.
- Contractor needs to plan the disposal in the following way:
 - Identify the disposal area.
 - Prepare a Contractors debris disposal plan with design drawings for each identified area and get it approved by the Engineer.
 - Need to photograph the present land use and condition of the area.
 - Construct all required structures (e.g. retaining wall).
 - The dumpsites filled only up to the ground level with compaction of the debris materials in layers after disposal.
 - The 30 cm top layer of disposal pit shall be provided with good earth suitable for development of vegetation/plantation.
 - After levelling, the site could be suitably rehabilitated by planting local species of grass (turfing), shrubs and other plants as decided by the Engineer.

CONSTRUCTION OF WATER RECHARGE PITS:

Storm water recharge pits shall be located such that it should be in the valley of the surface layout nearby cross drainage structures and other water bodies along the project road. Water recharge pits shall be located at a height of 3 m. above the ground water table of the area as per the Central Ground Water Board norms. Recharge pits are constructed by the side of the guiding drains such that all the storm water shall be directed to the recharge pit. Any proposal for change in number and location recharge pits by the contractor shall be checked and approved by the Engineer.

Pits, trenches, abandoned dug wells, recharge wells or abandoned bore wells shall be connected by the rain water harvesting system with the consent of the respective owner or as approved by the Engineer.

CONSTRUCTION OF SILT TRAPS:

Silt fences shall be planned such that each recharge pit will have one silt fence to prevent silt from entering the nearest water bodies and also prevent choking of recharge pit by the silt coming from runoff water and increase the life of recharge pits. Silt fence are mounted in guiding drains at a distance of 3 to 5 M in the upstream direction depending on the gradient of the guiding drains. However any proposal for change in number and location silt fences by the contractor shall be checked and approved by the Engineer. Sand / silt removal facilities such as sand traps, silt traps and sediment basins should be provided to remove sand / silt particles from run-off.

SCARIFIED BITUMEN DISPOSAL PITS:

Scarified bitumen generated out of scarification of existing pavement is used for approach roads by mixing it with fresh bitumen or other granular materials to achieve the required strength followed by profiling and compaction.

The left out portion of the scarified bitumen is disposed safely in a clay lined pit or as directed and approved by the Engineer. A typical clay lined bitumen disposal pit with standard dimensions has been worked out. The dimension of the bitumen disposal pit may change provided the clay lining of required thickness is adhered to.

The selection of sites for disposal of scarified bitumen is made on following lines:

- Locating the bitumen disposal sites is the sole responsibility of the contractor with the approval of Engineer.
- Selection of bitumen disposal site is avoided in the quarry regions. If the disposal site is located in the abandoned quarry, region is suitably treatment seal the fractures and fissures.
- Joint inspection of all disposal sites shall be done by Engineer and Contractor prior to approval.
- Disposal sites shall be located at least 1000 m away from sensitive locations like Settlements, Water body notified forest areas, Sanctuaries or any other sensitive locations.
- Disposal sites do not contaminate any water sources, rivers etc. for this, site should be located away from water body and disposal site should be lined properly to prevent infiltration of water.
- Public perception about the location of bitumen disposal site has to be obtained before finalizing the location.
- Permission from the Village/local community is to be obtained for the Disposal site selected.
- Contractor will resolve all claims arising out of waste disposal at his own cost. Contractor needs to plan the bitumen disposal in the following way:
 - Identify the disposal area.
 - Prepare a Contractors bitumen disposal plan with design drawings for each identified area and get it approved by the Engineer.
 - Need to photograph the present land use and condition of the area.
 - Construct all required structures (e.g. retaining wall) along with clay lining and measures to prevent the seepage of bitumen leachate.
 - The dumpsites filled only up to the ground level with compaction of the materials in layers after disposal.
 - The 30 cm top layer of disposal pit shall be provided with good earth suitable for development of vegetation/plantation.
 - After levelling, the site could be suitably rehabilitated by planting local species of grass (turfing), shrubs and other plants as decided by the Engineer and the supervision consultant.

(p) PROVISION FOR OIL INTERCEPTORS:

Location of Oil Interceptors shall be considered such that each construction camp having refuelling stations, oil and lubricants storage places will have one oil interceptor to stop & separate the floating oils. However the number of interceptors shall be increased as the situation demands or during the accidental spillages with the consent of the Engineer.

(q) ENVIRONMENTAL MONITORING:

Environmental Monitoring of Air, Noise, Water and Soil parameters shall be carried by the contractor as per the consents and latest environmental norms, guidelines and policies of national and state level environmental authorities. The Contractor shall comply by all obligations and make sure that there are no deviations from them or from the Contract.

Environmental standards for Air, Noise and water are outlined below.

1. Ambient Air Quality Standards (National)

Sl. No.	Pollutants	Time weighted average	Concentration in ambient air		Method of measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Area (notified by Central Government)	
1.	Sulphur Dioxide (SO ₂) µg/m ³	Annual*	50	20	- Improved West and Geake - Ultraviolet Fluorescence
		24 hours**	80	80	
2.	Nitrogen Dioxide (NO ₂) µg/m ³	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
		24 hours**	80	80	
3.	Particulate Matter (size less than 10 µm or PM ₁₀) µg/m ³	Annual*	60	60	- Gravimetric - TOEM - Beta attenuation
		24 hours**	100	100	
4.	Particulate Matter (size less than 2.5 µm or PM _{2.5}) µg/m ³	Annual*	40	40	- Gravimetric - TOEM - Beta attenuation
		24 hours**	60	60	
5.	Ozone (O ₃) µg/m ³	8 hours**	100	100	- UV Photometric - Chemiluminescence - Chemical method
		1 hour **	180	180	
6.	Lead (Pb) µg/m ³	Annual*	0.5	0.5	- ASS/ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7.	Carbon Monoxide (CO) mg/m ³	8 hour	02	02	- Non Dispersive Infra-Red (NDIR)
		1 hours**	04	04	- Spectroscopy
8.	Ammonia (NH ₃) µg/m ³	Annual*	100	100	- Chemiluminescence 24 - Indophenol blue method
		24 hours**	400	400	
9.	Benzene (C ₆ H ₆) µg/m ³	Annual*	05	05	- Gas chromatography based on continuous analyser

Sl. No.	Pollutants	Time weighted average	Concentration in ambient air		Method of measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Area (notified by Central Government)	
					- Adsorption and desorption followed by GC analysis
10.	Benzol (O) Pyrene (BaP) – Particulate phase only ng/m ³	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11.	Arsenic (As) ng/m ³	Annual*	06	06	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12.	Nickel (Ni) ng/m ³	Annual*	20	20	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
*	Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.				
**	24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.				

2. Water quality Standards (IS 10500: 1991)

S. No.	Parameter	Requirement desirable Limit	Remarks
1.	Colour	5	May be extended up to 50 if toxic substances are suspected
2.	Turbidity	10	May be relaxed up to 25 in the absence of alternate
3.	pH	to 8.5	May be relaxed up to 9.2 in the absence
4.	Total Hardness	300	May be extended up to 600
5.	Calcium as Ca	75	May be extended up to 200
6.	Magnesium as Mg	30	May be extended up to 100
7.	Copper as Cu	0.05	May be relaxed up to 1.5
8.	Iron	0.3	May be extended up to 1
9.	Manganese	0.1	May be extended up to 0.5
10.	Chlorides	250	May be extended up to 1000
11.	Sulphates	150	May be extended up to 400
12.	Nitrates	45	No relaxation
13.	Fluoride	to 1.2	If the limit is below 0.6 water should be rejected, Max. Limit is extended to 1.5
14.	Phenols	0.001	May be relaxed up to 0.002
15.	Mercury	0.001	No relaxation
16.	Cadmium	0.01	No relaxation
17.	Selenium	0.01	No relaxation
18.	Arsenic	0.05	No relaxation
19.	Cyanide	0.05	No relaxation
20.	Lead	0.1	No relaxation
21.	Zinc	5.0	May be extended up to 10.0
22.	Anionic detergents (MBAS)	0.2	May be relaxed up to 1
23.	Chromium as Cr+6	0.05	No relaxation
24.	Poly nuclear aromatic Hydrocarbons	--	--
25.	Mineral Oil	0.01	May be relaxed up to 0.03
26.	Residual free Chlorine	0.2	Applicable only when water is chlorinated
27.	Pesticides	Absent	--
28.	Radio active	--	--

3. Ambient Noise Quality Standards in respect of Noise

Area code	Category of Area / Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note:-

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
 2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
 3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority
 4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.
- * dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A “decibel” is a unit in which noise is measured.

“A”, in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specified period.

Note: The Principal Rules were published in the Gazette of India, vide S.O. 123(E), dated 14.2.2000 and subsequently amended by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2000 vide S.O. 1046(E), dated 22.11.2000 and by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2002 vide S.O. 1088(E), dated 11.10.2002, under the Environment (Protection) Act, 1986.

(r) Compliance with the foregoing will not relieve the Contractor of any responsibility for complying with the requirements of any highway authority in respect of the roads used by him.

SPECIFICATIONS SECTION B

TECHNICAL SPECIFICATIONS

Part 1- General Technical Specifications

- B1.1 Introduction
- B1.1.1 Part-1 General Technical Specifications shall comprise the **“Specifications for Road and Bridge Works (Fifth Revision 2013) published by the Indian Roads Congress on behalf of the Government of India, Ministry of Road Transport and Highways (the “MoRT&H specifications”)**.
- B1.1.2 Certain provisions of the MoRT&H Specifications are amended by Section B Part 2 – Particular Technical Specifications of this Specifications. In the event of conflict or discrepancies between the MoRT&H Specifications and the Particular Technical Specifications, the provisions of the Particular Technical Specifications shall prevail.
- B1.1.3 Words like ‘ Contract’, ‘Contractor’, ‘Drawings’, ‘Works’, ‘Site’, and ‘Provisional Sum’ used in the MoRT&H Specification shall have and shall be deemed to have the same meaning as understood from the definition of these terms in and as included in the Conditions of Contract.
- B1.1.4 Words like ‘Specifications’, ‘Technical Specifications’, ‘General Technical Specifications’, ‘Particular Technical Specifications’ and ‘Additional Technical Specifications’ shall have and shall be deemed to have the same meaning as per Specifications Section B Part1 and Part 2.
- B1.1.5 **These are intended for general guidance. DPR Consultants may customize for their respective project requirements.**
- B1.1.6 Copies of the MoRT&H Specifications may be obtained from:
- The Secretary General
Indian Roads Congress
Jamnagar House,
Shahjahan Road,
New Delhi
&
Sector 6, R.K. Puram,
Kama Koti Marg,
New Delhi

SPECIFICATIONS SECTION B

Part 2 – Particular Technical Specifications

B.2.1 Introduction

B.2.1.1 This Part 2 – Particular Technical Specifications of Section B of the Specifications revises certain clauses of Part 1 – General Technical Specifications.

B.2.1.2 All the amendments issued to the MoRT&H’s “Specifications for Road and Bridge Works – Fifth Revision”, shall apply to the relevant Clauses, otherwise as specified in this section.

B.2.1.3 These revisions comprise substitutions, modifications or additions to clauses of the MoRT&H Specifications referred to in Part 1 - General Technical Specifications and accordingly the said specifications so amended shall form part of the Contract.

B.2.1.4 In the absence of any definite provisions on any particular issue in the aforesaid specifications, reference may be made to the latest IRC Codes of Practice, IS Specifications along with their amendments or Indian Railway Codes in that order, failing which the construction and completion of works shall conform to sound engineering practice. In the event of ambiguities or inconsistencies arising out of the interpretation of the above, the decision of the Engineer shall be final and binding.

B.2.1.5 The following list shows the Clauses of the MoRT&H Specifications, which are modified or added by this Particular Technical Specifications:

Section 100: 105, 106, 107, 108, 109, 110,111 (Replaced as Specifications Section A), 112, 114, 115, 116 and 120
Section 200: 201 and 202
Section 300: 301, 304, 305, 306 and 315
Section 400: 401 and 406
Section 500: 501, 502, 503, 505 and 507
Section 800: 803, 804 and 811
Section 900: 902
Section 1000: 1006, 1007, 1008, 1009, 1010, 1012 and 1014
Section 1400: 1402
Section 1500: 1501, 1502 and 1503
Section 1600: 1604, 1605, 1606 and 1607
Section 1700: 1701, 1703, 1705, 1706, 1708, 1709, 1711, 1712, 1713, 1717 and 1719
Section 2000: 2001 and 2005
Section 2200: 2204 and 2210
Section 2300: 2304
Section 2600: 2602
Section 2700: 2702 and 2706
Section 2800: 2802
Section 2900: 2902, 2910 and 2912
Section 3000: 3001, 3003 and 3004

B2.2 SECTION 100 GENERAL.

B2.2.1 CLAUSE 105 SCOPE OF WORK

B2.2.1.1 Sub Clause105.3

Add **the following to the** Sub Clause 105.3

The Contractor shall establish, adhere to, monitor and maintain an adequate quality assurance programme (QA-programme) based on the requirements of EN ISO 9001.

The QA-programme shall cover the quality assurance aspects of all services rendered, all items to be supplied and all construction activities to be performed under the Contract, also including temporary structures and equipment which will influence the quality of the completed works or the progress of the Contract.

The QA-programme shall as a minimum cover subjects listed below:

- Organization and Management Responsibility
- Document and data control
- Construction programme
- Method statements
- Process control
- Working, inspection, testing and documentation procedures
- Safety and emergency procedures
- Control and documentation of purchasing and handling of materials
- Product realization
- Non-conformity and corrective / preventive action
- Measurement, analysis and improvement
- Internal quality audits
- Servicing
- Education and training of staff
- Site Environmental Plan
- Competence / skill requirement for Human resources
- Customer communication

The QA-programme giving the general procedures shall be submitted to the Engineer not later than twenty-eight days after the date of receipt of letter of acceptance. Detailed procedures with respect to specific items of work shall be submitted successively prior to the commencement of such activity.

B2.2.1.2 Sub Clause105.5

Add **the following as** Sub Clause 105.11

Contractor shall take steps to minimize the negative impact of construction operations on environment.

Hot Mix Plants should be located at least 1-2 Km away from the nearest habitation unless otherwise required by statutory requirements. Vehicles and machinery used for road construction are to be regularly maintained to conform to SPCB (State Pollution Control Board) norms. Blasting as per Indian Explosive Act will be adopted. People living near such blasting site should have prior information of operation hours. Workers at blasting site will be provided with earplugs. Vehicle transporting earth materials will be covered. Water shall be spread to control the dust.

The Contractor will make arrangement to clean up the spoil as soon as the work finishes in a stretch. If such sites are located outside the ROW, restoration of the site to a level acceptable to the landowner will be done within time period agreed between landowner and the Contractor. Spilling of oil and bituminous products during construction phase will be avoided to reduce the chances of contamination of surface as well as ground water. The construction camps shall be situated at places involving least risks of the nature considering the factors like ground slopes, underground water table and shall conform to local building regulations, as applicable.

Construction camps shall be properly located to avoid contamination of water through wastewater drainage into river and canals. Seasonal pollution issues may arise when flow of river is slow. To prevent such contamination, wastewater generated at campsite will be discharged in soak pits. For human excreta, proper disposal facilities shall be available through Septic Tanks.

B2.2.2 CLAUSE 106 CONSTRUCTION EQUIPMENT

B2.2.2.1 Add the following sub Para (l) and (m) after sub Para (k):

- l) Adequate standby equipment including spare parts shall be available.
- m) All measuring devices and gauges shall be in good working condition. Measuring devices that can affect product quality shall be calibrated prior to use and at prescribed intervals against certified equipment. Calibration procedures shall be established, maintained and documented and corrective actions taken when results are unsatisfactory. Calibration of all measuring devices and gauges etc., which the Contractor intends to use in the contract, shall be calibrated from a competent/reputed authority/agency and the frequency of the calibration shall be as directed by the Engineer. Accuracy and fitness of measuring devices shall be ensured by proper maintenance.

B2.2.3 CLAUSE 107 CONTRACT DRAWINGS

B2.2.3.1 Replace the Sub-clause 107.2 as follows:

“Two copies of good for construction drawings, on the basis of which actual execution of the work to be proceeded, shall be given to the Contractor by the Engineer progressively according to the work programme submitted by the Contractor and accepted by the Engineer. Drawings of particular activity shall be

issued to the Contractor at least 30 days in advance of the scheduled date of the start of the activity.

After careful study of the drawings issued by the Engineer, the Contractor shall prepare 3 sets of detailed construction drawings / working drawings with necessary field/construction information and shall submit the same to the Engineer for approval along with a construction methodology at least 21 days in advance of the scheduled date of the start of the activity.

After reviewing the construction drawings, the Engineer shall issue back 2 sets drawings to the Contractor duly stamped “Good for Construction” along with Drawing Number, Revision Number and date at least 7 days in advance of the scheduled date of the start of the activity.

The above issued drawings shall be kept at the Contractor’s site office, one set for daily use and the second set with the document control section. These sets of drawings shall be available for inspection at any time. All superseded/cancelled drawings shall be clearly marked “superseded” or “cancelled”. The Contractor’s document control procedure as per the QA-programme shall be applicable to the drawings.

Any drawings and sketches the Contractor prepares as part of his written correspondence with the Engineer and the Employer shall be considered incidental to works and to be prepared at his cost.

B2.2.4 CLAUSE 108 SITE INFORMATION

B2.2.4.1 Add the following as Sub-clause 108.4:

Identification of quarry sites, borrow areas and other sources of material is the responsibility of the Contractor. Material to be procured from quarry sites and borrow areas identified by the Contractor and to be used in the works shall be as per specifications for particular items of work. He shall satisfy himself that the required materials are available in adequate quantities and complying with the requirements of specifications. No claims shall be entertained on account of non-availability of materials, and increase in leads, etc.

As far as possible natural sand shall be used for sand/fine aggregates. If natural sand is not available within 100 Km or Government has stopped sand mining, the Contractor shall obtain suitable alternative viz. crushed stone, crushed sand, etc. to substitute then at rural sand. All alternative sand shall conform to IS: 383 and tests for conformity shall be carried out as per IS: 2386 (Parts I to VIII). No separate payment will be made on account of non-availability of natural sand, arranging crusher sand and increase in leads, etc. It is the sole responsibility of the Contractor to arrange the quarries, borrow areas etc., on license / lease basis or otherwise, and study in detail before tendering, the scope of taking the quarry on lease. Advance information must be collected by the Contractor regarding the procedure laid down and the consequent delay in arranging the quarries on lease and must make alternative arrangement to

procure the quarry products from lease holders. No separate payment will be made for arranging such quarries, borrow areas, etc.”

B2.2.5 CLAUSE 109 SETTING OUT

B2.2.5.1 Sub Clause 109.6 the Last Sentence of the first paragraph shall be replaced with following sentences

The Contractor, in connection with the staking out of the centreline, shall survey the terrain along the road and cross sections at intervals 10m and 5m in Straight and Curve portions respectively as per the following guidelines.

1. Work request shall be given for joint inspection/survey for taking of “Original ground levels of road cross-sections” 7 days in advance before starting of site clearance.
2. Preliminary site clearance such as removal of shrubs and bushes has to be done without disturbing the original ground surface.
3. Joint survey shall be carried out and the “Original Ground levels (OGL)” along the road centre line and cross sections shall be taken jointly.
4. Engineer shall furnish Copy of the approved records of Centre line co-ordinates & OGL field books to the Employer for record.
5. The cost of these surveys, processing of survey data and preparation of cross-section drawings shall be deemed to be included in the rates and prices of items quoted by the Contractor in the Bill of Quantities.

B2.2.5.2 Sub Clause 109.7 Replace the 1st sentence of the paragraph with the following

After obtaining approval of the Engineer, work on site clearance can commence and the profile and cross sectional OGLs shall form the basis for measurements and payment.

B2.2.5.3 Sub Clause 109.8 Add the following paragraph in Sub Clause 109.8 Surveying Equipment and Personnel

The Contractor shall provide the necessary surveying equipment, accessories, surveyors and labourers required for setting out and related measurements, including making available these to the Engineer and his representatives at different stages of the work. The surveying equipment shall be of high standard of manufacture as approved by the Engineer, in good working condition with adequate numbers and shall include inter alia the following:

- i. Precision automatic level with micrometre attachment with tripod and levelling staff reading to 5 mm accuracy by direct observation and to 1 mm accuracy by estimation or better
- ii. Theodolite with tripod – Electronically operated with computerized output attachment reading to 20 seconds of angle accuracy or better.
- iii. Total Station with 2 spare batteries and a charger, three tripods plus tangents sufficient for a 4 km range, together with an electronic data recorder, 6 data packs and all necessary software for operation.

- iv. Precision staffs 4m & 5m type
- v. 3 metre straight edge and measuring wedge fitted with handles, wedges 100 mm height and 1 mm accuracy.
- vi. Field umbrellas
- vii. Ranging rods 50 mm diameter 3 m long straight with a conical metallic shoe at one end and painted alternatively black and white at 300 mm C / C along the length.
- viii. Camber templates 2 lane fitted with handles.
- ix. Steel tape graduated in metres, centimetres and millimetres
 - 1. 10 m long
 - 2. 20m long
 - 3. 50m long
- x. Reference markers and pegs
- xi. Safety Jackets (Reflective)
- xii. Bump Integrator (Wheel mounted)
- xiii. Nails, chalk piece, paints, brushes etc.,

The Contractor shall maintain the surveying equipment in good condition during the full duration of works and replace the ones, which get worn out or otherwise become unworkable.

The surveying equipment and related resources shall be provided under the general obligations of the Contractor requiring no separate payment

B2.2.6 CLAUSE 110 PUBLIC UTILITIES

B2.2.6.1 Sub Clause 110.1 Delete the first paragraph of sub-clause 110.1 and add the following

110.1 The information provided in the bid documents about public utilities like water/oil/gas pipelines, sewers, cables etc. may not be exhaustive, and it shall be the responsibility of the Contractor to ascertain the utilities that are likely to be affected by the works through site investigations and collection of information from the concerned utility owners:

B2.2.6.2 Sub Clause 110.3 Delete sub-clause 110.3 and add the following

110.3 Any utility likely to be affected by the Contractor's work shall be brought to the notice of the Engineer and such work shall be undertaken only after getting written clearance from the Engineer

B2.2.7 CLAUSE 111 PRECAUTIONS FOR SAFEGUARDING THE ENVIRONMENT

Delete Entire Clause and Sub-Clauses of 111 and replace with the following:

B2.2.7.1 Sub Clause 111.1 Delete sub-clause 111.1 General and add the following sub-clause:

The Contractor shall take all precautions for safeguarding the environment during the course of the construction of works. He shall abide by all rules, regulations and laws in force governing pollution and environmental protection that are applicable to the area where the works are situated.

NOISE:

The Contractor shall mitigate against any sustained increase in base line ambient Noise levels at sensitive receptors during construction of work.

All construction operations shall be performed in a manner to minimize noise and vibration. The parameters for noise are detailed below.

- 70 dB (A) for day and night;
- 50 dB (A) for day and 45 dB (A) for night for sensitive receptors

If the noise levels are found to be above these standards and it is determined by the Engineer that these levels are due to the equipment or plant being deployed by the Contractor, he shall undertake, at his own cost measures as approved by the Engineer, to bring these levels down to the specified levels. Blasting should be done as per Indian Explosive Act. People living near such blasting sites shall have prior information of operational hazards. Blasting will not be undertaken at night. Workers at blasting sites will be provided with earplugs. Material haulage roads will be properly regulated.

Labour shall be warned against the hunting of wild life, if any. No archaeological site shall be disturbed.

B2.2.7.2 Sub Clause 111.2 Delete Sub-clause 111.2 Borrow pits for Embankment Construction and add the following sub-clause:

Borrow pits shall not be dug within the Right-of-Way of the road. Arable lands will not be used for earth borrowing. The Contractor will ensure that proper excavation techniques are used to improve stability and safety of the borrow area. The excavation shall be carried out in such a way that the area does not inundate during monsoons or generate cesspools of water to become mosquito-breeding sites. The borrow pits shall not be left in a condition likely to cause hazard to human or animal life. The stipulations in Clause – 305.2.2 shall govern.

B2.2.7.3 Sub Clause 111.3 Delete Sub-clause 111.3 Quarry Operations and add the following sub-clause:

The Contractor shall obtain material from licensed quarries only after the consent of the Mining Department or other concerned authorities. The quarry operation shall be undertaken within the purview of the rules and regulations in force. The Contractor shall ensure scheduling the movement of transport carrying material to and from the site during non-peak hours. The trucks carrying all the dusty material, red earth, moorum and fly ash/ pond, ash shall be covered with a tarpaulin and provided with

adequate free board to prevent spillage. End boards shall be provided in loaders to prevent spillage.

Stockpiling of material shall be properly planned so as to ensure that no traffic jam takes place on the highway.

B2.2.7.4 Delete Sub Clause 111.5 and Add new Sub Clause 111.5 Precautions against Dust

The Contractor shall take all reasonable steps to minimize dust nuisance during the construction of the works. All existing highways and roads used by vehicles of the Contractor or any of his sub-Contractors or suppliers of materials or plant, and similarly any new roads which are part of the works and which are being used by traffic shall be kept clean and clear of all dust / mud or other extraneous material dropped by the said vehicles or their tyres. Similarly, all dust / or mud or other extraneous material from the works spreading on these highways shall be immediately cleared by the Contractor. Clearance shall be effected immediately by manual sweeping and removal of debris, or, if so directed by the Engineer, by mechanical sweeping and clearing equipment, and all dust, mud and other debris shall be removed entirely from the road surface. Additionally, the road surface including haul road from Quarries and Plants shall be hosed or watered using suitable equipment to avoid dust pollution. Special care shall be taken to combat dust problem originating from use of fly ash/pond ash.

B2.2.7.5 Delete Sub Clause 111.6 and Add new Sub Clause 111.6 Pollution from Hot Mix Plant, WMM Plant, Batching Plant & Crusher and Other Construction Machinery

The Contractor shall ensure the use of a relatively new, well maintained hot mix plant (batch type) so that any emission conforms to the CPCB norms and be fitted with a dust extraction unit to avoid prolonged engine powered equipment illness. Hot Mix Plant, WMM plant, Batching Plant & Crusher shall be located more than 500 m from any community or residence. The Contractor has to obtain necessary consent/clearance from State Pollution Control Board to operate Hot Mix Plant, WMM plant, Batching Plant, DG Set & Crusher before commencement of works.

All vehicles, equipment and machinery needed for construction will be regularly maintained to ensure that pollution emission levels conform to CPCB norms. All vehicles should be fitted with silencers.

Construction vehicles, machinery & equipment will move or be stationed in designated areas to avoid compaction of soil to ensure the preservation of the top soil for agriculture.

B2.2.7.6 Delete Sub Clause 111.7 and Add new Sub Clause 111.7 Road Safety

The Contractor shall provide adequate circuit for traffic flow around construction areas, control speed of construction vehicles through road safety and training of drivers, provide adequate signage, barriers and flag persons for traffic control. If there are traffic jams during construction, measures shall be taken to relieve the

congestion with the assistance of local traffic police. Safety of workers undertaking various operations during construction will be ensured by providing helmets, masks, safety goggles, etc. One Qualified Safety Officer and one Safety Supervisor must be available in the Contractor's working team for the entire construction period.

B2.2.7.7 Delete **Sub Clause 111.8** and Add new **Sub Clause 111.8** Sanitation & Waste Disposal in Construction Camp

The Contractor shall ensure that construction camps are located at a distance of minimum 200m from water sources. Special attention shall be paid to the sanitary conditions of the camps. The Contractor shall ensure that sufficient measures are taken i.e. provision of garbage tanks and sanitation facilities. Waste in septic tanks shall be cleaned periodically. Garbage shall be collected in four empty drums at each construction site and disposed of daily. The Contractor shall provide adequate measures for the health care of workers and arrange their regular medical check-up to ensure that they do not suffer from any communicable disease. At every workplace, good & sufficient water supply will be maintained to avoid waterborne / water related diseases. If any pits are dug at construction / camp sites which are not filled and then may turn into mosquito breeding sites during monsoons shall be filled up properly so that no water accumulates.

B2.2.7.8 Delete **Sub Clause 111.9** and Add new **Sub Clause 111.9** Substance Hazardous to Health

The Contractor shall not use or generate any material in the works, which is hazardous to the health of persons, animals or vegetation. Where it is necessary to use some such substance which can cause injury to the health of the workers, the Contractor shall provide suitable protective clothing or appliances to his workers, viz. earplugs, helmets or dust masks.

B2.2.7.9 Delete **Sub Clause 111.10** and Add new **Sub Clause 111.10** Damage to Existing road/CD Structures

Any structural damage caused to the existing roads/structures by the Contractor's construction equipment shall be made good without any extra cost.

B2.2.7.10 Delete **Sub clause 111.11** and Add new **Sub Clause 111.11** Use of Nuclear Gauges

Nuclear gauges shall be used only where permitted by the Engineer. The Contractor shall provide the Engineer with a copy of the regulations governing the safe use of nuclear gauges he intends to employ and shall abide by such regulations. Without written approval, no such equipment shall be used at any level of the work.

B2.2.7.11 Delete **Sub Clause 111.12** and Add new **Sub Clause 111.12** Environmental Monitoring

In order to carry out periodic checks, environmental monitoring will be carried out by the Engineer as per schedule and if any parameter is found above the acceptable

standards, mitigation measures / control measures as decided by the Engineer shall be complied with by the Contractor.

B2.2.7.12 Delete Sub Clause 111.13 and Add new Sub Clause 111.13 Protection of Existing Trees

Some of the existing trees within the right of way are likely to be cut down by the Employer prior to handing over of the site to the Contractor. The Contractor shall take all necessary measures to ensure safety and protection of the remaining trees from any action whatsoever relating to his construction operations in the adjoining areas.

Giant neighbourhood trees recognized locally as important shall be preserved and engineering designs modified to accommodate these wherever possible depending on Engineer's directions.

B2.2.7.13 Add new Sub Clause 111.14 Disposal of Materials outside Work Site

Notwithstanding other relevant provisions in the contract, the excess material generated by dismantling, excavation, waste material and lubricants, used oil, gasoline and other such substance etc., shall be removed from site outside the right of way at regular intervals and site shall kept clean from all such disposable materials. Grease, cotton and other waste construction materials shall be disposed off in shallow pits and periodically burnt in a incinerator constructed at each construction site. Such intervals shall not exceed one month under any circumstances. The selection of the disposal site shall be the responsibility of the Contractor and he shall ensure that the selected site does not result in any claim for damages to the Employer or violation of any existing laws.

This section of Technical Specifications sets out instructions, recommended standards and technical specifications for the design and implementation of EMP mitigation works associated with construction of roads.

Environmental Management Plan has been prepared for the Project road, which needs to be followed during the implementation of the civil works. The key responsibility of the contractor/sub-contractor will be the successful implementation of the EMP. In addition, he will update MoRT&H on the progress of environmental protection and / or enhancement works as envisaged in the EMP. Execution of environmental mitigation measures meeting the requirement of Technical Specifications in conformity with applicable legislation will be the responsibility of the contractor. It shall also be accompanied with relevant documents (statements of compliance, certificates of compliance, test reports, etc.), evidencing their conformity with the statutory regulations.

B2.2.7.13.1 DISPOSAL OF UNSERVICEABLE MATERIALS:

The locations of Disposal sites have to be selected such that:

- Locating the disposal sites is the sole responsibility of the contractor with the approval of Engineer.
- Joint inspection of all disposal sites shall be done by Engineer and Contractor prior to approval.
- No residential area are located downwind side of these locations,
- Disposal sites are located at least 1000 m away from sensitive locations like
- Settlements, Water body notified forest areas, Sanctuaries or any other sensitive locations.
- Disposal sites do not contaminate any water sources, rivers etc. for this site should be located away from water body and disposal site should be lined properly to prevent infiltration of water.
- Public perception about the location of debris disposal site has to be obtained before finalizing the location.
- Permission from the Village/local community is to be obtained for the Disposal site selected.
- Contractor will resolve all claims arising out of waste disposal at his own cost.
- Contractor shall utilize the suitable borrow areas, abandoned quarries and other waste land for the debris disposal.
- Contractor needs to plan the disposal in the following way:
 - Identify the disposal area.
 - Prepare a Contractor's debris disposal plan with design drawings for each identified area and get it approved by the Engineer.
 - Need to photograph the present land use and condition of the area.
 - Construct all required structures (e.g. retaining wall).
 - The dumpsites filled only up to the ground level with compaction of the debris materials in layers after disposal.
 - The 30 cm top layer of disposal pit shall be provided with good earth suitable for development of vegetation/plantation.
 - After levelling, the site could be suitably rehabilitated by planting local species of grass (turfing), shrubs and other plants as decided by the Engineer.

B2.2.7.13.2 CONSTRUCTION OF WATER RECHARGE PITS:

Storm water recharge pits shall be located such that it should be in the valley of the surface layout nearby cross drainage structures and other water bodies along the project road. Water recharge pits shall be located at a height of 3 m. above the ground water table of the area as per the Central Ground Water Board norms. Recharge pits are constructed by the side of the guiding drains such that all the storm water shall be directed to the recharge pit. Any proposal for change in number and location recharge pits by the contractor shall be checked and approved by the Engineer.

Pits, trenches, abandoned dug wells, recharge wells or abandoned bore wells shall be connected by the rain water harvesting system with the consent of the respective owner or as approved by the Engineer.

B2.2.7.13.3 CONSTRUCTION OF SILT TRAPS:

Silt fences shall be planned such that each recharge pit will have one silt fence to prevent silt from entering the nearest water bodies and also prevent choking of recharge pit by the silt coming from runoff water and increase the life of recharge pits. Silt fence are mounted in guiding drains at a distance of 3 to 5 M in the upstream direction depending on the gradient of the guiding drains. However any proposal for change in number and location silt fences by the contractor shall be checked and approved by the Engineer. Sand / silt removal facilities such as sand traps, silt traps and sediment basins should be provided to remove sand / silt particles from run-off.

B2.2.7.13.4 SCARIFIED BITUMEN DISPOSAL PITS:

Scarified bitumen generated out of scarification of existing pavement is used for approach roads by mixing it with fresh bitumen or other granular materials to achieve the required strength followed by profiling and compaction.

The left out portion of the scarified bitumen is disposed safely in a clay lined pit or as directed and approved by the Engineer. A typical clay lined bitumen disposal pit with standard dimensions has been worked out. The dimension of the bitumen disposal pit may change provided the clay lining of required thickness is adhered to.

The selection of sites for disposal of scarified bitumen is made on following lines:

- Locating the bitumen disposal sites is the sole responsibility of the contractor with the approval of Engineer.
- Selection of bitumen disposal site is avoided in the quarry regions. If the disposal site is located in the abandoned quarry, region is suitably treatment seal the fractures and fissures.
- Joint inspection of all disposal sites shall be done by Engineer and Contractor prior to approval.
- Disposal sites shall be located at least 1000 m away from sensitive locations like Settlements, Water body notified forest areas, Sanctuaries or any other sensitive locations.
- Disposal sites do not contaminate any water sources, rivers etc. for this, site should be located away from water body and disposal site should be lined properly to prevent infiltration of water.
- Public perception about the location of bitumen disposal site has to be obtained before finalizing the location.
- Permission from the Village/local community is to be obtained for the Disposal site selected.
- Contractor will resolve all claims arising out of waste disposal at his own cost. Contractor needs to plan the bitumen disposal in the following way:
 - Identify the disposal area.
 - Prepare a Contractors bitumen disposal plan with design drawings for each identified area and get it approved by the Engineer.
 - Need to photograph the present land use and condition of the area.

- Construct all required structures (e.g. retaining wall) along with clay lining and measures to prevent the seepage of bitumen leachate.
- The dumpsites filled only up to the ground level with compaction of the materials in layers after disposal.
- The 30 cm top layer of disposal pit shall be provided with good earth suitable for development of vegetation/plantation.
- After levelling, the site could be suitably rehabilitated by planting local species of grass (turfing), shrubs and other plants as decided by the Engineer and the supervision consultant.

B2.2.7.14 PROVISION FOR OIL INTERCEPTORS:

Location of Oil Interceptors shall be considered such that each construction camp having refuelling stations, oil and lubricants storage places will have one oil interceptor to stop & separate the floating oils. However the number of interceptors shall be increased as the situation demands or during the accidental spillages with the consent of the Engineer.

B2.2.7.15 ENVIRONMENTAL MONITORING:

Environmental Monitoring of Air, Noise, Water and Soil parameters shall be carried by the contractor as per the consents and latest environmental norms, guidelines and policies of national and state level environmental authorities. The Contractor shall comply by all obligations and make sure that there are no deviations from them or from the Contract.

Environmental standards for Air, Noise and water are outlined below.

Ambient Air Quality Standards (National)

Sl. No.	Pollutants	Time weighted average	Concentration in ambient air		Method of measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Area (notified by Central Government)	
1.	Sulphur Dioxide (SO ₂) µg/m ³	Annual*	50	20	- Improved West and Geake - Ultraviolet Fluorescence
		24 hours**	80	80	
2.	Nitrogen Dioxide (NO ₂) µg/m ³	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
		24 hours**	80	80	
3.	Particulate Matter (size less than 10 µm or PM ₁₀)	Annual*	60	60	- Gravimetric - TOEM - Beta attenuation
		24 hours**	100	100	

Sl. No.	Pollutants	Time weighted average	Concentration in ambient air		Method of measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Area (notified by Central Government)	
	µg/m ³				
4.	Particulate Matter (size less than 2.5 µm or PM _{2.5}) µg/m ³	Annual*	40	40	- Gravimetric - TOEM - Beta attenuation
		24 hours**	60	60	
5.	Ozone (O ₃) µg/m ³	8 hours**	100	100	- UV Photometric - Chemiluminescence - Chemical method
		1 hour **	180	180	
6.	Lead (Pb) µg/m ³	Annual*	0.5	0.5	- ASS/ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7.	Carbon Monoxide (CO) mg/m ³	8 hour	02	02	- Non Dispersive Infra-Red (NDIR)
		1 hours**	04	04	- Spectroscopy
8.	Ammonia (NH ₃) µg/m ³	Annual*	100	100	- Chemiluminescence 24 - Indophenol blue method
		24 hours**	400	400	
9.	Benzene (C ₆ H ₆) µg/m ³	Annual*	05	05	- Gas chromatography based on continuous analyser - Adsorption and desorption followed by GC analysis
10.	Benzol (O) Pyrene (BaP) – Particulate phase only ng/m ³	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11.	Arsenic (As) ng/m ³	Annual*	06	06	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12.	Nickel (Ni) ng/m ³	Annual*	20	20	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

Sl. No.	Pollutants	Time weighted average	Concentration in ambient air		Method of measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Area (notified by Central Government)	
*	Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.				
**	24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.				

2. Water quality Standards (IS 10500: 1991)

S. No.	Parameter	Requirement desirable Limit	Remarks
1.	Colour	5	May be extended up to 50 if toxic substances are suspected
2.	Turbidity	10	May be relaxed up to 25 in the absence of alternate
3.	pH	to 8.5	May be relaxed up to 9.2 in the absence
4.	Total Hardness	300	May be extended up to 600
5.	Calcium as Ca	75	May be extended up to 200
6.	Magnesium as Mg	30	May be extended up to 100
7.	Copper as Cu	0.05	May be relaxed up to 1.5
8.	Iron	0.3	May be extended up to 1
9.	Manganese	0.1	May be extended up to 0.5
10.	Chlorides	250	May be extended up to 1000
11.	Sulphates	150	May be extended up to 400
12.	Nitrates	45	No relaxation
13.	Fluoride	to 1.2	If the limit is below 0.6 water should be rejected, Max. Limit is extended to 1.5
14.	Phenols	0.001	May be relaxed up to 0.002
15.	Mercury	0.001	No relaxation
16.	Cadmium	0.01	No relaxation
17.	Selenium	0.01	No relaxation
18.	Arsenic	0.05	No relaxation
19.	Cyanide	0.05	No relaxation
20.	Lead	0.1	No relaxation
21.	Zinc	5.0	May be extended up to 10.0
22.	Anionic detergents (MBAS)	0.2	May be relaxed up to 1
23.	Chromium as Cr+6	0.05	No relaxation
24.	Poly nuclear aromatic Hydrocarbons	--	--
25.	Mineral Oil	0.01	May be relaxed up to 0.03
26.	Residual free Chlorine	0.2	Applicable only when water is chlorinated
27.	Pesticides	Absent	--
28.	Radio active	--	--

3. Ambient Noise Quality Standards in respect of Noise

Area code	Category of Area / Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note:-

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
 2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
 3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority
 4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.
- * dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A “decibel” is a unit in which noise is measured.

“A”, in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specified period.

Note: The Principal Rules were published in the Gazette of India, vide S.O. 123(E), dated 14.2.2000 and subsequently amended by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2000 vide S.O. 1046(E), dated 22.11.2000 and by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2002 vide S.O. 1088(E), dated 11.10.2002, under the Environment (Protection) Act, 1986.

B2.2.7.16 Add new Sub Clause 111.15 as follows

Compliance with the foregoing will not relieve the Contractor of any responsibility for complying with the requirements of any highway authority in respect of the roads used by him.

B2.2.8 CLAUSE 112 ARRANGEMENT FOR TRAFFIC DURING CONSTRUCTION

B2.2.8.1 Replace the Sub Clause 112.1 of MORT&H with the following

The Contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all works involving improvements to the existing highway, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the highway. The objective shall be to provide for the

proper management of the construction site so that all road users, i.e. pedestrians, cyclists, motor cyclists, animals and animal drawn traffic and vehicular traffic are properly and safely accommodated. Two weeks before taking up any construction or maintenance operation/work, the Contractor shall prepare a Traffic Management Plan for each work zone and submit it to the Engineer for his prior approval. This plan should include inter alia.

- (i) A qualified safety officer with support staff to serve as a site safety team
- (ii) Provision of 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 500mm dia and 1000 mm high) made of plastic/rubber having retro-reflective red and white band, at a spacing of 5m along with a reflective tape (red and white band) to be tied in between the gaps of cones/drums. A bulb using solar energy or other source of light is to be placed on the top of the cone/drum for delineation in dark hours and night.
 - c) Portable barricades using iron sheet (plain) with adequate iron railing /frame painted with retro-reflective paint in alternate yellow and white stripes.
 - d) Pavement markings
 - Temporary fence/guard rail
 - e) Temporary concrete barriers including special pedestrian barriers
 - f) Construction zone signs covering advance warning zone, approach transition zone, work zone, terminal transition zone.
 - g) Other regulatory, warning and information signs
 - h) Red lanterns or warning lights
 - i) Provision of flagmen
- (iii) Safety measures for workers engaged including personal Protection equipment
- (iv) First Aid and emergency response arrangements
- (v) Details and drawings of arrangements in compliance with other sub clauses of this clause.

The Contractor shall ensure that all the traffic management devices as per Traffic Management Plan approved by the Engineer are in position before opening of sites of work.

B2.2.8.2 Replace the Sub Clause 112.2 of MoRT&H with the following

112.2. Passage of Traffic along a part of the Existing Carriageway under improvement

For widening / strengthening of existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be **ensured** on the side on which work is not in progress. The shoulder shall consist of at least 150mm thick granular **or stabilized** base course covered with 20 mm thick open graded premix surfacing as per clause 511.1 in a width of at least 1.5m such that the total paved width available for traffic including part of the

existing road and treated shoulder is not less than 5.5m and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length along one side of the road in which such work shall be carried out, would be limited normally to 500 m at a place.

However, where work is allowed by the Engineer in longer stretches passing places at least 20 m long with additional paved width of 2.5 m shall be provided at every 0.5 km interval.

In case of widening existing two-lane to four-lane, the additional two lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. However, in case where on the request of the Contractor, work on existing two-lane carriageway is allowed by the Engineer with traffic using part of the existing carriageway, stipulations as in *sub* para above shall apply.

After obtaining permission of the Engineer, the treated shoulder shall be dismantled, the debris disposed of and the area cleared as per the direction of the Engineer.

B2.2.8.3 Replace the Sub Clause 112.3 of MoRT&H with the following

Sub Clause 112.3 Passage of Traffic along a Temporary Diversion

In stretches where it is not possible to pass the traffic on part width of the carriageway, a temporary diversion shall be constructed with 5.5 m carriageway and 2.5 m earthen shoulders on each side (total width of roadway 10.5 m) with the following provision for road crust in the 5.5 m width:

- (i) 200 mm (compacted) granular or stabilized subbase;
- (ii) 225 mm (compacted) granular base course; and
- (iii) 20 mm thick open graded premix surfacing as per clause 510.1

The use of fly ash in temporary diversions shall not be permitted.

The location of such stretches, alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

The Contractor shall be responsible for the design of temporary diversions and submit the designs to the Engineer for his approval. If the Contractor finds it necessary to construct part of any diversion outside the Right of Way, the temporary use of additional land shall be arranged for by the Contractor at his own risk and cost. Further as per Conditions of Contract, the Contractor shall indemnify the Employer and the Engineer against any claims or proceedings resulting from the occupancy and use of such areas of additional land. Any roadside trees that have to be removed for the construction of temporary diversions shall be at the responsibility and cost of the Contractor.

B2.2.8.4 Replace the Sub Clause 112.4 of MORT&H with the following

Sub Clause 112.4 Traffic Safety and Control

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per the Traffic Management Plan submitted by the Contractor and approved by the Engineer, referred to in Sub-Clause 112.1. Before taking up any construction, an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.

The barricades erected on either side of the carriageway / portion of the carriageway which is closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device to the directions of the Engineer. At night, the passage shall be delineated with lanterns or other suitable light source.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory / warning signs as approved by the Engineer shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs shall be of approved design and of reflectory type, as directed by the Engineer.

The Provisions made in Bill of Quantities shall be the ceiling for the Contract during the Contract Period. The Additional claims due to damage and theft of the same shall be deemed incidental to works. No extra payment shall be made towards additional quantities for these bill items.

B2.2.8.5 Replace the Sub Clause 112.5 of MoRT&H with the following

Sub Clause 112.5 Maintenance of Diversions and Traffic Control Devices

All the signs, delineators and pavement markings shall be maintained in a clean and bright condition at all times; and adequate lighting and other arrangements shall be maintained for proper visibility during the passage of the work area, till such time they are required and as directed by the Engineer. The temporary travelled way shall be kept free of dust by frequent applications of water.

B2.2.8.6 Replace the Sub Clause 112.6 of MORT&H with the following

Sub Clause 112.6 Measurements for Payment and Rate

(i) All arrangements for traffic during construction including provision of temporary cross drainage structures, if required and treated shoulder as described in Clause 112.2 including their maintenance, dismantling and clearing debris, where necessary, shall be considered as incidental to the works and shall be the Contractor's responsibility, **unless provided as a separate payable item in the BOQ.**

(ii) The construction of temporary diversion including temporary cross drainage structures at the site of bridge reconstruction locations as described in Clause 112.3, shall be **payable** and measured in linear metre and the unit contract rate shall be inclusive of full compensation for construction (including supply of material, labour, tools, etc.), maintenance, final dismantling, and disposal.

B2.2.9 **CLAUSE 114 SCOPE OF RATES FOR DIFFERENT ITEMS OF WORK**

B2.2.9.1 **Sub Clause 114.2 Item (ii) of Clause 114.2 shall read as follows:**

“A detailed resource based construction programme (using computerized critical path network method) in a form which facilitates control of the progress of the works and consequences of any changes in terms of time. The programme shall also include detailed network activities for the submission and approval of materials, procurement of critical materials and equipment, fabrication of special products/ equipment and their installation and testing and for all activities of the Contractor that are likely to affect the progress of work, etc. including updating all such activities on the basis of decisions taken at the periodic site review meetings or as directed by the Engineer. The Contractor shall submit data via electronic media and hard copy to the Engineer in a form readily compatible with the Engineer’s planning system.”

B2.2.9.2 **Sub Clause 114.2 Add the following as item (xix) for sub-clause 114.2:**

“The Contractor shall prepare detailed working drawings for each structure as required, on the basis of the drawings given in Bid Documents and get them approved by the Engineer. The drawings shall be submitted to the Engineer at least 8 weeks before commencement of construction of the structures”.

B2.2.9.3 **Sub Clause 114.2 Add the following as item (xx) for sub-clause 114.2:**

“Monthly progress report in a format acceptable to the Engineer. The report shall state the progress which has been achieved compared with the planned progress, illustrate delays in proportion to the progress planned, analyze the consequences and state planned corrective measures. Intermediate progress reports may also be required.

The first issue of the detailed construction programme including the detailed description of the system and the procedures shall be submitted to the Engineer for acceptance not later than 28 days after the date of receipt of the letter of acceptance.”

The Contractor shall submit to the Engineer for approval & consent, the updated & revised programme at every six months interval or as such as directed by the Engineer. The updated & revised programme shall be submitted showing the actual progress achieved (physical & financial) and the effects of the progress achieved on the timing of the remaining work including any change to the sequence of the activities”.

B2.2.9.4 Sub Clause 114.2 Add the following as item (xxi) in Sub-Clause 114.2

Cost of carrying out Topographic Surveys and Auto Level Surveys.

B2.2.9.5 Sub Clause 114.4 Add the following new Sub Clause 114.4

114.4 If any work executed by the Contractor does not meet the specifications, it shall be deemed as rejected. The Engineer, after obtaining approval of employer, may consider a proposal by the Contractor to retain an element or part of such work. The Contractor’s proposal shall be supported by calculations, drawings and other data to prove the soundness of the proposal and shall clearly describe the additional measures required to ensure the intended performance of the work. Rectification / remedial work to bring such work to acceptable standard shall be executed by Contractor at his cost.

B2.2.10 Clause 115. METHODOLOGY AND SEQUENCE OF WORK;

B2.2.10.1 Delete Sub Clause 115.2 and add the following as Sub Clause 115.2 Submission of Method statement

The Contractor shall submit a method statement. The method statement shall be submitted in two parts.

The General part of the method statement shall describe the Contractor’s proposals regarding preliminary works, common facilities, and items that require consideration at the early stage of the contract. The General part shall be issued along with the first issue of the construction programme (refer clause 114.2) and shall include information on:

- a) Sources of materials like coarse aggregate and fine aggregate, quantity and quality of materials available in different sources;
- b) Sources of manufactured materials like cement, steel, reinforcement, prestressing strands and bearings. Wherever possible the Contractor shall identify at least two sources for each of the items; he shall also submit samples/test certificates of recently manufactured materials for the consideration of the Engineer.
- c) Locations of site facilities like batching plant, hot mix plant, aggregate processing plant, etc.

- d) Details of facilities/approaches for transportation of personnel, equipment and materials like concrete for construction of pavements, foundations and substructures in river bed.
- e) Information on procedures to be adopted by the Contractor for prevention and mitigation of negative environmental impact due to construction activities.
- f) Any other information required by the Engineer subsequent to the scrutiny of the method statement submitted along with the Bid.

The general part of the Q.A. Programme shall accompany the method statement.

B2.2.10.2 Delete Sub Clause 115.3 and add the following as Sub Clause 115.3

The special part of the method statement shall be submitted to the Engineer by the Contractor for each important item of work like construction of embankments and sub-grade, pavements, pile foundations, concreting, pre-stressing, repair and rehabilitation of existing structures, concrete superstructure and for any other item as directed by the Engineer. These statements shall be submitted at least 4 weeks in advance of the commencement of the activity or item of work, unless otherwise stipulated in the contract.

The statement shall give information on:

- i) Details of personnel both for execution and quality control of the work.
- ii) Equipment deployment with details of number of units, capacity, standby arrangements.
- iii) Sequence of construction, details of temporary or enabling works like diversions, cofferdams, formwork including specialised formwork for superstructure, details of borrow areas, method of construction of embankment and sub-grade, pavements, piles, concreting procedures, details of proprietary processes and products (e.g. details of pre-stressing systems, proprietary piling systems, bearings, expansion joints etc.) and details of equipment to be deployed. Wherever necessary, technical literature, design calculations and drawings shall be included in the method statement.
- iv) Testing and acceptance procedures including documentation.
- v) Special part of the Q.A. Programme referred in clause 105.3 for the particular item of work shall be submitted along with the method statement for the concerned activity.
- vi) The Engineer shall examine and approve the method statement or direct the Contractor to re-submit the statement with required modifications. The modified statement shall be submitted within 14 days after receipt of Engineer's comments. The sole responsibility for the safety and adequacy of the methods adopted by the Contractor shall rest on the Contractor irrespective of any approval given by the Engineer.

B2.2.10.3 Delete Sub clause 115.4 and add the following as Sub Clause 115.4 Approval of proprietary product/ process/ system

Only proprietary products proven by international usage in comparable projects shall be permitted to be used. Fully authenticated details of licensing and collaboration

arrangement shall be submitted by the manufacturer, where relevant. Within 90 days of award of work the Contractor shall submit the following information for all proprietary products for approval by the Engineer.

- i) Name of manufacturer of product/ process/ system.
Complete details of the manufacturer of the product/ process/system shall be furnished. Details of projects where similar product/process/ system have been successfully used shall be furnished. Authenticated copies of license/ collaboration agreement shall be furnished.
- ii) General features of the product/product process/ system.
Detailed write-up with methods statement shall be furnished for each product/ process/ System. This shall include complete working drawings & installation drawings, technical specifications covering fabrication, materials, system of corrosion, protection etc.
- iii) Details of product development and development testing.
- iv) Acceptance test and criteria.
Manufacturer shall submit a quality assurance system document. Details of acceptance test and criteria of acceptance shall be furnished in this document.
- v) Installation procedure.
- vi) Maintenance procedure and schedule.
- vii) Warranty proposal.
The Engineer may order any additional tests required under relevant codal specifications for the purpose of accepting the product. The manufacturer shall make the facility for such additional tests available. The charges of these additional tests shall be borne by the Contractor.

B2.2.10 .4 CLAUSE 116 CRUSHED STONE AGGREGATES

B2.2.10.4.1 Delete the Sub Clause 116 Add the following

116. Crushed Stone Aggregates

Where the terms crushed gravel/shingle, crushed stone, broken stone, stone aggregate or aggregate appear in any part of the Tender document, Drawings issued for work, they refer to aggregates obtained through the use of Cone crusher, Vertical Shaft Impactor and vibratory screens of suitable capacity

B2.2.11 CLAUSE 120 FIELD LABORATORY

B2.2.11.1 Sub Clause 120.2 Delete both the paragraphs of Sub-Clause 120.2 and add new paragraphs as follows.

120.2.1 Description

The Contractor shall arrange to provide fully furnished and adequately equipped field laboratory. The field laboratory shall be located in close proximity to the

Works site. It shall be provided with electricity supply, electrical wiring and points, all necessary electrical fittings and fixtures; potable water supply including pipes, pumps, storage tanks, plumbing, all necessary fittings and fixtures; septic tank, sewer lines, drains; surfaced access road; fencing and security lighting; security services etc.

The floor space requirement for the field laboratory shall be as indicated in the drawings. It shall include office space for the Materials Engineers, one from the Contractor's side and another from the Engineer's side, space for the installation of equipment, and space for other facilities. The field laboratory shall be fitted complete with laboratory equipment, laboratory tables and cupboards, wash basins, toilet facilities, curing tank around 4m x 2m x 1m in size for the curing of samples, a fume chamber, working platform area of about 1m x 10m against the walls, cupboards above and below the working platform, space for storage of accessories such as sample moulds, space for storage of samples etc. At least 4 racks of slotted angles and M.S. sheets shall also be provided. The furnishing in each of two offices of the Materials Engineers shall include working tables and chairs.

120.2.2

The items of laboratory equipment to be provided by the Contractor shall include, but not be limited to, the following. Notwithstanding, the Contractor shall ensure that the laboratory is adequately equipped for site quality control of materials and Works.

General

(i)	Drying Oven with minimum capacity of 700 litres – Electrically operated, thermostatically controlled, range up to 2000C sensitivity 10C (1.5 watts capacity)	2 Nos.
(ii)	Platform balance 300 kg capacity	1 No.
(iii)	Balance 20 kg capacity – self indicating type	1 No.
(iv)	a) Electronic Balance 5 kg capacity accuracy 0.5 gm	2 Nos.
	b) Electronic Balance 0.2 kg capacity accuracy 0.01 gm	2 Nos.
	c) Electronic Balance 0.5 kg capacity accuracy 0.01 gm	-
(v)	Water bath – electrically operated and thermostatically controlled with adjustable shelves, sensitivity 10C, minimum capacity of 10 liters	1 No.
(vi)	Thermometers:	4 No.
	a) Mercury-in-glass Thermometer range 00 to 2500C	2 No.
	b) Portable dial – type Thermometer with 64mm diameter dial and 650mm long stem, range 50 to 2500c or Digital Asphalt Thermometer and probe	1 No.
(vii)	Gas stove or electric hot plate	2 Nos.
(viii)	Glassware's, spatulas, wire enamel, steel scales, measuring tape, casseroles, karahis, pestle-mortar, porcelain dishes, gunny bags, plastic bags, chemicals, digging tools like pickaxes, shovels etc.	As required
(ix)	Set of IS sieves with lid and pan:	
	450 mm diameter: 75mm, 63 mm, 53mm, 45mm, 37.5mm, 26.5mm, 22.4mm,	1 set

	19.0mm, 13.2 mm, 11.2mm, 10.0mm, 9.5mm, 6.7mm, 5.6mm, 4.75mm, 3.35mm, 2.8mm, 1.4mm, 710microns, 355microns, 180microns, 90microns 200 mm diameter: 4.75mm, 2.36mm, 2.0 mm, 1.18mm, 600micron, 425 micron, 300micron, 150micron and 75micron	2 sets
(x)	Kit for Water testing as per Clause 1010	1 set
(xi)	First aid box	2 sets
(xii)	Relevant IS/BS/IRC/ASTM/Asphalt Institute MS series Codes of laboratory testing	1 set
(xiii)	Personal Computer System (IBM/Compaq/HP/DELL) - Intel Pentium Dual Core 2.0 GHz with 400 MHz FSB - Intel Mother Board with Intel 850 Chip set - 1GB SD RAM - 1x 120 GB PCI – IDE Hard Disk - 58 X CD-ROM Drive - 17” TFT Colour Monitor - PS/2 Mouse with pad and Keyboard (107 keys) - Windows 2000 XP Professional preloaded with license - MS-Office 2000, MS-Project, Autocad-2000 preloaded with license - 1x HP DeskJet 1280 Colour Printer	1 No.

For soils and aggregates

(i)	Riffle Box of slot size 50mm as per ASTM C-136	1 No.
(ii)	Atterberg Limits (liquid and plastic limits) determination apparatus as per IS:2720,(Part 4)-1985 a) Casagrande Apparatus b) Cone Penetrometer	2 sets 2 sets
(iii)	a)Automatic Compactor b) Compaction Test Equipment for Heavy to the requirement of IS-T180 complete with color, base plate and 4.5kg rammer and standard compaction as per IS: 2720 (part 8) c) Wooden Mallets	1 set 2 sets 6 Nos.
(iv)	In-situ Density Test apparatus a) with 10cm diameter sand pouring cylinder, tray, can etc., complete as per IS:2720, (Part 28)-1974 b) with 15cm diameter sand pouring cylinder, tray, can etc., complete to the requirement of ASTM:D 1556 and as per IS:2720, (Part 28)-1974	2 sets 2 sets
(v)	Speedy Moisture Meter complete with chemicals	1 set
(vi)	Post – hole Auger with extensions, 10cm diameter	1 set
(vii)	Core cutter apparatus 10cm diameter, 10/12cm height, complete with dolly, rammer etc. as per IS:2720, (Part 29)-	5 sets

	1975	
(viii)	Aggregate Impact Value Test apparatus/Los Angeles Abrasion Test apparatus as per IS:2386 (Part -4)or IS:5640 AND IS:2386 (Part-4)	1 set
(ix)	Flakiness and Elongation Test Gauges as per B.S.812	1 set
(x)	Standard measures of 30, 15 and 3 Liters capacity along with standard tamping rod	1 set
(xi)	California Bearing Ratio test apparatus Motorized as per IS:2720, (Part 16)-1987	1 set
(xii)	CBR Moulds, surcharge weight and accessories as per IS: 10074-1982 plus gauges for swell measurement	65 Nos.
(xiii)	Triaxial Tests Equipment with Triaxial Cell, pressure gauge and accessories as per IS: 2720	1 set.
(xiv)	Direct Shear Test as per IS 2720, (Part 13)-1986 and accessories	1 set
(xv)	Sample Extractor to take soil samples from UDS Tubes	1 set.
(xvi)	10% Fines value Test Moulds and Accessories for Aggregates Testing as per BS:812(Part 111)	2 set
(xvii)	Soundness Test Kits including Sodium Sulphate of Magnesium Sulphate as per IS: 383-1970	1 set
(xviii)	100 ml Measuring Jars to conduct Differential Free Swelling Tests as per IS: 2720- Part 40-1977	20 sets
(xix)	Specific Gravity Bottles as per IS:2386 (Part-3)-1963	6 sets
(xx)	Swelling Pressure Test Equipment as per as per IS:2720, (Part 16)-1987	S sets
(xxi)	Aggregate Crushing Strength Tests Moulds as per IS:2720 (Part16)-1987	2 sets
(xxii)	Steel cups to determine Moisture Content	50 Nos.
(xxiii)	Sieve Shaking Machine – Motorized	1 Nos.
(xxiv)	MS / Steel Trays to store samples 1.5 x 1.5 x 1.5 ft 2 x 2 x 2 ft 3 x 3 x 3 ft	10 Nos. 10 Nos. 10 Nos.

For bitumen and bituminous mixes

(i)	Bitumen penetrometer automatic type including adjustable weight arrangement, and needles to the requirements of AASHTO : T – 49	1 Set
(ii)	Ring and Ball Apparatus as per IS : 1205 – 1978	1 Set
(iii)	Apparatus for Determination of Ductility Test as per IS 1208 –1978	1 Set
(iv)	Asphalt Institute Vacuum Viscometer as per IS : 1206 (Part II) –1978	1 Set
(v)	BS U–Tube Modified Reverse Flow Viscometer IS : 1206 (PartIII) –1978	1 Set
(vi)	Thin Film Oven Test apparatus to the requirements of AASHTO: T-179, including accessories	1 Set

(vii)	Constant temperature bath for accommodating bitumen test specimen, electrically operated, and thermos statically controlled, stainless steel interior, 50 litre capacity, temperature range ambient to 80° C	1 No.
(viii)	Riffle box – small size	1 No.
(ix)	Centrifuge type motorized bitumen extraction apparatus to the requirements of AASHTO : T - 164 with stock of solvent & filter paper	1 Set
(x)	Marshall compaction apparatus to the requirements of AASHTO: 245 as per ASTM T 1559-62 and complete with electrically operated automatic loading unit, compaction pedestal, heating unit, head breaking assembly, flow meter, load transfer bar, specimen moulds 100 mm diameter with base plate, collars, specimen extractor, compaction hammer 4.53kg x 457 mm fall (excluding constant temperature bath)	1 Set
(xi)	Core cutting machine with 15 cm diameter cutting cylinders with diamond cutting edge (including spares)	1 Set
(xii)	Vacuum pump and 3 specific gravity bottles	1 Set
(xiii)	Split Air Conditioner (Carrier make of 1.5 Tonne capacity with Temperature control facility) for Bitumen Lab in Laboratory building	1 No.
(xiv)	Apparatus of Determination of Specific Gravity Tests as per IS:1202-1978	2 Nos.
(xv)	Water Soaking Tank (8 x 6 x 4 ft)	2 Nos.
(xvi)	Apparatus for Determination of Loss on Heating IS : 1212-1978	1 Set
(xvii)	Bitumen laboratory mixer planetary action, 2 litre capacity, including required accessories electrically operated and fitted with heating jacket	1 No.
(xviii)	Dial type thermometer reading 0-200° C range, accuracy 2°C	2 Nos.
(xix)	Pensky – Martens closed Tester for testing flash and fire point as per IS : 1209 – 1978	1 Set
(xx)	Apparatus for Determination of water content (Dean and Stark Method) IS : 1211-1978	1 Set
(xxi)	Viscosity Meter	1 No

For cement and cement concrete

(i)	Vicat apparatus for testing setting times with plungers as per IS- 269-1968	1 set
(ii)	Soundness testing apparatus for cement (Le Chatelier's principle)	1 Set
(iii)	Slump testing apparatus as per IS:1199	4 sets
(iv)	Apparatus for Chemical Composition tests as per IS 8112-1989 & IS 12269	1 set
(v)	Chemicals solutions and consumables	As reqd.
(vi)	Chloride testing kit for chemical analysis of chloride content	1 No.

(vii)	ION exchange kit for rapid determination of sulphate content	1 No.
(viii)	Water still	1 No.
(ix)	Concrete permeability apparatus	1 Set
(x)	Compression and Flexural strength testing machine of 200tonne capacity with additional dial for flexural testing and adequate numbers of 15cm cube moulds, 15cm X 15cm X75cm beam moulds, compacting hammer and other necessary accessories. As per IS 456	1 No.
(xi)	Needle Vibrator	2 Nos.
(xii)	Vibrating hammer for vibrating dry mix as for Dry Lean Cement concrete sub-base	1 No.
(xiii)	15 x 15 x15 cmsMoulds for testing CC cubes	30 Nos.
(xiv)	7 x 7 x 7 cmsMoulds to tests Cement Mortar	10 Nos.
(xv)	Apparatus of Determination of Specific gravity as perIS:8112-1989	1 No.

Note: The item and their numbers listed above in this Clause shall be decided by the Engineer as per requirements of the Project and modified accordingly.

120.2.3 Equipment for Control of Profile and Surface evenness

120.2.3. For control of Profile and Surface evenness

(i)	String line arrangement for paving with sensor pavers	1 No.
(ii)	Z-250 profilometer or MERLIN for Calibrating Bump Integrator	1 No.
(iii)	Towed Fifth Wheel Bump Integrator or Equivalent	1 No.
(iv)	Camber templates 2-lane/3-lane straight run cross-section as approved by the Engineer	4 Sets.
(v)	Theodolite/Auto level for checking levels on completed pavement layers	As reqd

B2.2.11.2 Add new sub clause 120.2.4 as follows

120.2.4 Mobile Laboratory:

In addition to the field laboratory, the Contractor shall also provide a mobile laboratory should there be a requirement or should he choose to work in two separate Sections of the Works. The mobile laboratory shall be suitably equipped for conducting all necessary field quality control testing.

B2.2.11.3 Addthe following as new Sub Clause 120.6

There shall not be separate payment with respect to costs associated with the setting up, operation and maintenance of the laboratory. The Contractor shall allow in his rates and prices for the setting up of the field laboratory including the land, building, utility services & connections, fittings, fixtures, furniture, laboratory equipment,

external works, security fences, and all ancillary items; and operation and maintenance of the laboratory including utility services charges, consumables, security, and all ancillary items.

B2.2.12 CLAUSE 122 PLANTING OF TREE SAPLINGS AND SHRUBS

Add new clause 122 Planting of Tree Saplings and Shrubs

122.1 Scope

The work shall consist of providing, planting, protecting and maintaining roadside tree saplings and shrubs, all as described in these specifications.

122.2 Materials

122.2.1 Compost: shall be of well-decayed vegetable matter obtained in the dry state from sources approved by the Engineer. The compost shall be free from earth, stone, brickbats or other extraneous material and shall all pass a 16mm sieve before use.

122.2.2 Farmyard Manure: shall be well-decayed animal waste, free from earth, stone, brickbats or other extraneous material.

122.2.3 Oil Cake (Neam, Castor or Groundnut): shall be the residue after the extraction of oil and shall be free of other extraneous material.

122.2.4 Topsoil or agricultural soil: shall be organic soil of loamy texture free from kanaka, moorum, shingle, or other extraneous material and from clods or lumps of sizes bigger than 75mm. It shall have a pH value ranging between 6 to 8.5.

122.2.5 Tree Saplings: shall be at least three year old and shall consist of hardy indigenous tree species. Details of tree saplings proposed for use (species and proportion) shall be submitted to the Engineer for approval.

122.2.6 Shrubs: shall be local indigenous species suitable for hedge formation. Details of shrubs proposed for use (species and proportion) shall be submitted to the Engineer for approval.

122.2.7 Tree guards: shall be made of mild steel and shall be 500mm inside diameter, made up as follows:

- (i) Uprights, 3 No., 2.0m long with an additional 5cm foot at one end at right angles, forming an L shape. To be made with 25x25x3mm angle section.
- (ii) Framing rings, 3 No., 500mm inside diameter, in two sections, which can be bolted together (to allow future removal). To be made from 25x5mm flat section and suitable bolts and nuts.
- (iii) Vertical bars, 15 No., 1.55m long by 6mm diameter.

The three uprights shall be equally spaced round the circumference, with the feet facing outwards, and shall be held in place by welding them inside the three framing

rings, the rings being at heights of 700mm, 1200mm and 1700mm respectively above the feet of the uprights. The vertical bars shall also be welded to the inside of the rings, equally spaced around their circumference, with the top of each bar level with the top of the uprights. The entire tree guard shall be given two coats of paint over a prime coat, using paint of a brand and shade approved by the Engineer.

122.3 Planting Tree Saplings

Planting of tree saplings shall only commence, with the agreement of the Engineer, when the weather conditions are suitable and disturbance by other construction activities is unlikely to occur. Tree saplings shall be planted, wherever possible, in a line on both sides of the road, at an average rate of 100 trees per km. Where there are roadside ditches the tree line shall be located beyond the ditches. The exact position of the tree line at each location shall be agreed with the Engineer and the proposed position of individual trees staked out and approved. For each tree sapling a hole 600mm diameter and 450mm deep shall be excavated. Any stones, roots and foreign matter in the excavated material shall be removed and disposed of and the rest saved for reuse after breaking up any clods greater than 75mm diameter. Topsoil or agricultural soil, in quantities required to replace discarded material, shall be brought and stacked at site by the Contractor.

In the bottom of each hole a 1:1 mixture of farmyard manure and oil cake shall be placed in a layer 50mm thick. The tree sapling shall be held in the center of the hole with the root bulb touching the bottom layer and the hole loosely back-filled around the sapling to about half the remaining depth of the hole. The backfill shall consist of the excavated soil plus added topsoil if required, first mixed with compost in the ratio of 10:1 by loose volume. A tree guard shall then be carefully lowered over the sapling into the hole and forced down into the loose backfill until it is firmly seated. The rest of the hole shall then be backfilled and the backfill copiously watered to cause it to settle and bed down. The final level of the backfill shall be between 50mm and 75mm below ground level.

122.4 Planting Shrubs

Planting of shrubs shall only commence, with the agreement of the Engineer, when weather conditions are suitable, disturbance by other construction activities is unlikely to occur and work on the new tree line has been completed. Where there is sufficient space within the Road Reserve behind the tree line a band of shrubs shall be planted at the rate of approximately 800 shrubs per km in order to eventually form a hedge to discourage intrusion into the road reserve. The position and layout of the band of shrubs shall be agreed with the Engineer. Shrub planting will be done in excavated holes of size appropriate to the type of shrub and the holes firmly back filled with excavated soil from which all stones, roots and foreign matter has been removed.

122.5 Maintenance

Trees saplings and shrubs shall be maintained until a Taking-Over Certificate has been issued by the Client for the section of road concerned. Maintenance shall

include watering and weeding as and when necessary, protection, damage repair and replacement of all defective saplings and shrubs with others of similar species and age, all as instructed by the Engineer. Saplings and shrubs that become defective during the Defects Liability period shall be replaced by the Contractor.

122.6 Measurements

Planting of trees and shrubs shall be measured by number.

122.7 Rate

The rate shall include the cost of all labour and materials involved in all the operations described above including the cost of maintenance and replacement.

B2.2.13 CLAUSE 123 AS-BUILT DRAWINGS

Add new clause 128 As-Built Drawings

The Contractor shall prepare and submit to the Engineer “As-Built” drawings of the Construction Works covering every component, upon completion. The “as-built” drawings shall be prepared in A2 size. 2 sets of A2 size bound hardcopies on polyester film of quality to be approved by the Engineer and 1 set of electronic files on CD shall be submitted to the Engineer. Where the Construction Works is in Sections, “As-Built” drawings shall be submitted for each Section as the Construction Works are completed for that Section. All costs associated with the preparation and submission of “As-Built” drawings including the production of the stipulated number of sets of hardcopies and electronic files shall be deemed to be included in the rates and prices of items quoted by the Contractor in the Bill of Quantities.

B2.3 SECTION 200 SITE CLEARANCES.

B2.3.1 CLAUSE 201 CLEARING AND GRUBBING

B2.3.1.1 Sub Clause 201.1 Delete all Paragraphs in Sub-Clause 201.1 and add the following Paragraph.

This work shall consist of cutting, removing and disposing of all materials such as trees of girth up to 300mm, bushes, shrubs, stumps, roots, grass, weeds, top soil (all types of soils) not exceeding 150mm 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, berms, drains, cross-drainage structures, junctions, bus bays, truck parking areas and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation by harrow discs or any other suitable equipment, back filling the excavated area up to a maximum depth of 150mm and also complete backfilling of pits resulting from uprooting of trees and stumps by suitable/approved soil and making the surface in proper grade by suitable equipment and compacted by power roller to required compaction as per Section 300, handling, salvaging, and disposal of cleared soil / materials. The work also includes keeping the cleared material in stock pile within

the ROW not less than 500m in distance, keeping the stock pile till completion of bituminous work, re-using the top soil in turfing and disposal of unsuitable material.

Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these specifications. Areas as well as depth requiring clearing and grubbing shall be determined by the Engineer. The Contractor shall ensure free flow of surface water / run-off in to the drains by way of clearing the topsoil between earthen shoulder edge / embankment edge and inner edge of the drain.

If the topsoil is more than 150 mm in thickness and not exceeding 500 mm, then the additional thickness shall be graded off / removed to the required slope or as directed by the engineer and the cost for the additional cut is to be considered as incidental to the Clearing and Grubbing work. **Clearing and grubbing work shall be considered incidental in Road way excavation and drains and shall not be measured and shall be deemed to have been included in the rates quoted for the earth work excavation.**

B2.3.1.2 Sub Clause 201.3 Delete 3rd Paragraph in Sub-Clause 201.3 and add the following

All Excavations below original ground level arising out of the clearing and grubbing and also for removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface fit for the next layers in accordance with the section 300 of Specifications

B2.3.1.3 Sub Clause 201.5 Delete 1st sentence in the 1st Paragraph in Sub-Clause 201.5 and add the following sentence.

Clearing and grubbing for road embankment, drains and cross drainage structures shall be measured as areas in plan basis in terms of hectares

Delete Last sentence in the 1st Paragraph in Sub-Clause 201.5 and add the following sentence

Cutting including removal of foundations of sign boards, hoarding boards, concrete posts, kilometer / hectometer stones, boundary stones, back filling to required compaction up to general original ground level and of any pits shall be measured and paid in respective item of BOQ

B2.3.1.4 Sub Clause 201.6 Delete second sentence in the in Sub-Clause 201.6.1 and add the following sentence.

These will also include removal of stumps of trees less than 300 mm in girth as well as stumps of any girth size left over after cutting of trees carried out by another agency either before execution or during execution, excavation and back filling to required density, where necessary and handling, salvaging, piling and disposing of the cleared materials with all lifts up to a lead of 1000 m.

**B2.3.2 CLAUSE 202 DISMANTLING CULVERTS, BRIDGES AND
OTHERSTRUCTURES/PAVEMENTS**

B2.3.2.1 Sub Clause 202.3 Dismantling of Pavement – Add at the end of 2nd paragraph as follows”

“The existing bituminous pavement surface, base and sub-base courses shall beremoved by ripping, pavement breaker or any other suitable equipment, or any othersuitable means as approved by the Engineer.

Dismantling of existing base, sub-base and surface courses shall be measured bytaking cross-sections at 200 m intervals before dismantling by making 30 cm widetrench in full width and depth and computing the volumes in cum by the method ofaverage cross-sectional areas”.

B2.3.2.2 Sub Clause 202.4 Delete the Sub Clause 202.4 and add the following202.4 back Filling

Holes and depressions caused by dismantling operations encountered in thealignment shall be backfilled with Granular material/**Sand** and compacted torequired density as directed by the Engineer

B2.4 SECTION 300 EARTHWORK, EROSION CONTROL ANDDRAINAGE

B2.4.1 CLAUSE 301 EXCAVATION FOR ROADWAY AND DRAINS

B2.4.1.1 Sub Clause 301.1 Scope

Insert the following between the words “roadway” and “side drains” in the secondline: “road shoulders/paved shoulders, junctions, busbays, truck parkings”

B2.4.1.2 Sub Clause 301.2 Delete sentence (d) and add the following

(d) Hard Rock (requiring controlled blasting)

Hard rock requiring blasting as described under (c) but where blasting woulddamage abutting structures like building, bridge foundations, etc. and excavationhas to be carried out by controlled blasting without causing any detrimental damageto nearby structures and in accordance with Additional Technical SpecificationsA-4. The excavated material shall be stacked with all leads and lifts to the placeshown and as directed by the Engineer and shall be handed over to the Authoritiesas directed by the Engineer.

B2.4.1.3 Sub Clause 301.3 Delete Sub-clause 301.3.7 and add the following

301.3.7 In works involving widening of existing pavements or providing pavedshoulders, the existing paved shoulders/hard shoulder/earthenshoulders/verge/median shall be removed to required width and to levels as shownon drawings or as indicated by the Engineer, preparation of cut

formation as per clause 305 supporting subgrade/embankment. Method of benching shall be followed with each successive top layer of existing pavement crust cut at least 250 mm wider than the bottom layer. 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 side vertical and the disturbed/loosened portion be removed completely and re-laid as directed by the Engineer, at the cost of the Contractor.

Existing material to a depth of 500mm or more below the bottom of the sub base shall be checked for the following criteria in order to retain the same material as sub grade below the sub base layer

1. 4 day soaked CBR in compliance with specification shall not be less than the design CBR as stipulated in drawings
2. The relative density of the existing subgrade material shall comply with the specified density requirement as given in Table 300-2 of MoRT&H specifications

If the existing material having 4 day soaked CBR value more or equal to design CBR value and does not comply with the density requirement, then the same shall be loosened to a depth of 500mm and compacted in layers in accordance with the requirements Clause of 305 Any unsuitable material encountered in this portion of subgrade shall be removed and replaced with suitable material and compacted in accordance with Clause 305.

B2.4.1.4 Sub-clause 301.3.11 add the following paragraph after the 1st paragraph

All Environmentally hazardous material viz. dismantled/scarified existing bituminous layers and existing road base material mixed with bituminous layer obtained due to excavation shall be disposed by environmentally acceptable practice in accordance with the Implementation of Environmental Management Plan as per contract.

Unsuitable and surplus material, which, in the opinion of the Engineer cannot be used in the works, shall be removed from site by the Contractor and disposed of at the nearest dip or other approved location with all lifts and leads in accordance with contract Provisions.

B2.4.1.5 Sub Clause 301.6 Preparation of Cut Formation

B2.4.2 CLAUSE 304 EXCAVATION FOR STRUCTURES

B2.4.2.1 Sub Clause 304.3 Delete the words “or cut slopes to a safer angle or both” from 5th line of the 1st paragraph in Sub-clause 304.3.2 and add the following paragraph at the end

As the existing open foundations are close by, no cut slopes will be permitted for the excavation of the new foundation trenches. **The length and width of excavation for open foundations shall be as per the detailed drawings issued for construction any additional width and length shall be deemed as incidental.** In case where new foundations are not joined with the existing foundations cofferdams to the sufficient depth shall be driven around the new foundation and the excavation shall proceed.

Delete the words “Lean Concrete (1:3:6 nominal mix)” in paragraphs 2 and 3 in Sub-clause 304.3.4 and Substitute with the following words in place of the above “Concrete M15 Grade”

B2.4.3 CLAUSE 305 EMBANKMENT CONSTRUCTION

B2.4.3.1 Sub Clause 305.1 add for construction of roadway, junctions, Bus Bays and Truck Parking at the end of first sentence in Sub Clause 305.1.1.

B2.4.3.2 Sub Clause 305.2 Delete sentence (e) in Sub-clause 305.2.1.1 and add the following sentence

(e) Clayey soils and other soils having liquid limit exceeding 40 and plasticity index exceeding 18;

B2.4.3.3 Delete the Sub-clause 305.2.1.2 and add the following Sub Clause

305.2.1.2 Expansive soils such as CH, MH or OH 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 in construction of any subgrade or embankment

B2.4.3.4 Delete the Sub-clause 305.2.1.4 and add the following Sub Clause

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 subgrade. The maximum particle, size shall not be more than two-thirds of the compacted layer thickness. **The material to be used in Subgrade should satisfy the requirement of 4 day soaked design CBR of 7%, when tested as per IS:2720 (Part 16) at 97% maximum dry density (IS: 2720 (Part 8)-1983)**

B2.4.3.5 Sub Clause 305.2.1.5 Delete the table 300.1 below 305.2.1.5 and add the following table

Sl. No.	Type of Work	Engineering Properties of sample remoulded as per IS 2720 (Part 8)
		Max dry density (gm/cc)
1.	Embankment upto 3 meters height, not subjected to extensive flooding	Not less than 1.65
2.	Embankment exceeding 3 meters	Not less than 1.75

	height or embankments of any height subject to long periods of inundation.	
3.	Subgrade and earthen shoulders/verge/backfill	Not less than 1.85

Replace the note (2) below the Table 300-1 by the following.

The material to be used in the Subgrade shall have a 4-day soaked CBR as specified, when compacted to the density requirements of Table 300-2, not less than the design CBR stipulated in the drawings.

B2.4.3.6 Clause 305.2.2.2 BORROW MATERIALS

Replace the Para 1 of this Clause by the following:

“No borrow area shall be made available by the Employer for this work. The arrangements for the source of supply of the material for embankment and subgrade as well as compliance to the different environmental requirements in respect of excavation and borrow area as stipulated, from time, by the Ministry of Environmental and Forest Government of India and the local bodies, as applicable shall be the sole responsibility of the Contractor”.

B2.4.3.7 Delete last sentence” It shall be ensured that the subgrade material design CBR value of the subgrade” in 1st paragraph (page-66) in Subclause 305.2.2.4 and add the following sentence

“When compacted to the density requirements of Table 300-2, the material used for the construction of the Subgrade and shoulder fill shall have a 4-day soaked CBR as specified, not less than the design CBR stipulated in the drawings.

B2.4.3.8 Sub Clause 305.3 Delete the 1st paragraph in Sub-clause 305.3.4 and add the following paragraph

305.3.4. Compacting ground supporting embankment/subgrade: Where necessary the original ground shall be levelled, scarified, mixed with water and then compacted by rolling to facilitate placement of first layer of embankment so as to achieve minimum dry density as given in Table 300-2.

B2.4.3.9 Add the following paragraph at the end of 2nd Paragraph in Sub Clause 305.3.4

Backfilling layers in pits, trenches and below the original ground are to be compacted to the relative natural ground density. The natural ground density shall be determined by conducting field density tests at three widely spaced locations along the central line of the proposed carriageway at a depth in between 0.5m to 1.0m. Samples of natural ground are collected at each location, and are tested in accordance with IS: 2720 (Part 8). The relative density (i.e. the percentage of the field dry density to the laboratory maximum dry density) is assessed for each sample, and the greatest relative density obtained is selected as the “natural ground

density”. If the natural ground density is less than 85% then these are to be compacted after necessary watering so as to achieve not less than 85% of relative compaction”.

Where necessary to facilitate compaction of the subgrade to 97% relative compaction as stated above, a further depth of maximum thickness of 0.2m shall be loosened, watered and compacted in accordance with Sub Clause 305.3.5 and 305.3.6 to not less than 95% of dry density determined in accordance with IS: 2720(Part-I).

B2.4.3.10 Sub Clause 305.3.6 Delete the first sentence of second paragraph under Sub-clause 305.3.6 and add the following paragraph

Vibratory roller of not less than 8-10 tonne static weight with plain or pad foot drum or pneumatic tyre roller of 15-30 tonne weight having tyre pressure of at least 7 kg/sq.cm shall be used for compaction.

B2.4.3.11 Sub Clause 305.4.3 Delete Sub-clause 305.4.3 and add the following paragraph

305.4.3 Earthwork over existing road surface

Where the embankment/ subgrade 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 500 mm of the top of new subgrade, the existing surface shall be scarified to a depth of 50 mm, or more if specified, so as to provide ample bond between the old and new material. After scarification, the ground shall be prepared in accordance with Sub-Clause 305.3.4.

(ii) If the existing road surface is of granular or bituminous type and lies more than 500mm below the top of new subgrade, the existing surface shall be permitted to stay in place without any modification.

(iii) If the existing road surface is of cement concrete type and lies within 1 m of the top of new subgrade, the same shall be removed completely.

B2.4.3.12 Sub Clause 305.5 Delete the entire paragraph in Sub-clause 305.5 and add the following paragraph

305.5 Plying of Traffic

No vehicular traffic of any kind shall be permitted to use the prepared surface of the embankment and/or subgrade except the construction equipment/machinery and trucks/dumpers carrying the materials, required for the next layer of construction.

B2.4.3.13 Sub Clause 305.7 Subgrade Strength Delete Sub Clause 305.7.1 and replace with the following paragraph

It shall be ensured prior to actual execution that the borrow material or material brought from road way excavation to be used in sub-grade has a CBR not less than

the design CBR specified in the Drawings when tested on specimens compacted at 97% MDD and soaked in water for 4 days.

B2.4.3.14 Sub Clause 305.8.1 Delete the contents in Sub-clause 305.8.1 and add the following paragraph

Earth embankment/sub-grade construction shall be measured separately by taking cross sections at intervals after clearing and grubbing and if necessary compaction of original ground before the embankment work starts and after its completion and computing the volumes of earthwork in cubic metres by the method of average end areas basis

B2.4.3.15 Sub Clause 306.4 Add the following paragraph at the end in Sub-clause 306.4

However, all temporary sedimentation and pollution control works shall be deemed as incidental to the earthwork and other items of work and, as such, no separate payment shall be made for the same

B2.4.4 CLAUSE 315 LINED SIDE DRAINS

B2.4.4.1 Add the following as new Clause 315

Lined side drains shall be constructed true to the drawings

B2.5 SECTION 400 SUB-BASES, BASES (NON-BITUMINOUS) AND SHOULDERS

B2.5.1 CLAUSE 401 GRANULAR SUB-BASE

B2.5.1.1 Sub Clause 401.1 Delete the Sub-Clause 401.1 and add the following Sub Clause

401.1. Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade along the roadway and also at locations of junctions, busbays and truck parking areas in accordance with the requirements of the Specifications. The material shall be laid in one or more layers as granular sub-base. The GSB layer shall be extended upto the proposed road embankment side slopes. The granular sub-base material shall be prepared in a mechanical mixing plant and laid in uniform layers with mechanical paver or motor grader, and compacted with vibratory power rollers to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

B2.5.1.2 Sub Clause 401.3 Add the following paragraphs at the end of the 1st paragraph of Sub-Clause 401.3.1: Preparation of Subgrade

Where the existing pavement is to be overlaid by a granular base/ sub-base and embankment (i.e. new subgrade depth) of less than 500 mm total thickness then the pavement shall be scarified in accordance with Sub Clause 501.8.3.2. Where the existing pavement contains multiple bituminous layers the scarification shall be to the underside of the lowest bituminous layer. The Contractor will verify that all

bituminous layers have been removed using appropriate methods approved by the Engineer. The bituminous surfacing material removed from the existing pavement may be used in other parts of the works as directed by Engineer provided it complies with the relevant specification clauses.

After scarification and removal to the satisfaction of the Engineer of the bitumen surface from the existing pavement to be overlaid, the surface shall be lightly sprinkled with water if necessary and rolled with three passes of an 8-10 Ton smooth wheeled roller. The existing pavement shall then be proof rolled with a 8 tonne single drum vibrating roller in the presence of the Engineer who shall determine of the surface for overlay.

B2.5.1.3 Sub Clause 401.5 Add the following sentence at the end of the Sub-Clause 401.5

No vehicular traffic of any kind shall be permitted to use the finished surface of the Granular Sub-Base except the construction equipment/machinery and trucks/dumpers carrying the materials, required for the next layer of construction.

B2.5.2 CLAUSE 406 WET MIX MACADAM SUB-BASE/BASE

B2.5.2.1 Sub Clause 406.1 Delete the Sub-Clause 406.1 and add the following Sub Clause 406.1. Scope

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared subgrade/sub-base/base or existing pavement as the case may be in accordance with the requirements of these Specifications along the roadway, at junctions, busbay locations and truck parking areas. The material shall be laid by paver finisher in two uniform layers as necessary to lines, grades and cross-sections shown on the approved drawings 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 increased up to 150 mm upon approval of the Engineer.

B2.5.2.2 Sub Clause 406.2 Under Sub-Clause 406.2.1.1 Physical requirements

Delete 2nd Sentence in 1st Paragraph in the Sub Clause 406.2.1.1 and replace with the following Sentence

The constituents of the aggregates shall be produced by a multiple stage crushing and screening plant (Impact or Cone type of Crusher) and, unless otherwise instructed by the Engineer, crushing shall be carried out in at least two stages. The fraction of material passing through 4.75mm sieve shall be crusher run screening only.

B2.5.2.3 Add the following Paragraph at the end of 1st Paragraph in the Sub Clause 406.2.1.1

Soundness test shall be carried out in accordance with IS: 2386 (Part- 5), 1963. The average loss of weight of coarse aggregate after 5 cycles shall not exceed 12% when tested with sodium sulphate and 18% when tested with magnesium sulphate as specified in IS: 383-1970

B2.5.2.4 Sub-Clause 406.2.1.2 Delete the sentence below table 400-13 “Materials finer than” and add the following in place of the deleted sentence

Materials passing 425 micron sieve when tested according to IS: 2720 (part-5) shall have Plasticity Index ZERO (i.e. NON-PLASTIC).

B2.5.2.5 Delete the words” IS 2386 (part-1)” in Table 400 – 13, under the column head “Test Method”, in the row numbered as 2. Combined Flakiness and Elongation Index (Total)

B2.5.2.6 Add the words” IS 2386 (part – 1) – 1963 as amended in 1991” in place of the above deleted word.

B2.5.2.7 Sub Clause 406.3 Delete the 1st sentence of 2nd paragraph in Sub-Clause 406.3.4 and add the following in place of the deleted sentence.

The mix shall be laid by paver finisher. Motor graders shall be used, subject to the approval of the Engineer, in work operations for remedying high and low spots.

B2.5.2.8 Sub Clause 406.3 Delete the 1st Paragraph in Sub-Clause 406.3.5 and add the following Paragraph

406.3.5. Compaction: After the mix has been laid to the required thickness, grade and cross fall/camber the same shall be uniformly compacted to the full depth with suitable roller. For a compacted single layer of up to 150 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.

B2.5.2.9 Sub Clause 406.3 Delete 7th paragraph of Sub Clause 406.3.5. and add the following

Rolling shall be continued till the density achieved over the full thickness of the material laid is at least 98% of the maximum dry density as determined by the method outlined in IS:2720 (part 8) and satisfies the requirements of Sub Clause 903.3.

B2.5.2.10 Sub Clause 406.4 Delete all Paragraphs in Sub-Clause 406.4 and add the following Paragraph

406.4. Opening to Traffic

No vehicular traffic of any kind shall be permitted to use the finished surface of the Wet Mix Macadam except the construction equipment/machinery and trucks/dumpers carrying the materials, required for the next layer of construction.

B2.6 SECTION 500 BASE AND SURFACE COURSES (BITUMINOUS)

B2.6.1 CLAUSE 501 GENERAL REQUIREMENTS FOR BITUMINOUS PAVEMENT LAYERS

B2.6.1.1 Sub Clause 501.2 Delete the 1st Paragraph in Clause 501.2.2 and add the following in place of above

501.2.2. Coarse Aggregates: The coarse aggregates shall consist of crushed rock and shall be obtained through the use of cone crusher, vertical shaft impactor and vibratory screens of suitable capacity. They shall be clean, hard, and durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious matter. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents, as per the manufacturer's recommendations, without additional payment. Before approval of the source the aggregates shall be tested for stripping.

B2.6.1.2 Sub Clause 501.3 Para 1, Line 1, replace the word, "Adequate Capacity" with "Hot mix plant of Batch Mix type of minimum capacity of 100 T per hour."

B2.6.1.3 Sub Clause 501.6 Delete the last two sentences in 2nd Paragraph in Clause 501.6 and add the following in place of above

The intermediate rolling shall be done with a smooth wheeled tandem vibratory roller of 8-10 tonne weight followed by a pneumatic tyred roller of 12-15 tonnes weight having nine wheels, with a tyre pressure of at least 5.6 kg /sq. cm. The finish rolling shall be done with 8 -10 tonnes smooth wheeled tandem rollers

B2.6.1.4 Delete the last two sentences in last Paragraph in Clause 501.6 and add the following in place of above

Only minimum required moisture to prevent adhesion between the wheels of rollers and the bituminous mix should be used. Surplus water shall not be allowed to fall on the bituminous layer during rolling on the partially compacted pavement layer.

B2.6.1.5 Sub Clause 501.6 Add the following paragraph at the end of the Clause 501.6

First set of rolling operations or the break down rolling using heavy rollers should be started as soon as possible after the paver has laid sufficient length of the bituminous mix and the mix has just cooled enough to prevent formation of waves during the rolling operation. After the break down rolling, the intermediate rolling operations may be carried out using vibratory rollers or pneumatic tyred rollers, or both. The final rolling and finishing may be carried out using smooth wheeled tandem roller,

until the roller marks are not formed. Final rolling should be completed before the temperature of the bituminous mixes fall below 100⁰C.

B2.6.2 CLAUSE 502 PRIME COAT OVER GRANULAR BASE

B2.6.2.1 Sub Clause 502.2 Delete all the Paragraphs and Sub-Clauses in Clause 502.2 and add the following in place of above

502.2 Materials

502.2.1 Primer: The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified below:

- (i) Surfaces of low porosity
- (ii) Surfaces of medium porosity; such as wet mix macadam, water bound macadam and cement stabilised soil base,
- (iii) Surfaces of high porosity; such as a gravel base.

502.2.2 Primer viscosity: The type and viscosity of the primer shall comply with the requirements of IS: 8887, as sampled and tested for bituminous primer in accordance with these standards. Guidance on viscosity and rate of spray is given in Table 500-3.

B2.6.2.2 502.2.3 Choice of primer: The primer shall be bitumen emulsion, complying with IS: 8887 of a type and grade CSS-1 or as directed by the Engineer. The use of medium curing cutback MC-70 as per IS 217 shall be restricted only for emergency applications as directed by the Engineer.

B2.6.2.3 502.2.4.5 Tack Coat: Over the primed base course layer, tack coat shall be applied, if required, only as per the instructions of the Engineer.

B2.6.2.4 Sub Clause 502.8 Rate

B2.6.3 CLAUSE 503 TACK COAT

B2.6.3.1 Sub Clause 503.4 Delete all Paragraphs in Sub-Clause 503.4.1 and add the following in place of above

503.4.1 Equipment: The tack coat distributor shall be a self-propelled or towed bitumen pressure sprayer, equipped for heating and spraying the material uniformly at the specified temperature and rate of spread. Hand spraying of small areas, inaccessible to the distributor, or in narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

B2.6.3.2 Sub Clause 503.4.3 and add the following

Where the material to receive an overlay is a freshly laid bituminous layer that has not been subjected to traffic or contaminated by dust, tack coat is not mandatory where the overlay is completed within two days and shall be as directed by the Engineer.

The tack coat laying work should be planned in such a manner that not more than the required tack coat for the day's operation only should be placed on the surface.

B2.6.4 CLAUSE 505 DENSE GRADED BITUMINOUS MACADAM

B2.6.4.1 Sub Clause 505.1 Delete the entire paragraph and add the following paragraph.

Sub Clause 505.1.Scope

This clause specifies the construction of Dense Graded Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. DBM is also intended for use as road base material. This work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base along the entire length of the road including junctions, bus bays and truck parking areas. The thickness of a single layer shall be 50mm to 100mm.

B2.6.4.2 Sub Clause 505.2 Delete the Sub Clause 505.2.1 and add the following paragraph.

505.2.1 Bitumen: The bitumen shall be paving bitumen of Viscosity Grade complying with Indian Standard Specification for Paving bitumen, IS: 73-2006, and of the Viscosity Grade indicated in Table 500-10 or as decided by the Engineer appropriate to the region, traffic, rainfall and other environmental conditions. Guidelines for selection of bitumen are given in Table A4-1 and Table A4-2 in the amended Appendix – 4 to the MORT&H Specifications.

B2.6.4.3 Delete the words “crushed gravel or other hard material” from the 1st paragraph of the Sub Clause 505.2.2

B2.6.4.4 Delete 2nd Paragraph from Sub Clause 505.2.2

B2.6.4.5 Sub Clause 505.2 Delete the entire paragraphs in Sub-Clause 505.2.4 and add the following paragraph.

505.2.4 Filler: Filler shall consist of finely divided mineral matter such as hydrated lime or Portland cement. At least 2.0% by weight of total mineral aggregates in the mix shall be hydrated lime or Portland cement as approved by the Engineer. The filler shall be free from organic impurities and shall be **non-plastic**. Hydrated lime or Portland cement is not required when the aggregate consists of limestone. The lime or cement used as filler material should be in finely powdered form with 100% passing 0.6mm sieve, 95 to 100% passing 0.3mm sieve and 85 to 100% passing 0.075mm sieve.

Where the aggregates fail to meet the requirements of the water sensitivity test in table 500-8, then 2% by total weight of aggregate, of hydrated lime shall be added without additional cost.

B2.6.4.6 Following changes are to be made to the Sub-Clause 505.2.5

- i) In the gradation **Table 500-10**, the percent weight of aggregates passing 0.075mm sieve for Grading 1 and 2 may be modified as 4 – 8% (instead of 2 – 8%).
- ii) A minimum of 2% by weight of total aggregate shall be filler material consisting of hydrated lime or Portland cement.

B2.6.4.6A Sub Clause 505.2.5.In **Table 500-10**, the Bitumen grade shall be read as VG-30.

B2.6.4.7 Sub-Clause 505.3.5Delete the last sentence in the second paragraph and add

The density achieved in the field trial as well as during normal compaction in the field shall not be less than 99 percent of laboratory Marshall specimen, compacted with 75 blows on each side.

B2.6.5 CLAUSE 507 BITUMINOUS CONCRETE (BC)

B2.6.5.1 Sub Clause 507.1 Delete the entire paragraph and add **the following paragraph.**

This clause specifies the construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single or multiple layers of bituminous concrete on a previously prepared bituminous bound surface along the entire length of the road including junctions, bus bays and truck parking areas.

B2.6.5.2 Sub Clause 507.2 Delete the **Sub Clause 507.2.1** and add **the following SubClause 507.2.1**

507.2.1 Bitumen: The Polymer Modified Bitumen (PMB -40) shall be paving bitumen of as per IS 15462: 2004 and product application as per IRC SP 53:2002 for Paving bitumen, IS: 73-2006, and of the Viscosity Grade and design mix indicated in Table 500-17 or as decided by the Engineer appropriate to the region, traffic, rainfall and other environmental conditions.

Specification / Property	PMB 40
Softening Point, ⁰ C (min)	60
Penetration at 25 ⁰ C	30-50
Elastic Recovery of half thread, % (min)	70
Separation, Difference in softening point, ⁰ C (Max)	3

Usage	Viscosity (poise)	Temperature range, ⁰ C
Binder at mixing	Max 2	165 – 185
Mix at mixing plant	Max 4	140 – 160
Mix at laying site	Max 5	130 – 150

B2.7. CLAUSE 801 TRAFFIC SIGNS

B2.8 CLAUSE 802 OVERHEAD SIGNS

B2.9. CLAUSE 803 ROAD MARKINGS

B2.9.1. Sub Clause 803.2 Delete the entire Sub-Clause 803.2 and add the following Sub Clause

803.2. Materials

Road markings shall be of hot applied thermoplastic compound, or reflectorized paint as specified in the item and the material shall meet the requirements as specified below.

B2.9.2 Sub Clause 803.3 Delete the entire Sub-Clause 803.3

B2.9.3 Sub Clause 803.6 Delete the Sub-Clause 803.6.1 and add the following Sub Clause

803.6.1. The road marking shall be done with the appropriate road-marking machine as approved by the Engineer. 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.

B2.9.5 CLAUSE 804 RAISED REFLECTIVE PAVEMENT MARKERS (RPM)

B2.9.5.1 Sub Clause 804.2.2 At the end of Sub Clause 804.2.2 add the following
Reflective panels are electronically welded to the plastic body.

The marker body shall be produced in neutral white or yellow colour. The colour of the retro reflective element shall be as specified in the drawing.

Sub Clause 804.3 Delete the entire content in **Sub Clause 804.3** and add the following

The height, width and length shall be as indicated in the drawing or as directed by the Engineer and in no case should not exceed 20mm, 130mm and 105mm respectively. The slope of retro-reflecting surface shall preferably be within the limit of 35+/-5 degree to base.

The area of retro-reflecting surface shall not be less than 13.0 sqcm.

Sub Clause 804.4 Optical Performance

Sub Clause 804.4.1 Unidirectional and bi-directional studs

B2.9.6 CLAUSE 811 CRASH BARRIER

B2.9.6.1 Sub Clause 811.1

Delete **the entire** Sub Clause 811.1 **and add the following**
Sub Clause 811.1 This work shall consist of construction, provision and installation of concrete crash barrier at the edges of bridges of dimensions as shown in drawings or as directed by the Engineer.

B2.9.6.2 Sub Clause 811.2 CONCRETE CRASH BARRIER

Sub Clause 811.2.1.1Delete **the entire** Sub-Clause 811.2.1.1**and add the following**
Sub Clause 811.2.1.1Concrete barriers shall be constructed with M-40 grade concrete and with TMT bars satisfying requirements of High Yield Strength Deformed Bars (Grade designation S 500) conforming to IS: 1786.

B2.9.6.3 Sub Clause 811.3 METAL BEAM CRASH BARRIER

B2.9.6.3.1 Sub Clause 811.3.1Delete **the entire** Sub-Clause 811.3.1.1**and add the following****Sub Clause**

811.3.1.1Metal beam is a “W” profiled corrugated beam as specified in drawingsmade from cold rolled steel strip of 3.0 mm thick using high strength steel of IS:5986 Fe 510 grade and have properties as under:
Ultimate Tensile Strength (Min.): 483 Mpa.
Yield stress (Min.): 345 Mpa.
Elongation (Min.) in 50mm: 12%

The beam after forming shall have formed width of 330 mm and depth of 83 mm and shall have punched holes for fixing as specified in drawings. The metal beam crash barrier will be provided with trapezoidal reflectors at regular intervals.

The metal crash barrier post is made from cold rolled steel channel of 5 mm thickness and of steel conforming to IS: 5986 grade Fe.360 as specified in drawings.

The spacer is made of cold rolled steel channel with cross section and material same as that of post.

All bolt nuts and washers as specified in drawings shall conform to IS: 1367 & IS:1364 unless otherwise specified and are hot dip galvanised.

B2.9.6.3.2 Sub Clause 811.3.1.3Delete **the entire** Sub-Clause 811.3.1.3**and add the following**

Sub Clause 811.3.1.3. Concrete for bedding and anchor assembly shall conform to Section 1700 of these Specifications. The size of the concrete foundation block for embedding the posts and grade of concrete shall be as shown in the drawing.

B2.9.6.3.3 Sub Clause 811.3.3 Delete the entire Sub-Clause 811.3.3.5 and add the following

Sub Clause 811.3.3.5. Posts for metal beam guardrails on bridges shall be bolted to the structure as detailed in the drawings. The anchor bolts shall be set to proper location and elevation with templates and carefully checked.

B2.9.6.3.4 Sub Clause 811.3.7 Delete the entire Sub-Clause 811.3.7.1 and add the following Sub Clause

811.3.7.1. Metal beam railing barriers will be measured by linear metre of completed length as per plans and accepted in place.

B2.9.6.3.5 Delete the entire Sub-Clause 811.3.7.2 and add the following Sub Clause

811.3.7.2. No separate measurement for payment shall be made for Terminals / Anchors of various types required for the work. The cost of these elements shall be deemed to be included in the rate quoted by the Contractor. Furnishing and placing anchor bolts and/or devices for guard rail posts on bridges shall be considered incidental to the construction and the costs thereof shall be included in the price for other items of construction

**B2.9.6.3.6 Sub Clause 811.3.8 Add the following words at the end of the last sentence in Sub-Clause 811.3.8
“and drawings.”**

B2.10 SECTION 900 QUALITY CONTROL FOR ROAD WORKS

B2.10.1 CLAUSE 902 CONTROL OF ALIGNMENT, LEVEL AND SURFACE REGULARITY

B2.10.1.1 Sub Clause 902.4 Add the following paragraph at the bottom of the Sub-Clause 902.4

The Contractor shall, as directed by the Engineer, check the roughness of the surface layer with a roughometer (also known as a Bump Integrator), in the presence of the Engineer or his representative, before approval of the surface layer of any section for payment. The Roughometer shall be calibrated before carrying out any test run on the project roads, with any suitable system (e.g. Merlin wheel) to produce standard test results. The Contractor shall, at his own cost, calibrate Roughometer using a calibration system acceptable to the Engineer, to be available on site as and when required. Roughness shall be checked along the wheel paths in 3 trial runs and the Contractor shall submit an average roughness value at 100m intervals in a standard format to the Engineer. The average Roughness value per kilometer of a tested section (length not less than 500 m) shall satisfy the following criteria depending on the type of surface, failing which, the Contractor shall rectify the surface at defective locations at his own cost to the satisfaction of the Engineer, to give a acceptable riding surface.

Acceptable Roughness criteria:

Type of Surface	Roughness Value (BI)
Bituminous Concrete	Max. 2000 mm/km
Premix bituminous carpet	Max. 3000 mm/km

B2.11 SECTION 1000 MATERIALS FOR STRUCTURES.

B2.11.1 CLAUSE 1006 CEMENT

B2.11.1.1 Add the following to Clause 1006

Each delivery of cement to Site shall be accompanied by a certificate confirming that the cement complies with the requirements of the relevant standards and the Contractor shall forward a copy of this certificate to the Engineer within 24 hours of the delivery to Site.

Notwithstanding the provision of such certificates the Engineer may require independent tests to be carried out on the cement stored on Site, or require relevant tests to be carried out to determine its suitability for use in the Works as required by IS:269, IS:8112 or IS:12269. The Contractor shall arrange for samples to be provided either direct from the manufacturer or from the cement stored on Site, as may be determined by the Engineer. Cement that has been stored on Site for a period in excess of three months shall be re-tested before its use. The cost of providing such samples and re-testing shall be borne by the Contractor.

B2.11.2 CLAUSE 1007 COARSE AGGREGATES

B2.11.2.1 Delete the following from 3rd and 4th lines of 1st paragraph “Crushed gravelinert material”

B2.11.2.2 Add the following at the end of 2nd Paragraph “Costs of all tests shall be borne by the Contractor”

Add the following at the end of the Clause

Integrated stone crusher with Primary and Secondary (Cone or Impact Type) crushers shall be deployed for getting proper size and grading of coarse aggregates. The alkali aggregate reactivity should be measured and reported for getting approval for the source aggregates at the beginning of the work using methods given in IS: 2386. The tests may be repeated if the source or the type of rock being exploited for winning aggregates, changes.

B2.11.3 CLAUSE 1008 SAND/FINE AGGREGATES

Add the following paragraph at the end of the clause

The alkali aggregate reactivity should be measured and reported for getting approval for the source.

B2.11.4 CLAUSE 1009 STEEL

B2.11.4.1 Sub Clause1009.2: Add the following sentence at the end of the Sub Clause)
Stress relieved low relaxation seven-ply strand for prestressed concrete - IS:14268

B2.11.4.2 Sub Clause1009.3: Replace the following in the Table 1000.3IS: 1786 High Yield Strength Deformed bars (HYSD)WithIS: 1786 Thermo mechanically treated (TMT) High yield strength deformed bars(HYSD)

Any other reference to “HYSD” bars in the specifications shall be read as“TMT” bars.

B2.11.5 CLAUSE 1010 WATER

B2.11.5.1 Delete all paragraphs in Clause 1010 and substitute the following paragraphs

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel.

In case of doubt regarding development of strength, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time tests.

The sample of water taken for testing shall represent the water proposed to be used for concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

Average 28 days compressive strength of at least three 150 mm concrete cubes prepared with water proposed to be used shall not be less than 90 per cent of the average of strength of three similar concrete cubes prepared with distilled water.

The cubes shall be prepared, cured and tested in accordance with the requirements of IS: 516.

The initial setting time of test block made with the appropriate cement and the water proposed to be used shall not be less than 30 minutes and shall not be more than + 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of IS: 4031 (part 5).

The pH value of water shall be not less than 6. Potable water is generally considered satisfactory for mixing concrete. As a guide the following concentrations represent the maximum permissible values:

a) To neutralize 100 ml sample of water, using phenolphthalein as an indicator, it should not require more than 5 ml of 0.02 normal NaOH. The details of test are given in 8.1 of IS:3025 (Part 22).

b) To neutralize 100 ml sample of water, using mixed indicator, it should not require more than 25 ml of 0.02 normal H₂SO₄. The details of test shall be given in Clause 8 of IS:3025 (Part 23).

Permissible limits for solids shall be as follows:

PERMISSIBLE LIMITS FOR SOLIDS

	Tested as per	Permissible Limit
Organic	IS 3025 (Pt. 18)	200 mg/lit
Inorganic	IS 3025 (Pt. 18)	3000 mg/lit
Sulphates (as SO ₃)	IS 3025 (Pt. 28)	400 mg/lit
Chlorides (as Cl)	IS 3025 (Pt. 32)	2000mg/lit for concrete work not containing embedded steel and 500mg/lit for prestressed / reinforced concrete work.
Suspended matter	IS 3025 (Pt. 17)	2000 mg/lit

Mixing or curing of concrete with seawater is not permitted because of presence of harmful salts in seawater.

Water found satisfactory for mixing is also suitable for curing concrete. However, water used for curing should not produce any objectionable stain or unsightly deposit on the concrete surface. The presence of tannic acid or iron compounds is objectionable.

B2.11.6 **CLAUSE 1012 CONCRETE ADMIXTURES**

B2.11.6.1 **Sub Clause 1012.3.1: Add the following at the end of paragraph 1 of Clause 1012.3.1**

Admixtures shall not impair the durability of concrete; they shall not combine with the ingredients to form harmful compounds or endanger the protection of reinforcement against corrosion. Only chloride free admixtures shall be used.

B2.11.6.2 **Delete the paragraph 2 in Sub-clause 1012.3.1 and add the following paragraph**

For all admixtures being used the packing shall be marked with the name of the supplier/manufacturer, brand name (name of product) and main effect. A certificate for the admixture in question shall be submitted. The certificate shall include the following information:

A. General

- Chemical name of the active component in the admixture.
- Values of dry material content, ash content and relative density of admixture, which can be used for uniformity tests.
- Chloride ion content expressed as a percentage of weight of cement.
- pH value and colour.

- e) Normal side effects e.g. whether the admixture leads to air entrapment at recommended dosage and if so to what extent.
- f) Side effects when overdosed
- g) If two or more admixtures have to be used in one mix, their compatibility
- h) Increase in risk of corrosion to reinforcements and
- i) Embodiments due to the use of admixture.
- j) Latest date of test and name of test laboratory.

B. Storing

- a) Shelf life
- b) Max. & min. allowable temperature
- c) Other instructions (e.g. requirements of stirring)

C. Dosage

Maximum and minimum to be specified as a percentage of weight of cement.

B2.11.6.3 Add the following paragraphs at the end of the Sub-clause 1012.3.1

After selecting a few acceptable brands & types of admixture based on the manufacturer's data/technical literature, independent acceptance tests should be carried out for the same using the approved combinations of cement/sand/aggregates intended for use in the Project. After establishing the basic acceptability using strength criteria (compression & tensile strengths) a number of trial mixes be designed using different proportions of admixtures/cement/water etc. to establish the data bank on the behaviour of the admixture for the project site conditions. A spectroscopic signature of accepted product should be obtained and preserved for comparison for acceptance of the production lots. Retrials should be conducted with change in source/type of cement.

Workmanship

The dosage should be finalised on the basis of field trial and special mechanical devices should be used for dispensing the admixture in the batching / mixing plant. No addition of admixture after dosage is permitted (including addition in transit mixers).

Manufacturer's experts should be available for consultation/trouble-shooting of problems associated with their product. The conditions of storage, shelf life etc., as specified by the manufacturer should be strictly observed. The manufacturer's Quality Assurance Plan during process of production should be obtained and filed for reference/record.

B2.11.7 CLAUSE 1014 STORAGE OF MATERIALS

B2.11.7.1 Sub Clause 1014.3: Add the following to the Sub-clause 1014.3

Aggregates shall be stored or stockpiled in their respective size in such a manner that the various sizes will not become intermixed before proportioning. They shall be

stored, stockpiled and handled in such a manner that will prevent contamination by foreign materials.

B2.12 SECTION 1400 STONE AND CONCRETE BLOCK MASONRY
B2.12.1 CLAUSE 1402 MATERIALS

B2.12.1.1 REPLACE the Clause with the following Clause

1402. MATERIALS

Stone to be used, besides quarry stone, shall be obtained by dressing the boulders of average diameter not less than 300 mm and at least five faces shall be chiselled.

All other materials used in stone masonry shall conform to Section 1000 except cement mortar, which shall conform to clause 1304

B2.13 SECTION 1500 FORMWORK.

B2.13.1 CLAUSE 1501 DESCRIPTION

REPLACE the Clause with the following Clause

1501. DESCRIPTION

The Contractor shall prepare a formwork mobilization and utilization plan and submit the plan for Engineer's approval at least 21 days before the commencement of construction of structures. The requirement of formwork shall be worked out considering the overall construction program of all the structures to be cast in one or more stages, as specified in the drawings. The plan shall take into account the time required for erection of formwork, retention in position, stripping, and removal and subsequent use in the next and subsequent structures. Notwithstanding Engineer's approval of mobilisation plan, if due to any reason, Contractor has to arrange additional formwork, to meet the requirements of the construction program, it shall be done by the Contractor without any extra cost to the Employer.

B2.13.2 CLAUSE 1502 MATERIALS

Delete the last sentence in 1st paragraph

Delete the word "or timber" in 1st line of 2nd paragraph

B2.13.3 CLAUSE 1503 DESIGN OF FORMWORK

B2.13.3.1 Sub Clause 1503.1: Add the following to the Sub-clause 1503.1

For distribution of load and load transfer to the ground through staging, an appropriately designed base plate must be provided which shall rest on firm substratum

B2.14 SECTION 1600 STEEL REINFORCEMENT (UNTENSIONED)

B2.14.1 CLAUSE 1604 BENDING OF REINFORCEMENT

Add the following paragraph at the end of the Clause 1604

The separate bar bending schedule shall be prepared for auxiliary bars like spacers chair etc. Bar bending shall be done as per IS 2502.

B2.14.2 CLAUSE 1605 PLACING OF REINFORCEMENT

Delete item (i) in paragraph c) in Clause 1605 and add the following paragraph in place of the above

(i) Cover blocks shall be made of concrete or cement mortar with the same durability properties as the surrounding concrete and with the same type of constituents. In visible surfaces, the cover blocks shall be of the same colour and texture as the surrounding concrete. The Contractor's proposal for cover blocks shall be submitted to the Engineer for acceptance

B2.14.3 CLAUSE 1606 BAR SPLICES

B2.14.3.1 Sub Clause 1606.1: Delete the first sentence in Sub Clause 1606.1 and replace with the following sentence

To the extent possible, all reinforcement shall be furnished in full lengths as indicated in drawings.

B2.14.3.2 Add the following paragraph at the end of the Sub-clause 1606.1

The length of bars more than Standard (generally taken as 12m), in such cases lapping of bars (not shown in drawings) shall be submitted to the Engineer for approval.

B2.14.3.3 Sub Clause 1606.2: Add the following at the end of the Sub Clause 1606.2.1

In prestressed concrete members, when welding of un-tensioned reinforcement is permitted by the Engineer, it shall be carried out before insertion of the pre-stressing tendons.

B2.14.4 CLAUSE 1607 TESTING AND ACCEPTANCE

B2.14.4.1 Add the following two paragraphs at the end of second paragraph in Clause 1607

The reinforcement steel shall be from main/major Producers as approved by Ministry of Steel Government of India and no re-rolled steel from Induction Furnace route shall be supplied and used.

In case of procurement of steel from units other than the ministry of steel approved main/major producers specific approval of Engineer, in charge is required. For which credential verification shall be undertaken regarding the fact that these units are conversion agent of ministry of steel approved main/major producer for steel bars with clean track record of performance. The procurement of steel from conversion agents shall satisfy the following minimum requirements:

(a) Certificate from the conversion agent that he had used the billets supplied by ministry of steel approved main/major producer with production of co-related documents i.e. invoice/T.C need to be submitted along with each consignment document.

(b) In case of steel units having captive raw material manufacturing facility, facilities other than manufacturing technology satisfying clause 4.1 of IS 1786:2008 i.e. open hearth, electric, duplex, basic oxygen process or combination of these processes, approval will not be accorded. If any manufacturing facility through Induction furnace route, it would not be considered for approval under any circumstances.

(c) Certificate regarding continuity of the BIS license and agreement with the ministry of steel approved Main/Major producers being its authorized conversion agent during the currency of supply contract.

(d) The sampling and testing shall be laid down as per IS 1786:2008. Every consignment bar shall be inspected before assembling on the work and defective brittle or burnt bar and cracked ends of bars shall be discarded.

B2.15 SECTION 1700 STRUCTURAL CONCRETE

B2.15.1 CLAUSE 1701 DESCRIPTION

B2.15.1.1 Add the following paragraph after the first paragraph

The Contractor shall obtain prior approval from the Engineer for the method of mixing, batching and casting of pre-cast concrete members (girders, slabs) as per drawings. Quality control and quality assurance shall be complied at every stage from mixing, batching to casting. Arrangements shall be made for proper curing of pre-cast concrete members. Suitable arrangements shall be made for transportation, handling and erection of pre-cast concrete members in their final position as shown in the drawings or as directed by the Engineer. Care shall be taken while handling, transporting and erection of the pre-cast concrete members, so that they are not damaged.

B2.15.2 CLAUSE 1703 GRADES OF CONCRETE

B2.15.2.1 Sub Clause 1703.2: Delete all the paragraphs and Tables in Sub-clause 1703.2 and add the following in place of the above

1703.2. The lowest grades of concrete in bridges and corresponding minimum cement contents and water-cement ratios shall be maintained as indicated in the following Tables.

(A) For bridges with pre-stressed concrete or those with total length more than 60 m or those that are built with innovative design/construction.

Structural Member	Minimum grade of concrete and Conditions of Exposure		Min. Cement content for all exposure conditions (kg/cu m)	Maximum water cement ratio conditions of exposure	
	Moderate	Severe		Moderate	Severe
a) PCC members	M25	M30	360	0.45	0.45
b) RCC members	M30	M35	400	0.45	0.40
c) PSC Member	M35	M40	400	0.40	0.40

B) For bridges other than those mentioned in Table A for culverts and other incidental construction

Structural Member	Minimum grade of concrete and Conditions of Exposure		Min. Cement content for exposure conditions (kg/cu m)		Maximum water cement ratio conditions of exposure	
	Moderate	Severe	Moderate	Severe	Moderate	Severe
a) PCC members	M15	M20	250	310	0.50	0.45
b) RCC members	M20	M25	310	400	0.45	0.40

Notes: -

1. Moderate – conditions other than ‘severe’

The minimum cement content is based on 20mm size aggregates. For larger size aggregates it may be reduced suitably by not more than 10 percent similarly for smaller size aggregates, it may be suitably increased, but not more than 10 percent.

2. For under water concreting the cement shall be increased by 10% more than that required to develop the strength for the same mix placed in dry. However it shall not fall below the minimum cement content specified in above table.

3. Severe conditions of exposure shall mean alternate wetting and drying due to sea spray, alternate wetting and drying combined with freezing and buried in soil having corrosive effect.

4. Moderate conditions of exposure shall mean other than those mentioned in (iii) above.

The cement content shall be as low as possible but not less than the quantity specified above. In no case shall it exceed 540 kg/cum of concrete.

B2.15.2.2 Sub Clause 1703.4: Add the following at the end of the Sub-clause 1703.4
The concrete mixes leaner than M15 shall be called as nominal mix concrete.

"**Nominal mix concrete** is that concrete for which, concrete is not to be designed by tests and in which the proportions of materials are in accordance with the drawing and the specification Clause mentioned below:

- i. All the materials for this concrete shall conform to section 1000 of Part I of General Technical Specification.
- ii. Minimum cement content and maximum water cement ratio for above said nominal mix concrete shall conform to Clause 1703.2 Table 1700-3(A) of Part I of General Technical Specification.
- iii. Mixing of above said nominal mix concrete shall conform to Clause 1708 of Part I of General Technical Specification
- iv. Transporting, Placing and Compaction of above said nominal mix concrete shall conform to Clause 1709 of Part I of General Technical Specification".

B2.15.3 CLAUSE 1705 ADMIXTURES

Delete all the paragraphs in Clause 1705 and add the following paragraphs

Duly tested admixtures/additives conforming to IS: 6925 and IS:9103 (without replacement of cement) may be used subject to satisfactory proven use, with the approval of the Engineer. Admixtures generating Hydrogen or Nitrogen and containing chlorides, nitrates, sulphides, sulphates and any other material liable to adversely affect the steel or concrete shall not be permitted.

The general requirements, physical and chemical requirements shall be as per Clause 1012.

B2.15.4 CLAUSE 1706 SIZE OF COARSE AGGREGATE

Replace the value 40 with 20 in the TABLE 1700 – 7 under the column “Maximum Nominal Size of Coarse Aggregate (mm)” in the row numbered as iii) “Well cap or Pile cap, Solid type piers and abutments”

B2.15.5 CLAUSE 1708 BATCHING, MIXING, TRANSPORTING, PLACING AND COMPACTION

Sub Clause 1708.3 Mixing Concrete

B2.15.5.1 Add the following paragraph at the end of Clause 1708.3.1

The Contractor shall take precautions during periods of high wind to prevent cement being blown away during the process of batching and mixing.

B2.15.5.2 SUB CLAUSE 1708.5 PLACING OF CONCRETE

Add the following paragraph at the end of fourth paragraph

For Placing Concrete with Pumps: Pipelines from the pump to the placing area should be laid out with a minimum of bends. For large concrete placements stand by pumps shall be available. Suitable valves (air release valves, shutoff valves etc.) shall be provided as per the site needs. The pumping of concrete shall be preceded by a priming mix to lubricate the pump and pipeline. A rich mix of creamy consistency shall be required for lubricating the pipelines. Continuous pumping shall be done to the extent possible. After concrete has been placed, the pipelines and all related equipment shall be cleaned immediately. A plug sponge ball shall be inserted in the end near the pump and shall be forced through the line by either water or air pressure. Pipes for pumping should not be made from materials, which can harm concrete; aluminium alloy pipelines shall not be used.

B2.15.6 CLAUSE 1709 CONSTRUCTION JOINTS

B2.15.6.1 Add the following paragraph at the end

The number of joints shall be kept as minimum as possible and their construction should be simple. They should be either horizontal or vertical, because concreting sloping surfaces are unsatisfactory.

Where concrete is placed in vertical members e.g. walls and columns the Contractor shall form construction joints horizontally or, in the case of sloping members, at right angles to the axis of the member. He shall form construction joints at locations such that their visual impact is minimised, and shall place concrete in a continuous operation without breaks between construction joints.

The Contractor shall take care when erecting the formwork for subsequent pours to ensure that no leakage can occur at the construction joint.

B2.15.7 CLAUSE 1711 ADVERSE WEATHER CONDITIONS

B2.15.7.1 Sub Clause 1711.3: Add the following as new Sub-Clause 1711.3

1711.3. Wet Weather Conditions: The Contractor shall not carry out any concreting operations during periods of continuous heavy rain. The Contractor shall protect concrete after pouring from detrimental effects of wet weather.

B2.15.8 CLAUSE 1712 PROTECTION AND CURING

B2.15.8.1 Add the following at the end of the 1st paragraph

Wherever possible, use of water sprinklers or perforated pipes should be encouraged for curing of concrete. Such arrangement must be maintained for a minimum period

of 14 days after concreting. Approved concrete curing compounds should be preferred where water curing cannot be done reliably

B2.15.9 CLAUSE 1713 FINISHING

B2.15.9.1 Add the following to Clause 1713

The Contractor shall rectify any defects in the finish of the concrete exposed when formwork is removed in the following manner:

(i) Bulges and ridges shall be removed by careful chipping or tooling and the surface rubbed with a grinding stone;

(ii) Honeycombed and other defective areas shall be chipped out, the edges being cut as straight as possible and perpendicular to the surface, or slight undercut to provide a key at the edge of the patch;

(iii) Shallow patches shall be treated with a coat of thin grout composed of one part of cement and one part of sand then filled with mortar of the same mix as the one used in the parent concrete. The mortar shall be placed in layers of not more than 10mm thick and the surface of each layer roughened to provide a key for the subsequent layer. The final layer shall be finished to match the surrounding concrete by floating, rubbing or rolling on formed surfaces by pressing the form material against the patch while the mortar is still plastic;

(iv) Where necessary formwork shall be provided to contain concrete in large voids, such patches shall be treated with epoxy to provide an effective bond between the fresh concrete and the hardened concrete;

(v) Remedial work to defective concrete shall be cured in a like manner as the parent concrete, to the satisfaction of the Engineer.

B2.15.10 CLAUSE 1717 TESTS AND STANDARDS OF ACCEPTANCE

B2.15.10.1 Sub Clause 1717.7.6: Add the following to Sub-Clause 1717.7.6

Any concrete which gives results below the specified limits in relevant codes or becomes severely damaged due to cracking or shows excessive honey-combing and exposure of reinforcement or exhibits any fault which, in the opinion of the Engineer, so seriously impairs its function that it cannot be accepted as substandard work, shall be declared defective concrete. Such concrete shall be cut out, removed and replaced by fresh concrete of the specified quality at the Contractor's cost to the satisfaction of the Engineer.

In case of doubt regarding grade of concrete used, either due to poor workmanship or based on results of cube crushing strength, tests of concrete on the basis of any or all of the following shall be carried out. The Engineer shall be the final authority for interpreting the results of all these tests and the Contractor shall carry out these tests

at his own cost if the tests reveal that the concrete fails to meet the requirements of the Contract.

Core Tests

The points from which cores are to be taken and the number and size of cores required shall be instructed by the Engineer and it shall be representative of the whole of the concrete being investigated. In no case, however, shall fewer than three cores be tested. Cores shall be prepared and tested as described in IS: 516.

Concrete in the member represented by the core tests shall be considered acceptable if the average equivalent strength of 85% of the corresponding specified grade of concrete is achieved. The Contractor shall make good the areas from which the cores were taken to the satisfaction of the Engineer.

Other non-destructive tests

The Engineer may instruct non-destructive tests such as rebound hammer tests or ultrasonic tests.

B2.15.11 CLAUSE 1719 RATE

B2.15.11.1 Add the following paragraph at the end of 2 paragraph to clause 1719

For pre-cast concrete members, the contract unit rate in addition to above shall also include the cost of all materials, labour, tools and plants required to transport and place these members in their final position as shown on the drawings and as directed by the Engineer.

B2.16 SECTION 2000 BEARINGS

B2.16.1 CLAUSE 2001 DESCRIPTION

B2.16.1.1 Add the following paragraph at the end of the Clause 2001

Within 180 days of award of work, the Contractor shall submit detailed specifications, designs and drawings including installation drawings and maintenance manual, for the approval of the Engineer. Designs shall also include review and modifications of designs and drawings of bearing pedestals and other elements required for installation. The installation of bearings shall be carried out under the supervision of the manufacturer of the bearings.

B2.16.2 CLAUSE 2005 ELASTOMERIC BEARINGS

B2.16.2.1 Add the following to Sub-Clause 2005.1

Polymer identification test shall be carried out as per ASTM D-3677 by infraredspectro photometry and the spectra shall be comparable to a reference sample of polychloropene.

B2.16.2.2 Sub Clause 2005.2: Add the following after the first line of second paragraph of Sub-Clause2005.2

The mould shall be kept at a uniform temperature for 15 (fifteen) minutes to ensure effective vulcanisation of the bearing.

B2.16.2.3 Sub Clause 2005.4:Delete the word “Inspector” in the 1st line of 5th paragraphin Sub-Clause 2005.4 and replace with “Engineer or his authorized representative”

B2.16.2.4 Delete the last paragraph in Sub-Clause 2005.4.3.1 and add the followingparagraph

The test specifications and acceptance criteria shall conform to those given inAppendix 2 of IRC: 83 (Part II), by **replacing** the Fig. 11. “Determination of elasticmodulus” **with** the figure published in the journal “INDIAN HIGHWAYS”, April1998.

B2.17 CLAUSE 2100 OPEN FOUNDATIONS

B2.18 SECTION 2200 SUB-STRUCTURE

B2.19 CLAUSE 2204 PIERS AND ABUTMENTS

B2.19.1. Add the following paragraph at the end of Clause 2204.6

Where necessary suitable cofferdams or other means shall be provided to excludewater from the construction area the Contractor shall provide necessary pumpingequipment for dewatering in working areas.

B2.19.2 CLAUSE 2210 RATE

B2.19.2.1 Delete the entire paragraph in Clause 2210 and add the following paragraph

The contract rate for masonry, concrete and reinforcement in substructure shallinclude all works as given in respective sections and cover the cost of incidentalitems like providing cofferdams, dewatering, providing special formwork, wherenecessary, and all other items for furnishing and providing substructure asmentioned in this section

B2.20 SECTION 2300 CONCRETE SUPERSTRUCTURE

B2.20.1 CLAUSE 2304 REINFORCED CONCRETE CONSTRUCTION

B2.20.1.1 Sub Clause 2304.2: Delete the 1st paragraph in Sub-clause 2304.2 and add the following paragraph

Pre-cast RCC T beam and in-situ construction, as applicable shall be permitted

B2.21 SECTION 2600 EXPANSION JOINTS.

B2.21.1 CLAUSE 2602 GENERAL.

B2.21.1.1 Add the following to Clause 2602.4

The Contractor shall not incorporate any expansion joints into the Works without the approval of the Engineer. Such approval shall be dependent upon the Contractor submitting inspection certificates issued by the inspection authority or any other body acceptable to the Engineer certifying that the expansion joint components have been inspected and tested as per the Drawings and Specification.

All inspection and testing charges including cost of material shall be borne by the Contractor.

The Contractor shall ensure that the manufacturer has adequate testing facilities to enable the expansion joints to be tested at the place of manufacture. The expansion joints and accessories thereof shall be subjected to all the specified tests on both the raw materials as well as the finished product by the Engineer or his authorized representative at the manufacturer's works.

The Contractor shall ensure that an original copy of documentary evidence regarding the source of imported "elastomer" and other ingredients is provided by the manufacturer. The inspection agency shall ensure that the joints are manufactured by using the consignment of imported "elastomer" and other ingredients. The test certificate for the steel sections to be provided by the manufacturer shall be submitted to the Engineer by the Contractor.

B2.22 SECTION 2700 WEARING COAT AND APPURTENANCES

B2.22.1 CLAUSE 2702 WEARING COAT

B2.22.1.1 Sub Clause 2702.1: Delete all the paragraphs in Sub-clause 2702.1. and add the following paragraphs

Bituminous wearing coat shall comprise the following:

- i) 65 mm thick asphaltic concrete wearing coat in two layers, one of 40 mm thickness and other of 25 mm thickness as per Clause 512

B2.22.2 CLAUSE 2706 WEEP HOLES

B2.22.2.1 Delete the entire paragraph in Clause 2706 and add the following paragraph

Weep holes shall be provided in solid plain concrete / reinforced concrete brick or stone masonry abutments, wing walls, return walls as shown in the drawing or as directed by the Engineer to drive moisture from the back filling. Weep holes shall be provided with 100mm dia PVC (6 Kg/cm²) pipe and shall extend through the full width of concrete with slope of about 1 vertical: 20 horizontal towards the draining face.

The spacing of weep holes shall generally be 1 m in either direction or as shown in the drawing with the lowest at about 150 mm above the low water level or ground level whichever is higher or as directed by the Engineer

B2.23 SECTION 2800 REPAIR OF STRUCTURES

B2.23.1 Add following new Sub-Clause 2802.6

B2.23.1.1 2802.6 Repairs and Rehabilitation: In addition to the existing Clauses, following points shall be noted and shall be adopted wherever applicable or as directed by the Engineer for repairs and rehabilitation of Bridges.

Chipping

Chip off loose, weak and unsound concrete from structural members using chisels and hammers. Electrical/pneumatically operated chisels which also to be used wherever required up to average depth. The loose concrete behind reinforcement should be carefully removed and corroded reinforcement shall not be bent or damaged during the chipping operation. Care shall be taken to avoid damage to any part of existing structure. Only loose concrete shall be taken out.

All the chipped off, dismantled materials shall be disposed off. Materials/debris falling must be arrested using suitable arrangements to avoid harm to working personnel or others.

The Contractor at his cost shall restore damages caused to any component of the bridge structure/service lines during the chipping operation.

Surface Preparation

Removal of corrosion scales on corroded reinforcement bars should be done manually using sharp tools such as chisels to scrap rust scales from the surface without displacing/ damaging the reinforcement. Thereafter use wire brushes to clean the surface of bars. Since the brush would not be access behind the bars use emery papers to clean exposed surface as well as areas with difficult access. Rotary wire brushes, shaft type rotary wire brushes to be used where ever required.

Exposed concrete surfaces shall be cleaned with wire brushes/rotary wire brushes to remove all loose material, dust, dirt, oil etc. finally use oil free air blast to clean the surface.

Providing additional reinforcement

Wherever the reinforcement is reduced by corrosion, compensating extrareinforcement is to be provided along the existing steel by welding with a weldlength of 25mm and living gap of 100mm alternatively. Where ever thereinforcement is totally corroded leaving its two ends open, welding shall becarried out upto required length from both sides. And 100mm length anchorage's inthe form of shear connectors of 12 mm size shall be drilled and fixed along theadditional reinforcement at 300 mm c/c and welded. The anchorages shall be fixedusing epoxy grouts as per manufacture's specifications.

Anti- corrosive reinforcement treatment for exposed reinforcement bars

Reinforcing bars shall be coated with an anti-corrosive coating of 120 microns DFTconfirming to ASTM-B- 117 (salt spray 100 hours) as per manufacturer's specifications.

Epoxy bonding agent for concrete

Structural grade bonding agents of epoxy base conforming to ASTM-C-81-82(6.9N/mm²) bond strength shall be used for all structural repairs, for bondingbetween old and new concrete. The bonding agent should remain in tacky stateprior to placing of fresh concrete. Material shall be applied as per manufacture'sspecification for properties of epoxy bonding agent.

Application of Super Plasticized Micro silica repair mortar

Application of Micro silica and Fibre blended repair mortar is done as per manufacture's specification. The above mix is to be applied by trowel and finishedsmooth without excessive finishing. In one application 25mm of thickness is to bebuilt up. Subsequent layers to be done with one bond coat of cement slurry. Thisshould be covered with burlap and cure by spraying periodically with water for 10days and allow to dry for next 5 days.

Polymer modified mortar

All honey combed/exposed concrete surfaces of structural members shall beapplied with cement based polymer modified mortar which can be prepared at siteusing OPC, polymer, aggregates, as per manufactures specification. The polymer modified mortar shall be applied after priming the surface with non-re-emulsifiablelatex based bonding agent conforming to ASTM-1059 Type II.

Anti-corrosive& Anti carbonation protective coating to concrete surface

Concrete shall be coated with anti-corrosive and anti-carbonation protectivecoating.

Treatment of cracks and honey combed areas in structural members

For Cement grouting

Drill hole 14mm dia. in the concrete for a depth of 100mm and clean the holes with oil free air blast. Fix 12mm diameter aluminium nozzles of 100mm depth for a depth of 50mm into the hole using fixing compounds as per manufacturer's specification.

Cementitious Polymer grouts for cracks

Cementitious Polymer grouts shall be injected into the prefixed cement grouting nozzles with pressure not exceeding 5kgs/cm² till the nozzles refuse to take further grout. All the honeycombed areas where ever polymer modified mortar has been applied shall be grouted with cementitious polymer grouts as per manufacturer specifications.

B2.24 SECTION 2900 PIPE CULVERTS

B2.24.1 CLAUSE 2902 MATERIALS

B2.24.1.1 Add the following paragraphs to Clause 2902

Where pipe culverts are required on temporary diversions and access roads (sideroads) the Contractor shall use reinforced cement concrete pipes NP3 grade (as per IS: 458 – 1971).

Pipe culverts on the main highway shall be constructed using NP4 (as per IS: 458 – 1971) pipes as specified in Clause 1013 of the General Technical Specification.

B2.24.2 CLAUSE 2910 MEASUREMENT FOR PAYMENT

B2.24.2.1 Add the following paragraph to Clause 2910

Pipe culverts constructed on temporary diversions shall not be measured separately for payment purposes.

B2.25 CLAUSE 2912 ADD NEW CLAUSE 2912

B2.25.1 Add the following Clause 2912

B2.25.1.1 2912 Stone pitching for earth fill: Stone pitching shall be carried out as per guidelines of IRC: 89 and as per Tech. Spec. Clause 306 for the side slopes on the earth fill portions as indicated in the drawings.

B2.26 SECTION 3000 MAINTENANCE OF ROAD

B2.26.1 CLAUSE 3001: GENERAL

B2.26.1.1 Delete all paragraphs of the clause 3001 and add the following 3001.1 Scope

The Contractor shall be responsible for Initial Rectification of each section of the project roads as described below. Initial Rectification for the entire length of

the project road shall be carried out as per 3001.2 within 6 months after the issue of notice to proceed to work. It involves repairs to the extent necessary to put the road in a safe and reasonable condition for the passage of traffic.

When the Contractor starts the execution of works on any of the milestones /sections of the Contract, the Contractor becomes responsible at his own cost for providing and maintaining an adequate motorable roadway for traffic through that section / milestone until the section is completed and a Taking-Over Certificate is issued by the Client.

3001.2. Initial Rectification

3001.2.1 Tasks: The entire project road will be inspected jointly by the Engineer and the Contractor immediately after the commencement of the Contract and details of the Initial Rectification work required shall be agreed. Initial Rectification tasks shall include the following as appropriate:

- (i) Pavement Reinstatement of failed areas as per clause 3004.1
- (ii) Pothole Repair and Patching as per clause 3004.2
- (iii) Shoulder and Verge repairs as per clause 3003.
- (iv) Restoration of Rain Cuts, if they are considered to be a danger by the Engineer, as per clause 3002.
- (v) Culvert cleaning
- (vi) Side Ditch and Drain cleaning, including making sure that the outfalls from these ditches and drains are functioning adequately.

3001.2.2 Measurement for Payment and Rates

Initial Rectification for all the milestones / sections of the project road shall be incidental to the Works and shall be responsibility of the Contractor and at his own cost.

B2.26.2 CLAUSE 3003: MAINTENANCE OF EARTHEN SHOULDER

B2.26.2.1 Delete all paragraphs of **Sub-Clause 3003.1** and **add** the following paragraphs in place of above

3003.1. Scope

The work of maintenance of earthen shoulder shall include making up their regularities/loss of material on shoulder to the required level by adding fresh approved soil and compacting it with appropriate equipment or to strip excess soil from the shoulder surface as per the requirement of this Specification.

During the execution by the Contractor of the Works in any of the milestones /sections of the Contract, the maintenance of earthen shoulders in all milestones /sections shall be incidental to the Works and shall be responsibility of the Contractor and at his own cost.

B2.26.2.2 Delete all paragraphs of Sub-Clauses 3003.4 and 3003.5

B2.26.3 **CLAUSE 3004: BITUMINOUS WORK IN CONNECTION WITH MAINTENANCE AND REPAIR**

B2.26.3.1 **Delete all the paragraphs of Clause 3004.2 and add the following in place of above**

3004.2 Filling Potholes and Patch Repairs

3004.2.1 Scope

The work shall consist of cleaning out potholes in the pavement surface, trimming the sides of the holes and compacting the base, applying prime and tack coat, filling with specified materials and compacting as and when instructed by the Engineer. The location, extent and depth of each pothole to be patch repaired shall be as instructed by the Engineer. If the Engineer observes poor performance of the patch repairs prior to the onset of the monsoon season, the Contractor shall redo the work at his own cost to improve the performance. Pothole repair work shall be started immediately after issuing a notice to proceed to work and shall be completed within 3 months period.

During the execution by the Contractor of the Works for any of the milestones/sections of the Contract, the repair of potholes in that milestone/ section shall be considered incidental to the Works and shall be the responsibility of the Contractor and at his own cost. In the case of milestone/ sections not as yet commenced, the Contractor shall be paid for carrying out pothole repair and when instructed by the Engineer.

3004.2.2. Preparation

Potholes shall be cleaned out to a firm base and patches shall be excavated to the size and depth instructed by the Engineer. In both cases the sides shall be trimmed to give a rectangular shape with vertical sides. The area shall be thoroughly cleaned with compressed air or other appropriate method as approved by the Engineer to remove all dust and loose particles. The bottom of the pothole shall be thoroughly compacted.

3004.2.3 Filling

Potholes shall be filled with compacted Water Bound Macadam (WBM) complying with Clause 404 and surfaced with a 20mm Open graded Pre-mix Surfacing (PMS) complying with Clause 511. A prime coat complying with Clause 502 shall be applied to the WBM surface and a tack coat complying with Clause 503 shall be applied to the existing bituminous sides of the hole before placing the PMS. For shallow potholes, depth less than 30mm, the patching work shall be carried out using PMS as necessary. For potholes depth up to 100mm Patching work shall be carried out using 75mm thick WBM (GIII)/WMM and 20mm thick PMS, For pothole depth more than 100mm 150mm WBM (GIII)/WMM in two layers and

20mm thick PMS shall be used for patching. The materials shall be placed in layers and shall be compacted in layers with roller / plate compactor / hand roller / rammer to the compaction standards defined in the appropriate clauses of the specifications.

While placing the final layer (PMS), the mix shall be spread slightly proud of the surface so that after rolling, the surface shall be flush with the adjoining surface. If the area is large, the spreading and levelling shall be done using hand shovels and wooden straight edges. During the process of compaction, the surface levels shall be checked using a 3m straight edge.

B2.26.4 Replace Appendix 4 of MoRT&H Specification with the following Guidelines for selection of viscosity grade bitumen

The type and grade of bitumen to be used shall be specified in the Contract. Modified bitumen is suitable for use in very heavy trafficked roads in very hot climate.

Both the highest daily mean air temperature and the lowest daily mean air temperatures mentioned in Tables A4-1 and A4-2 can be obtained for the weather station nearest to the project site from the Indian Meteorological Organization (IMO). The IMO has data on daily mean high temperature for all 365 days in a year for all weather stations based on historical records of the last 30-40 or more years. This daily mean high temperature on a specific day is the same as daily "normal" high temperature for that day as usually reported in some newspapers. The highest of the 365 daily mean high air temperatures (which usually occurs in May or June) is used in Tables A4-1 and A4-2. Likewise, the lowest daily mean air temperature (which usually occurs in January) can also be obtained from the IMO.

Since these are mean temperatures based on the average of 30-40 years data, these temperatures are significantly lower than the absolute maximum temperatures, which may have occurred in a specific year.

Table A4-1 Selection Criteria for Viscosity-graded (VG) Paving Bitumens Based on Climatic Conditions

	Highest Daily Mean Air Temperature, °C		
Lowest Daily Mean Air Temperature, More than -10°C	Less than 20°C	20 to 30°C	More than 30°C
	VG-10	VG-20	VG-30
	VG-10	VG-10	VG-20

Table A4-2 Selection Criteria for Grade of Modified Bitumen

Lowest Daily Mean Air	Highest Daily Mean Air Temperature, °C		
	Less than 20°C	20 to 30°C	More than 30°C
	Grade of Modified Bitumen		
More than -10°C	PMB/NRMB	PMB/NRMB 70	PMB/NR

	120 CRMB 50	CRMB 55	PMB 40 CRMB 60
-10°C or lower	PMB/NRMB 40 CRMB 50	PMB/NRMB 120 CRMB 55	PMB/NR MB 70

PMB = Polymer modified bitumen
NRMB= Natural rubber modified bitumen
CRMB= Crumb rubber modified bitumen

ADDITIONAL TECHNICAL SPECIFICATIONS

CLAUSE A-1 INTER LOCKING CONCRETE BLOCKS

Clause A-1.1 Scope

The scope of work involves laying of M-40 concrete interlocking paver blocks of 80mm thickness conforming to BS 6717:2001 laid on Granular Sub-base and as directed by Engineer. The shape of blocks, the source of supply, the methodology for laying of blocks shall be got approved from Engineer.

Clause A-1.2 Unit of measurement

The unit of measurement shall be the area of the finished item of work of interlocking blocks measured in plan in sq m.

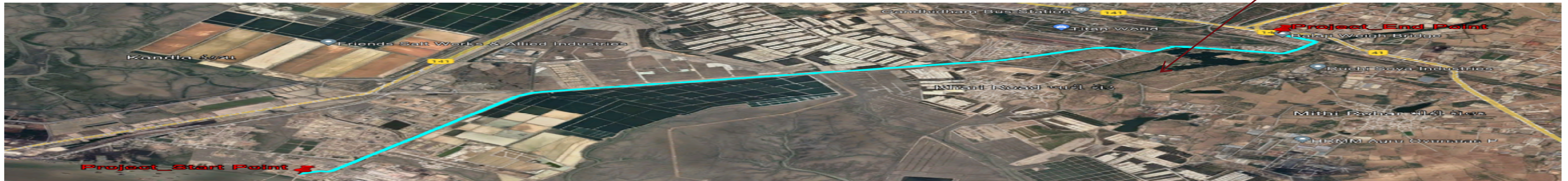
Clause A-1.3 Rate

The unit cost includes laying of interlocking paver blocks including the cost of Granular sub-base.



DEENDAYAL PORT AUTHORITY
ISO 9001:2008 | ISO 14001 | ISPS compliant port

Consultancy Service for Preparation of Details Project Report for widening & Improvement of Existing 2/4-lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)



FINAL DETAILED PROJECT REPORT **DRAWINGS [VOLUME - VI]**



MONARCH
SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.

HORIZONTAL AND VERTICAL DESIGN DETAILS

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6.485</td><td>6</td><td>1</td><td>55.20</td><td>35</td><td>5.40</td><td>0.6</td></tr></table>																								Horizontal Alignment Details																		Sl. No.	CIRCULAR CURVES								SPIRAL CURVES				Horizontal Intersection Point (HIP)						Design Speed	Super e	Extra Widen	Curve No.	Start Chainage (km)	End Chainage (km)	Start Easting (x)	Start Northing (y)	End Easting (x)	End Northing (y)	Radius (m)	Direction	Start Chainage (km)	Start Ls (m)	End Ls (m)	End Chainage (km)	Chainage (km)	Easting (x)	Northing (y)	Deflection			(kmph)	(%)	(m)	De g	Min	Sec	1	00+020.156	00+032.646	625028.969	2547245.483	625023.118	2547255.103	8	Left	-	-	-	-	00+028.080	625030.808	2547253.191	89	27	18.00	25	3.10	1.5	2	00+075.318	00+091.953	624981.911	2547266.116	624966.934	2547273.301	90	Right	00+055.318	20	20	00+111.953	00+083.659	624974.090	2547269.014	10	35	24.00	20	5.90	0.9	3	00+172.212	00+191.369	624902.224	2547320.719	624884.871	2547328.747	90	Left	00+152.212	20	20	00+211.369	00+181.827	624893.977	2547325.660	12	11	42.00	20	5.90	0.9	4	00+352.979	00+363.644	624730.735	2547372.105	624725.551	2547381.36	30	Right	00+312.979	40	40	00+403.644	00+358.368	624727.312	2547376.267	20	22	1.20	80	NC	1.5	5	00+487.866	00+497.954	624748.837	2547501.078	624744.014	2547509.884	30	Left	00+447.866	40	40	00+537.954	00+492.958	624747.173	2547505.890	19	16	1.20	80	6.30	1.5	6	00+946.470	01+016.347	624311.522	2547622.275	624243.509	2547638.306	10000	Left	-	-	-	-	00+981.409	624277.543	2547630.410	0	24	0.00	80	NC	NR	7	03+483.625	03+764.124	621840.299	2548196.85	621611.78	2548351.586	450	Right	03+433.625	50	50	03+814.124	03+628.599	621701.114	2548237.408	35	42	50.40	80	NC	NR	8	05+457.850	05+463.687	620643.013	2549740.884	620639.67	2549745.669	2000	Left	-	-	-	-	05+460.769	620641.345	2549743.279	0	10	1.20	80	NC	NR	9	06+555.740	06+575.709	620012.916	2550639.961	620001.537	2550656.371	2000	Right	-	-	-	-	06+565.724	620007.185	2550648.138	0	34	19.20	80	3.80	NR	10	07+018.433	07+032.584	619751.08	2551021.44	619743.033	2551033.081	2000	Left	-	-	-	-	07+025.509	619747.077	2551027.275	0	24	18.00	50	7.00	NR	11	08+000.376	08+131.006	619189.739	2551827.112	619104.158	2551925.585	750	Left	07+970.376	30	30	08+161.006	08+065.856	619151.248	2551880.084	9	58	44.40	50	5.80	NR	12	08+983.573	09+022.284	618479.461	2552505.777	618455.792	2552536.196	120	Right	-	-	-	-	09+003.098	618465.152	2552519.061	18	28	58.80	50	5.60	0.6	13	09+087.861	09+172.025	618424.354	2552593.747	618401.407	2552674.008	190	Right	-	-	-	-	09+130.645	618403.844	2552631.294	25	22	48.00	50	5.60	0.6	14	09+320.956	09+356.371	618392.923	2552822.697	618394.039	2552858.049	200	Right	-	-	-	-	09+338.710	618391.912	2552840.422	10	8	45.60	35	7.00	0.6	15	09+404.693	09+425.749	618399.827	2552906.022	618401.246	2552927.022	200	Left	-	-	-	-	09+415.231	618401.090	2552916.485	6	1	55.20	35	5.40	0.6
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3	00+172.212	00+191.369	624902.224	2547320.719	624884.871	2547328.747	90	Left	00+152.212	20	20	00+211.369	00+181.827	624893.977	2547325.660	12	11	42.00	20	5.90	0.9																																																																																																																																																																																																																																																																																																																																																																																																													
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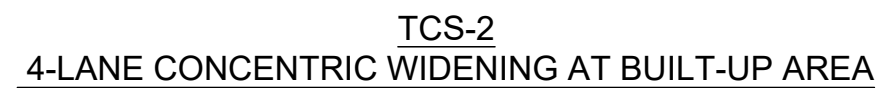
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G

Vertical Alignment Details													
Vertical Curve No.	Vertical Intersection Points (VIP) Details			Vertical Curve Details				Gadient Details			Curve Type	Curve Length (m)	K Value
	Chainage (Km)	Lavel, Z (m)	M Value	Start Ch. (Km)	Start Z. (m)	End Ch. (Km)	End Z (m)	In (%)	Out (%)	Algebric Diff. (%)			
1	0+135.000	5.074	-0.325	0+035.000	4.486	0+235.000	5.012	0.588	-0.062	-0.65	Hog	200	308
2	1+181.070	4.427	1.281	1+081.070	4.489	1+281.070	6.927	-0.06	2.5	2.562	Sag	200	78
3	1+516.000	12.8	-1.25	1+416.000	10.3	1+616.000	12.8	2.5	0	-2.5	Hog	200	80
4	1+784.000	12.8	-1.25	1+684.000	12.8	1+884.000	10.3	0	-2.5	-2.5	Hog	200	80
5	2+109.180	4.67	1.265	2+009.180	7.17	2+209.180	4.701	-2.5	0.031	2.531	Sag	200	79
6	5+856.000	5.828	0.193	5+706.000	5.782	6+006.000	6.743	0.031	0.61	0.579	Sag	300	518
7	6+462.000	9.526	-0.37	6+312.000	8.611	6+612.000	8.776	0.61	-0.5	-1.11	Hog	300	270
8	7+243.444	5.619	0.275	7+093.444	6.369	7+393.444	6.107	-0.5	0.325	0.825	Sag	300	364
9	7+888.333	7.716	-0.074	7+738.333	7.228	8+038.333	7.87	0.325	0.103	-0.222	Hog	300	1349
10	8+474.886	8.32	0.165	8+374.886	8.217	8+574.886	8.752	0.103	0.433	0.33	Sag	200	607
11	9+701.202	13.624	-0.263	9+551.202	12.975	9+851.202	13.087	0.433	-0.358	-0.79	Hog	300	380

H					<div>PROJECT EXECUTED BY:-</div> <div></div> <div>DEENDAYAL PORT AUTHORITY</div>	<div>DESIGN CONSULTANT:-</div> <div></div> <div>MONARCH</div> <div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div> <div>67, PANMALA, 1 - RUJETA</div> <div>SINHGAD ROAD, PUNE 411 030.</div> <div>PH:020/24330432,24330246,FAX:24330028,</div> <div>e-mail:enquiry@monarchpune.in</div>	DRAWN	P.W	PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)					
	DESIGN	M.P													
	CHECKED	Y.J													
	APPROVED	S.D	TITLE:	VERTICAL CURVE DETAIL KM 0+000 TO KM 9+000											
	Scale:							Date:							
	H							Mar - 2023							
REV	DATE	DESCRIPTION OF REVISIONS	BY	DRG NO.:	KA-GA/VCD-1	REV.	SHEET:								
	1		2		3		4		5		6		7		8

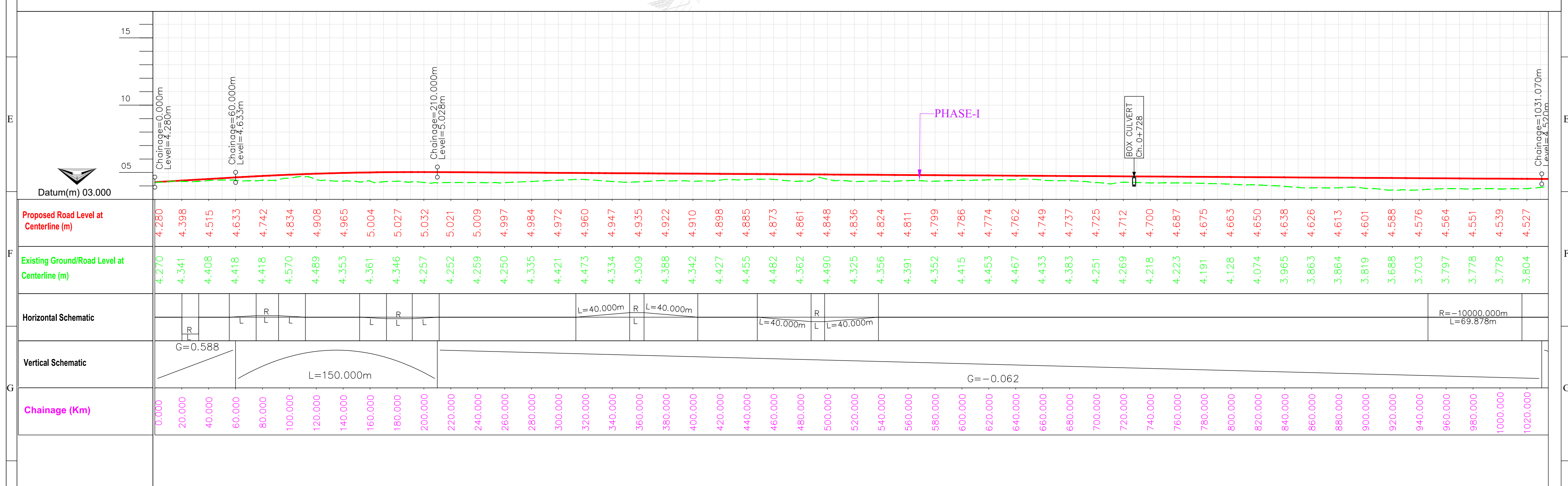
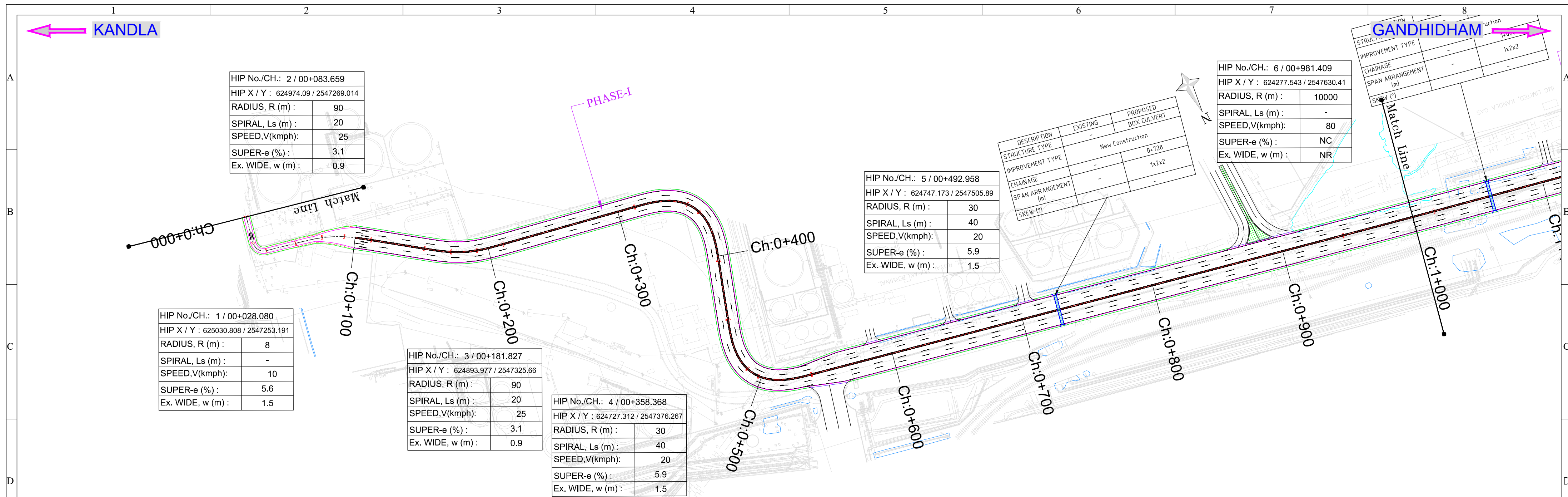
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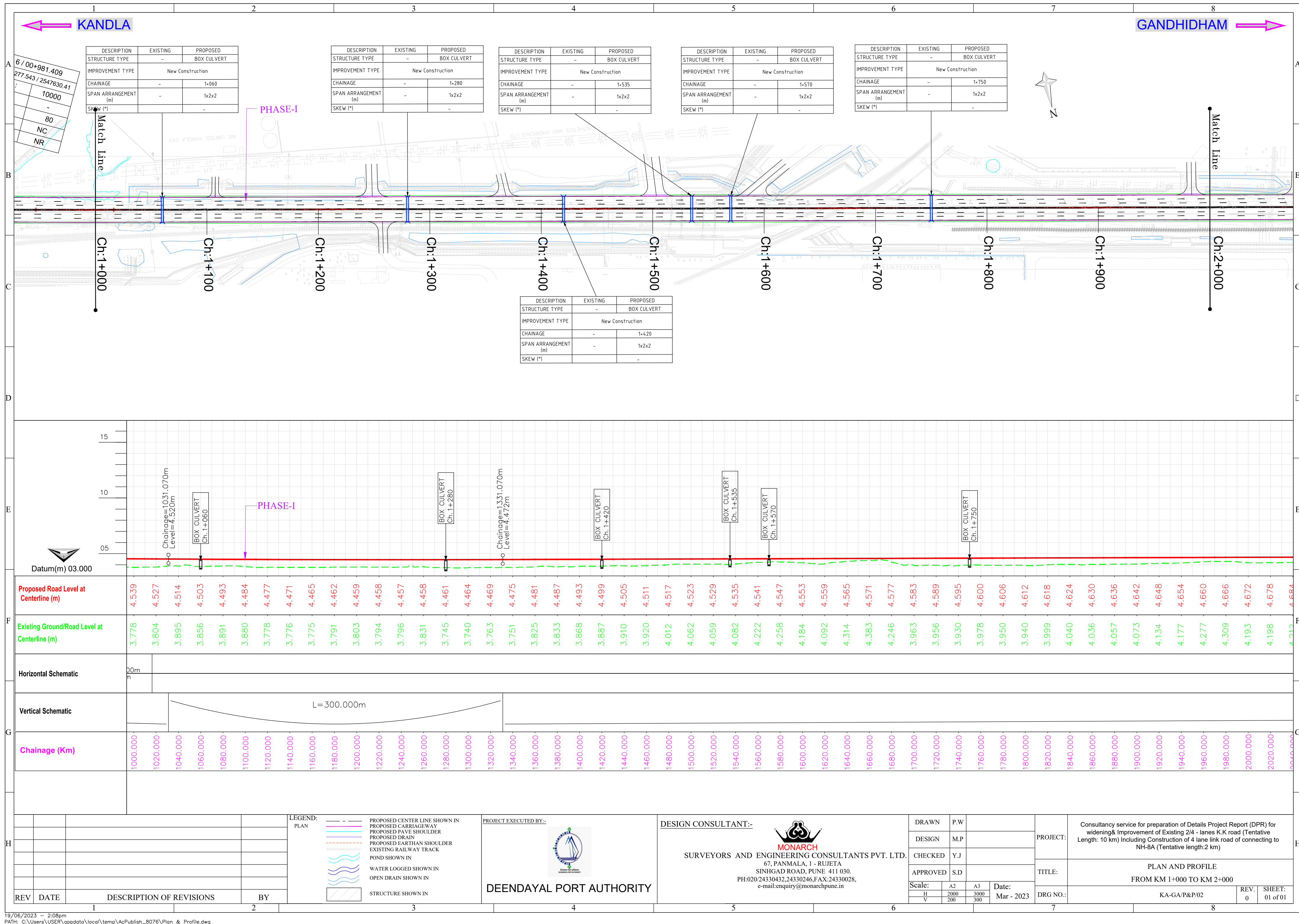
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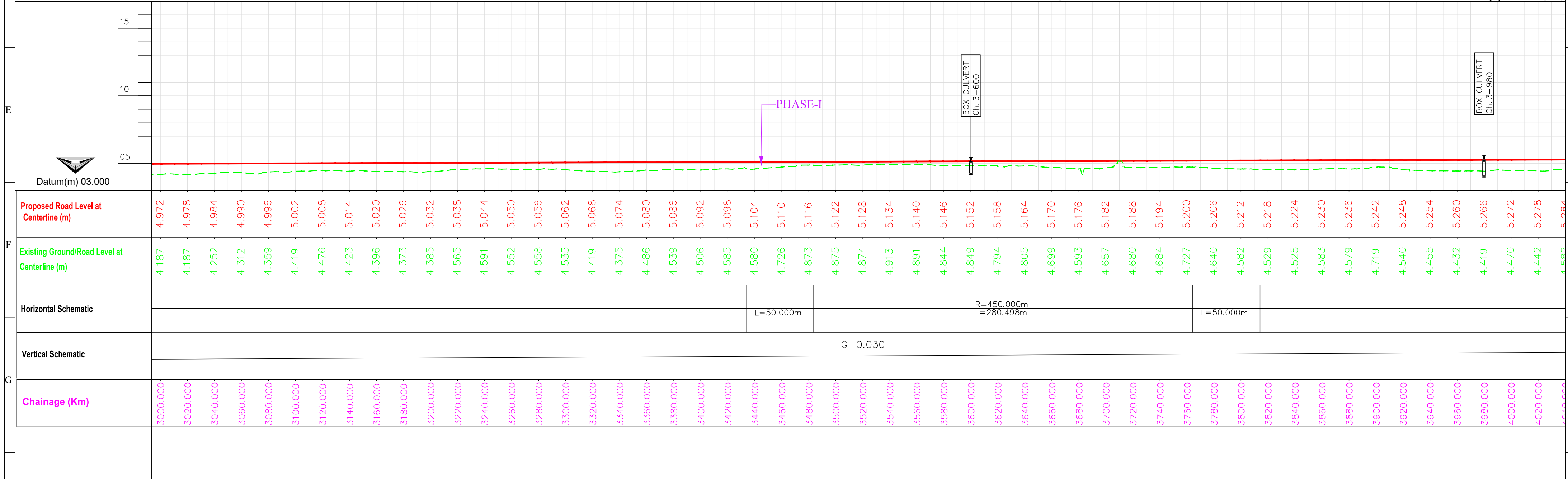
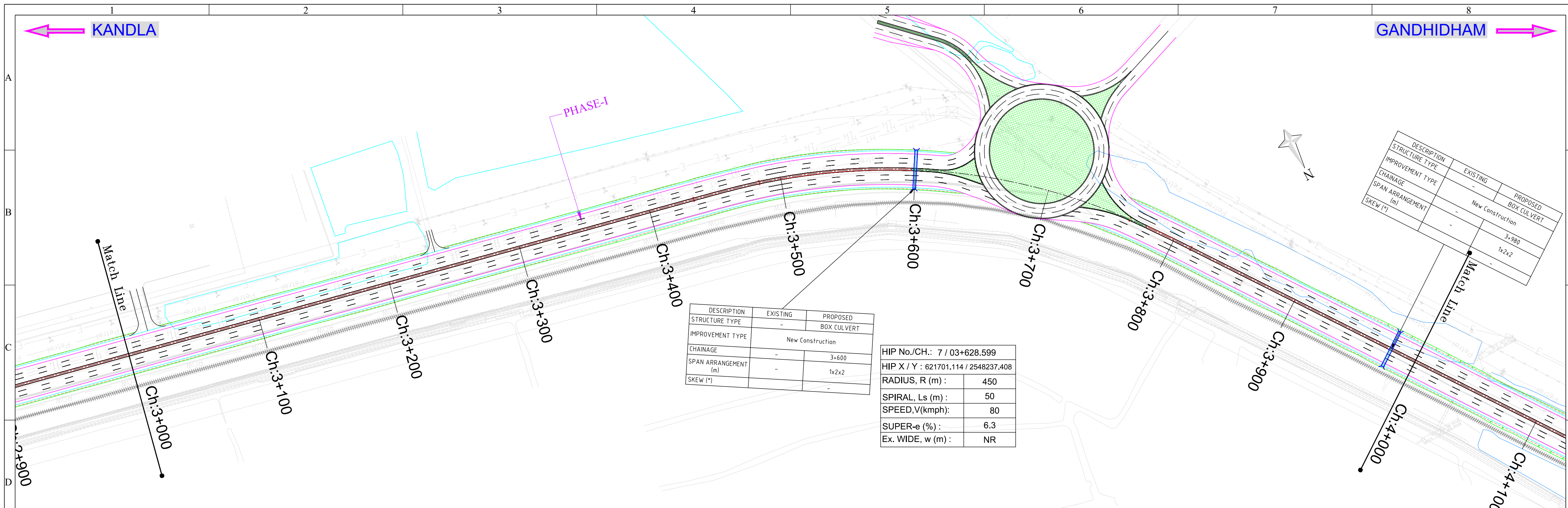


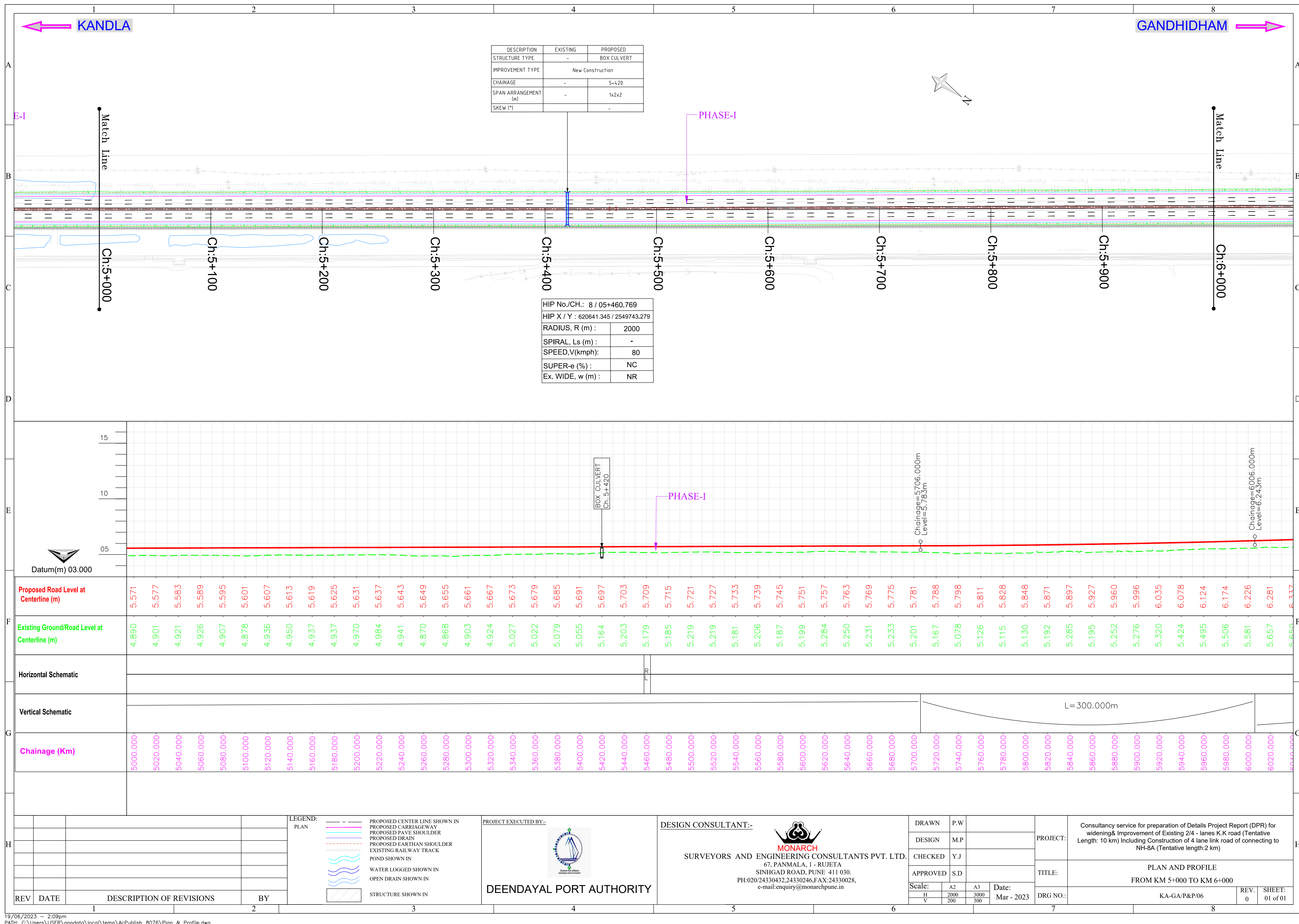
PLAN AND PROFILE

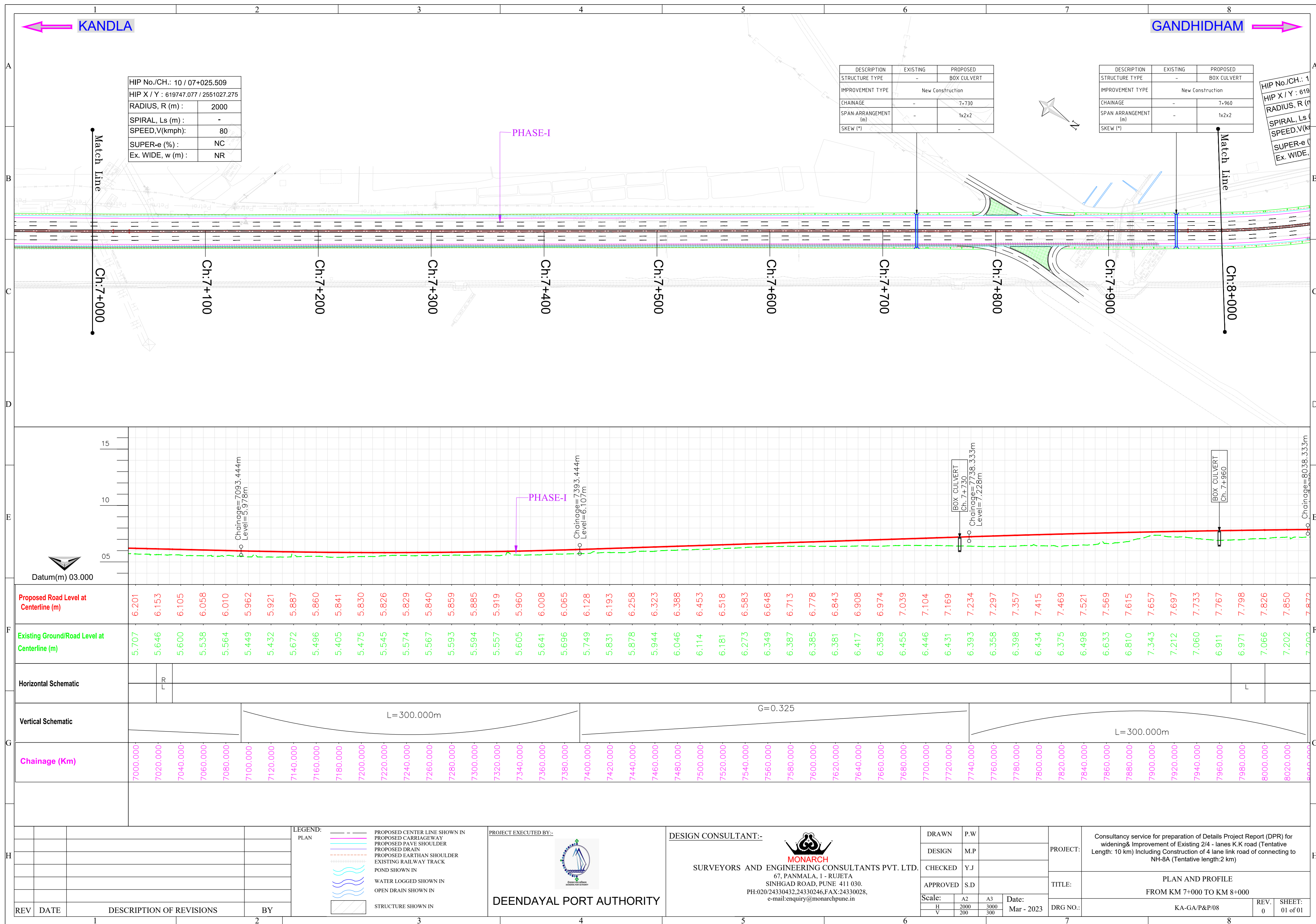


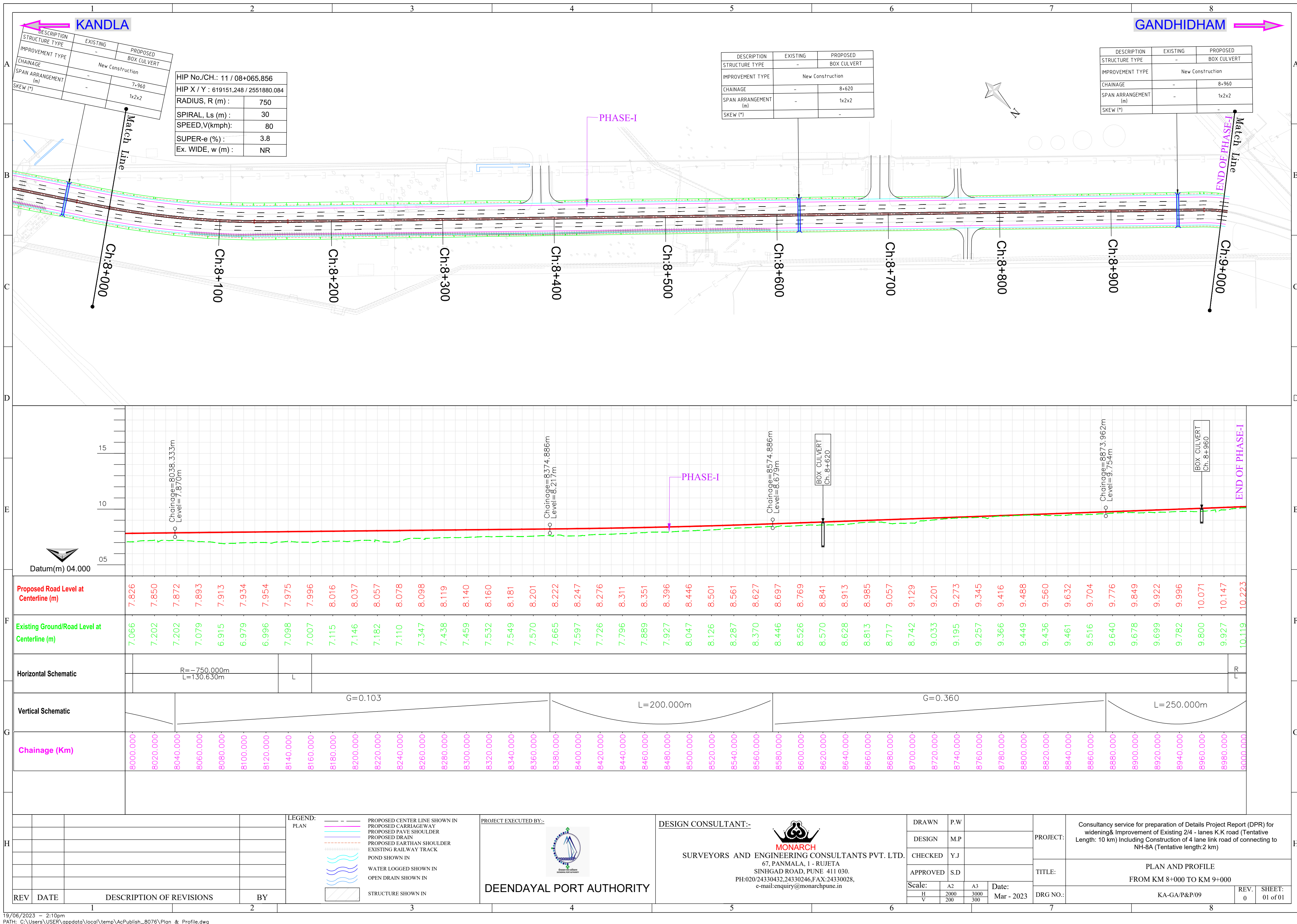
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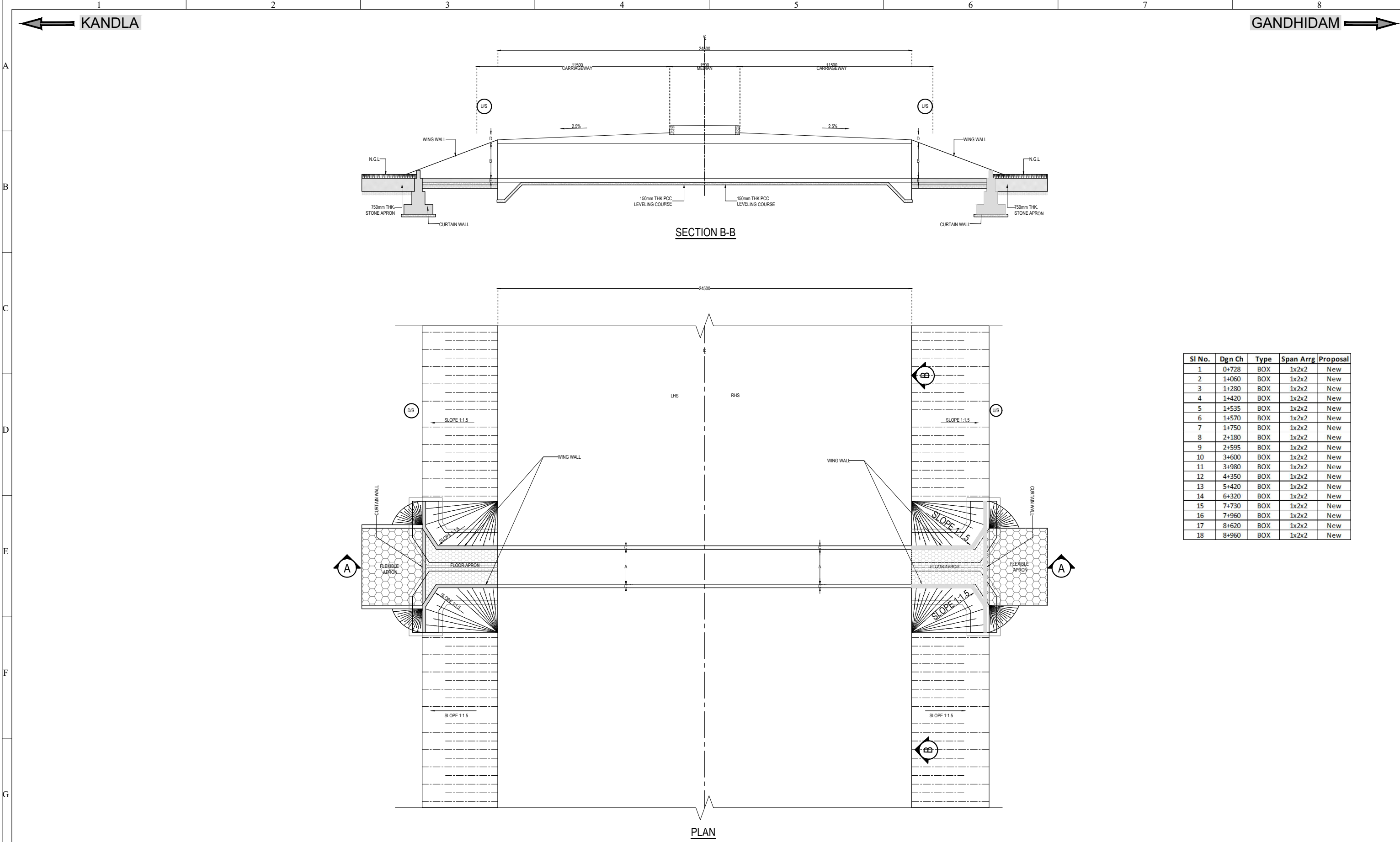
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STRUCTURES DETAILS



Sl No.	Dgn Ch	Type	Span Arrg	Proposal
1	0+728	BOX	1x2x2	New
2	1+060	BOX	1x2x2	New
3	1+280	BOX	1x2x2	New
4	1+420	BOX	1x2x2	New
5	1+535	BOX	1x2x2	New
6	1+570	BOX	1x2x2	New
7	1+750	BOX	1x2x2	New
8	2+180	BOX	1x2x2	New
9	2+595	BOX	1x2x2	New
10	3+600	BOX	1x2x2	New
11	3+980	BOX	1x2x2	New
12	4+350	BOX	1x2x2	New
13	5+420	BOX	1x2x2	New
14	6+320	BOX	1x2x2	New
15	7+730	BOX	1x2x2	New
16	7+960	BOX	1x2x2	New
17	8+620	BOX	1x2x2	New
18	8+960	BOX	1x2x2	New


REV	DATE	DESCRIPTION OF REVISIONS	BY

LEGEND:

PLAN


- PROPOSED CENTER LINE SHOWN IN
- PROPOSED CARRIAGEWAY
- PROPOSED PAVE SHOULDER
- PROPOSED DRAIN
- PROPOSED EARTHAN SHOULDER
- EXISTING RAILWAY TRACK
- POND SHOWN IN
- WATER LOGGED SHOWN IN
- OPEN DRAIN SHOWN IN
- STRUCTURE SHOWN IN

PROJECT EXECUTED BY:-



DEENDAYAL PORT AUTHORITY

DESIGN CONSULTANT:-



MONARCH
SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.
67, PANMALA, 1 - RUJETA
SINHGAD ROAD, PUNE 411 030.
PH:020/24330432,24330246,FAX:24330028,
e-mail:enquiry@monarchpune.in

DRAWN	P.W	
DESIGN	M.P	
CHECKED	Y.J	
APPROVED	S.D	
Scale:	A2 H 2000 V 200	A3 3000 300
Date:	APR - 2023	

PROJECT:

Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)

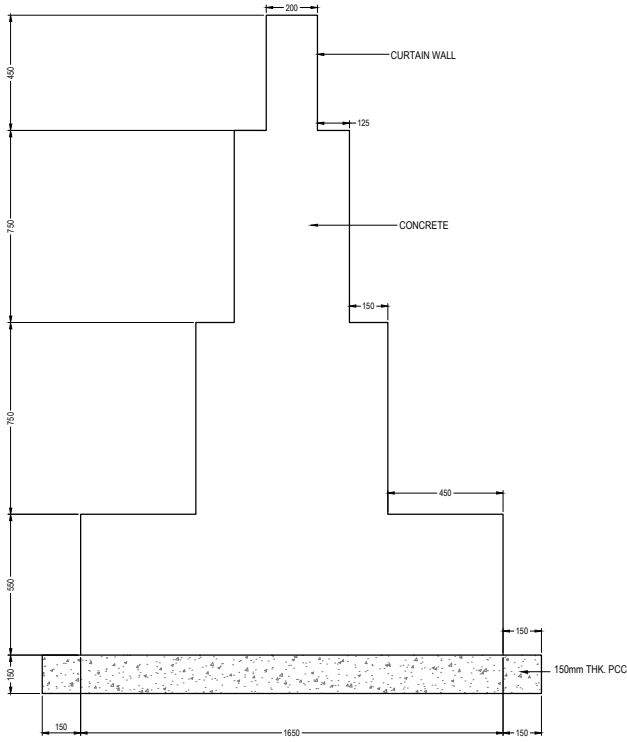
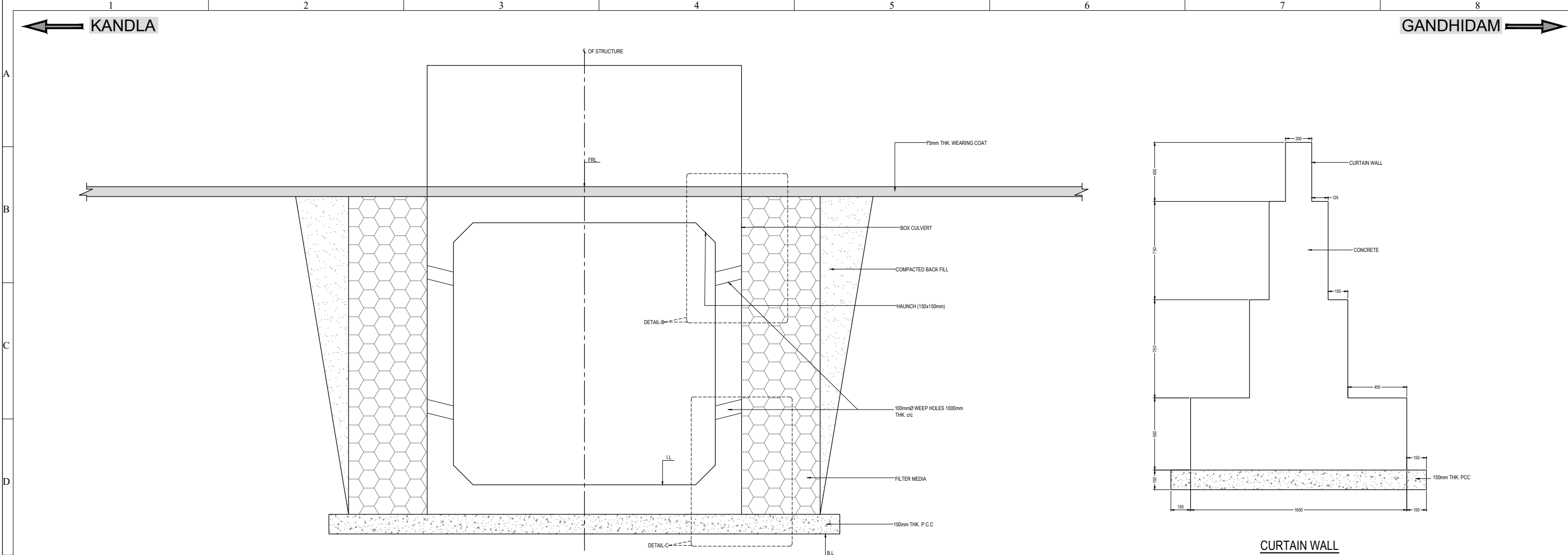
TITLE:

DETAILED PLAN & L-SECTION
BOX CULVERT 2X2M

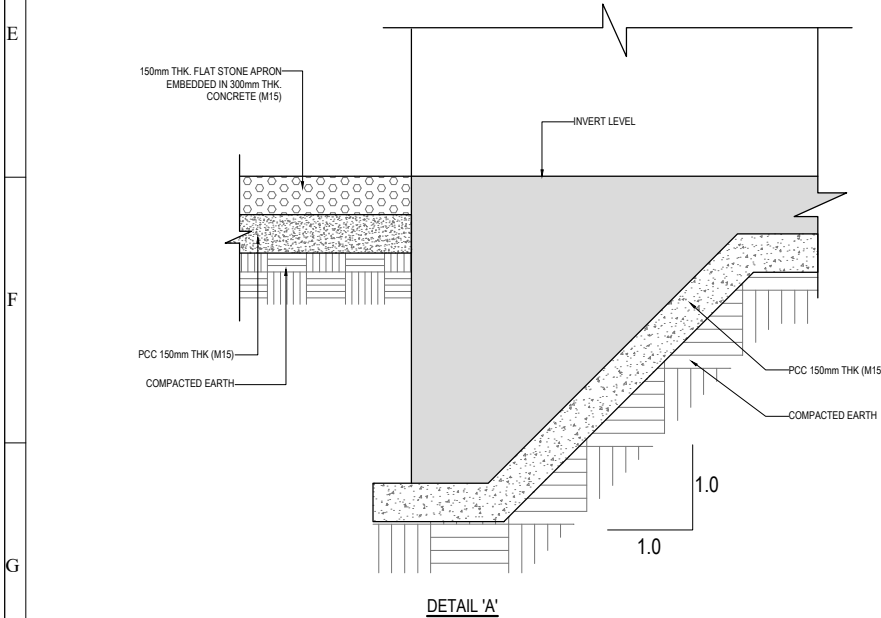
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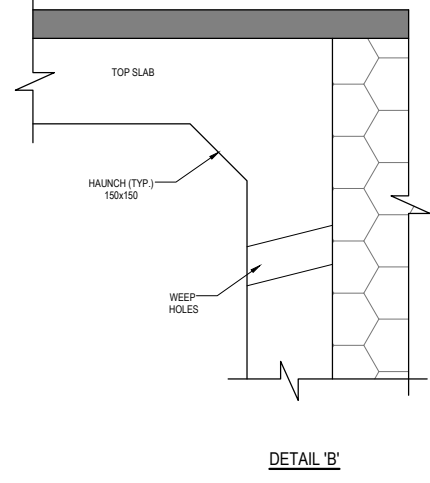
SHEET:



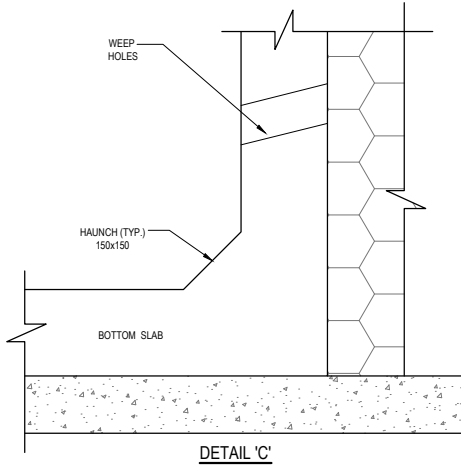
CURTAIN WALL



DETAIL 'A'



DETAIL 'B'





DETAIL 'C'

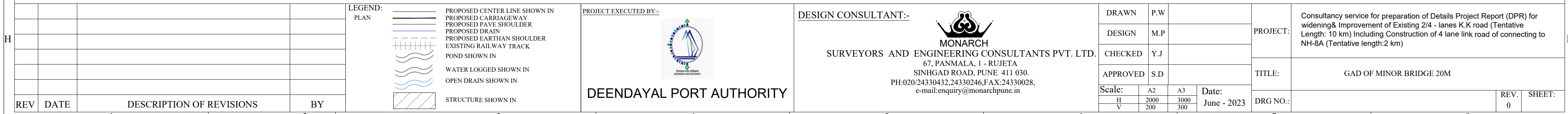
NOTES :-

- ALL DIMENSIONS ARE IN MILLIMETERS, LEVELS ARE IN METERS AND CHAINAGE ARE IN KILOMETERS, UNLESS OTHERWISE MENTIONED ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.
- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE RELEVANT PLAN AND PROFILE DRAWINGS OF ROAD.
- CONCRETE GRADE :-
 - RCC BOX : M25
 - LEVELING COURSE : M15
 - CRASH BARRIER : M40
- REINFORCEMENT GRADE - Fe500.
- MINIMUM CLEAR COVER TO ALL REINFORCEMENT SHALL BE :-

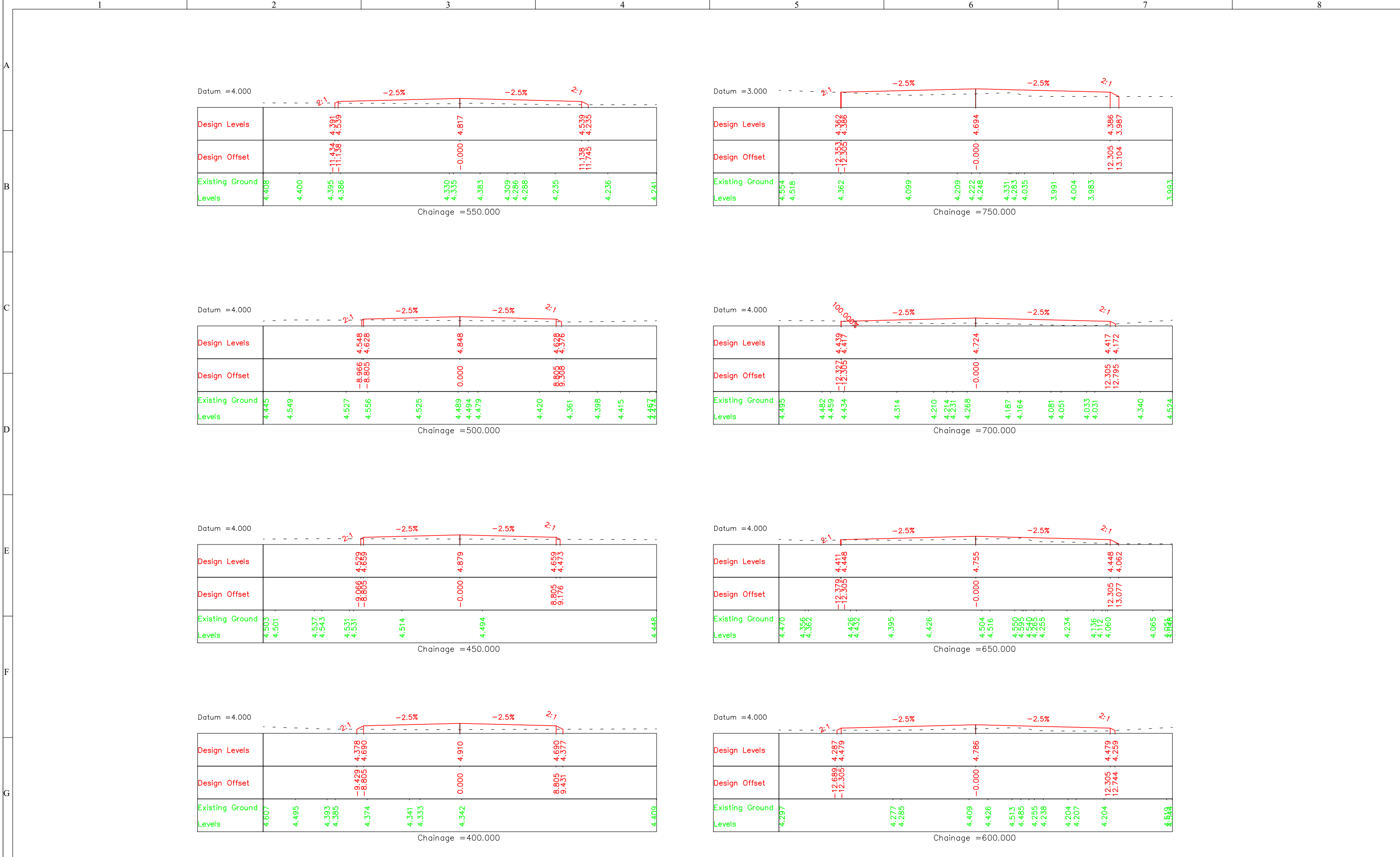
SLAB	EARTH FACE	OPEN FACE
TOP SLAB	75mm	50mm
BOTTOM SLAB	75mm	50mm
OUTER WALL	75mm	50mm
- 600mm THICK FILTER MATERIAL BEHIND ABUTMENT / RETAINING WALL SHALL BE AS PER APPENDIX-6 OF IRC : 78-2014 & MORTH SPECIFICATION.
- WEEP HOLES IN SLOPE 1:1.50, 100 DIA P.V.C. PIPE @SPACINGS 1000mm C/C BOTH HORIZONTALLY AND VERTICALLY SHALL BE PROVIDED IN STAGGERED MANNER IN MEDIAN WALL AND ABOVE GROUND LEVEL / LWL.
- "FRL CROSS-SECTION AND CAMBER ETC. SHOWN IN THIS DRAWINGS SHALL BE VERIFIED WITH CORRESPONDING APPROVED PLAN & PROFILE DRAWINGS AND APPROVED PLAN & PROFILE DRAWING THE SAME SHALL BE BROUGHT TO THE NOTICE OF ENGINEER FOR THE FOR HIS FINAL DECISION".
- THE FOLLOWING LOADS HAVE BEEN CONSIDERED IN THE DESIGN :-
 - DEAD LOAD.
 - SIDL - FILL & CRASH BARRIER.
 - CLASS AA TRACK.
 - 40T BOGGIE.
 - CLASS TOR WHEEL.
 - BREAKING LOAD IS TAKEN AS 20% OF THE LIVE LOAD ON TOP SLAB.
 - TEMPERATURE LOADING FOR UNIFORM RISE AND TEMPERATURE GRADIENT IS CONSIDERED.
- DRAINAGE SPOUT SHALL BE PROVIDED IN DECK AS PER MORTH STANDARD.
- 300mm THICK DRY STONE REVETMENT SHOULD BE DONE. OVER 150mm THICK FILTER MEDIA.
- SOIL BEARING CAPACITY :-
 - FOUNDATION HAS BEEN DESIGNED FOR PRESSURE 15 T/M².
 - DURING EXCAVATION FOR FOUNDATION LOOSE POCKETS SHOULD BE CLEARED AND FILLED WITH PCC BEFORE LAYING THE PCC LEVELING COURSE.
- SEISMIC ZONE V.
- REINFORCEMENT FOR CRASH BARRIER / PARAPET WALL ANCHORED IN THE TOP SLAB BEFORE CASTING THE SLAB.
- "DK IS DEPTH OF KEY AT BASE SLAB" :-

FOR BASE SLAB THICKNESS	VALUE OF 'DK'
16.1. UPTO 900mm	1200mm
16.2. UPTO 900mm	1200mm
16.3. GREATER THAN 900mm	d+300mm
16.4. d-BASE SLAB THICKNESS	
- PARAPET & WING WALL SEPARATE DRAWINGS WILL BE PROVIDED.
- FOR CLARITY PAVEMENT MATERIALS ARE NOT SHOWN.

H				<div>LEGEND:</div> <div>PLAN</div> <div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div></div> <div>PROPOSED CENTER LINE SHOWN IN</div> <div>PROPOSED CARRIAGEWAY</div> <div>PROPOSED PAVE SHOULDER</div> <div>PROPOSED DRAIN</div> <div>PROPOSED EARTHAN SHOULDER</div> <div>EXISTING RAILWAY TRACK</div> <div>POND SHOWN IN</div> <div>WATER LOGGED SHOWN IN</div> <div>OPEN DRAIN SHOWN IN</div> <div>STRUCTURE SHOWN IN</div>	<div>PROJECT EXECUTED BY:-</div> <div></div> <div>DEENDAYAL PORT AUTHORITY</div>	<div>DESIGN CONSULTANT:-</div> <div></div> <div>MONARCH</div> <div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div> <div>67, PANMALA, 1 - RUJETA</div> <div>SINHGAD ROAD, PUNE 411 030.</div> <div>PH:020/24330432,24330246,FAX:24330028,</div> <div>e-mail:enquiry@monarchpune.in</div>	<div>DRAWN</div> <div>P.W</div> <div></div> <div>DESIGN</div> <div>M.P</div> <div></div> <div>CHECKED</div> <div>Y.J</div> <div></div> <div>APPROVED</div> <div>S.D</div> <div></div> <div>Scale:</div> <div><div>H</div><div>V</div></div> <div><div>A2</div><div>2000</div><div>200</div></div> <div><div>A3</div><div>3000</div><div>300</div></div> <div>Date:</div> <div>APR - 2023</div>	<div>PROJECT:</div> <div>Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K,K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)</div>	<div>TITLE:</div> <div>DETAILED PLAN & L-SECTION</div> <div>BOX CULVERT 2X2M</div>	<div>DRG NO.:</div> <div></div>	<div>REV.</div> <div>0</div>	<div>SHEET:</div> <div></div>	
	REV	DATE	DESCRIPTION OF REVISIONS		BY	1	2	3	4	5	6	7	8

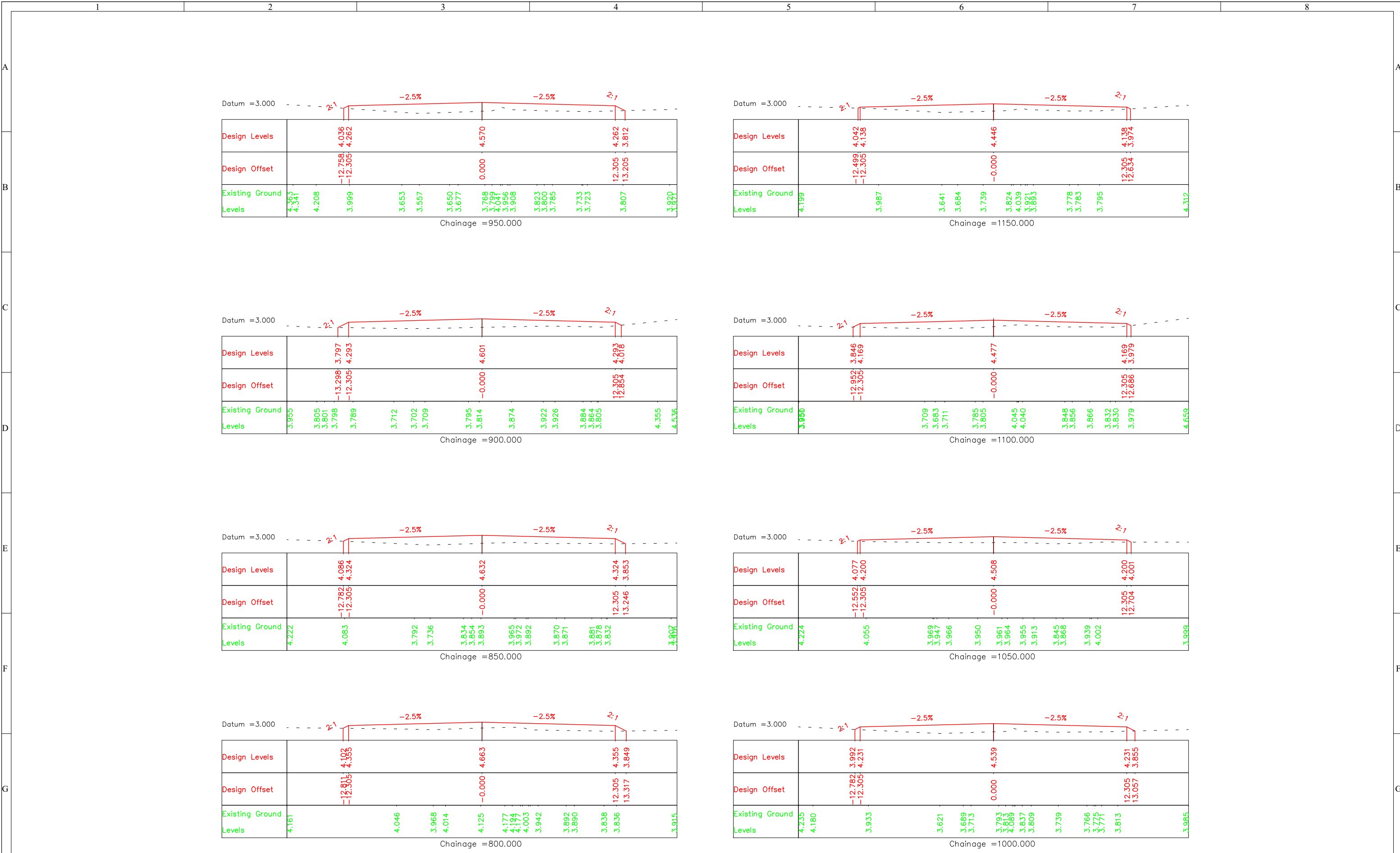


DETAILS CROSS SECTIONS

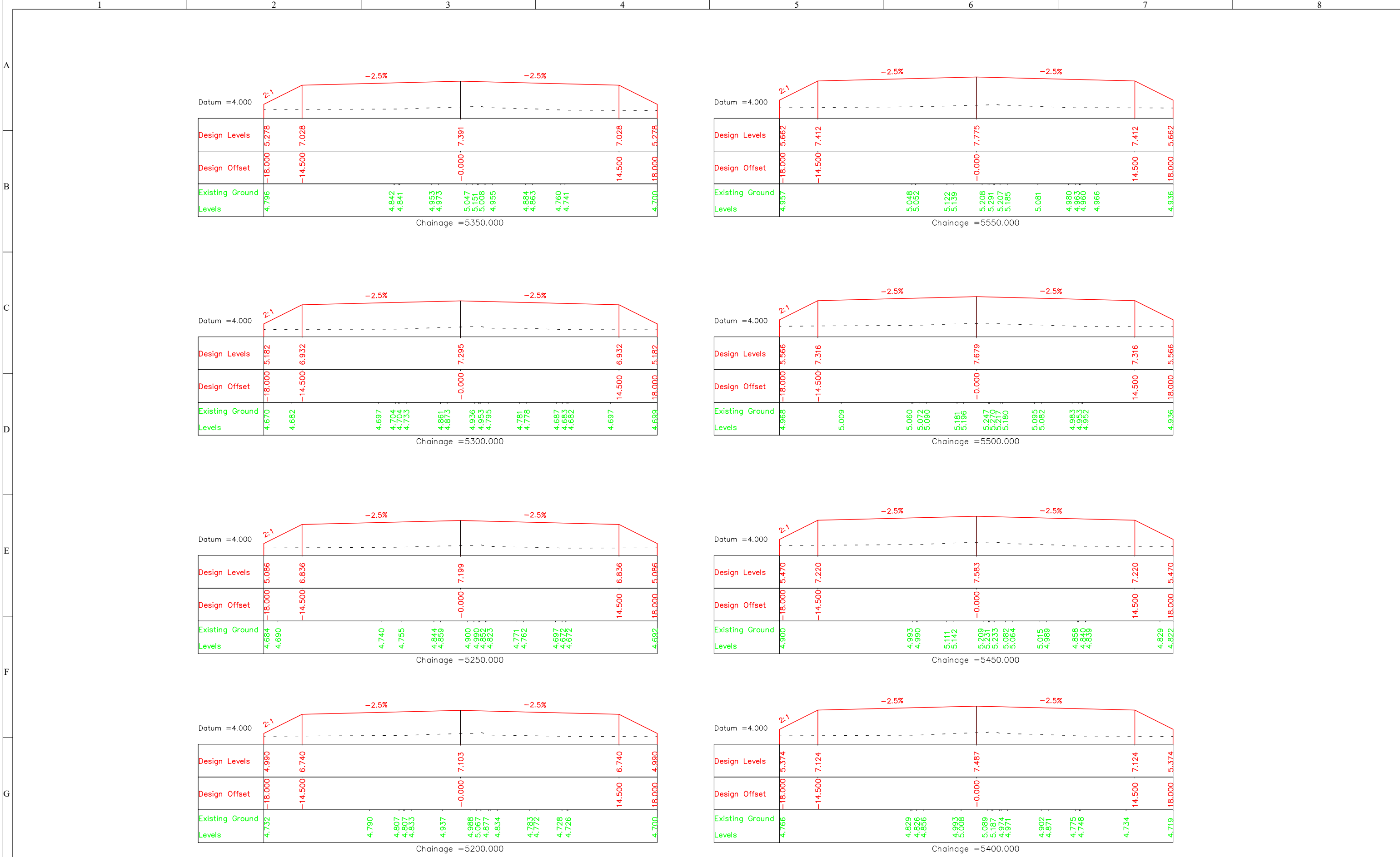


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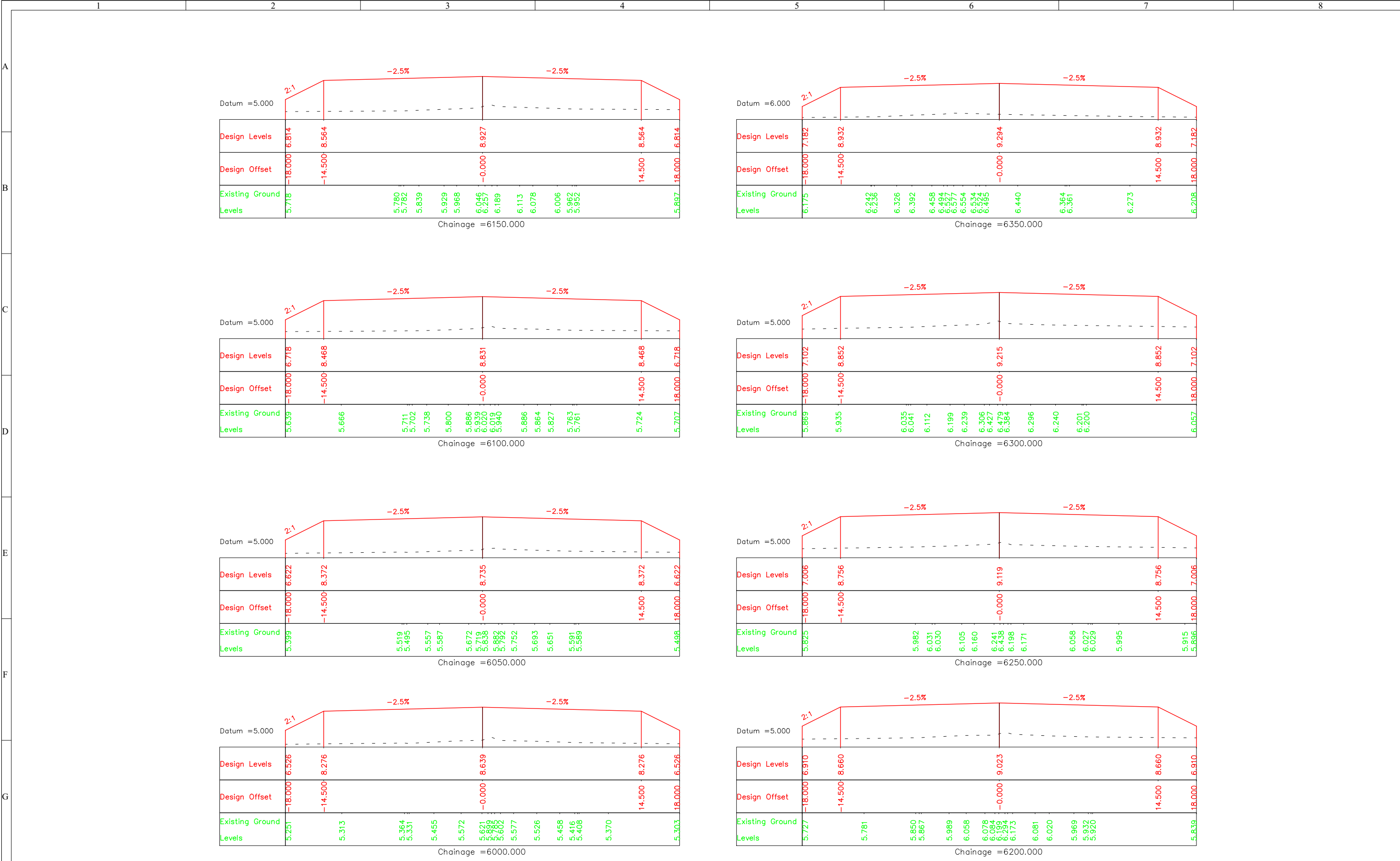


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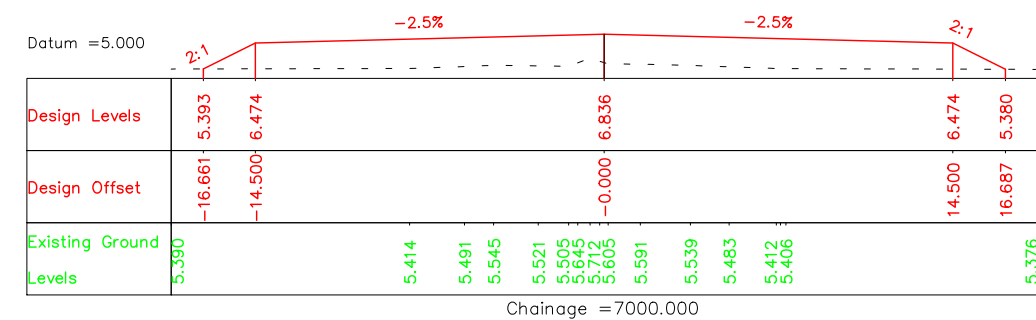
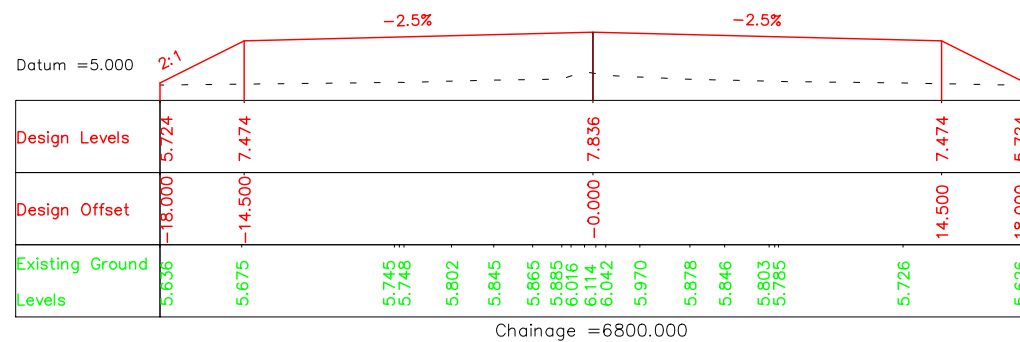
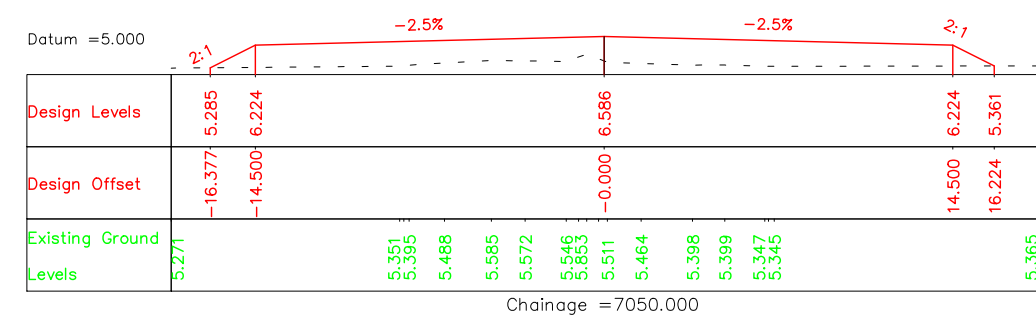
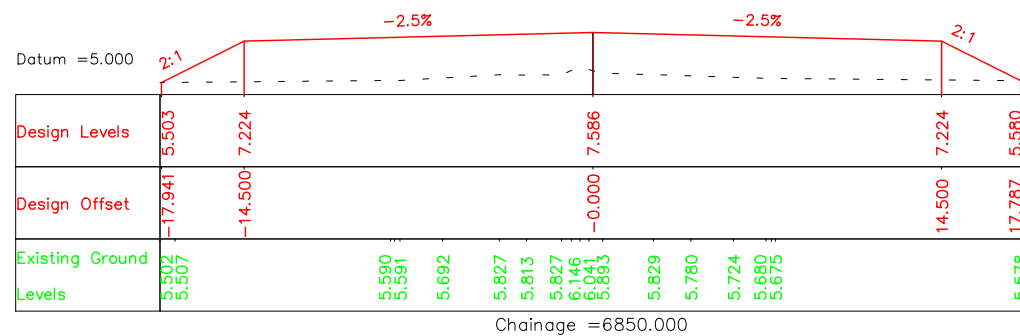
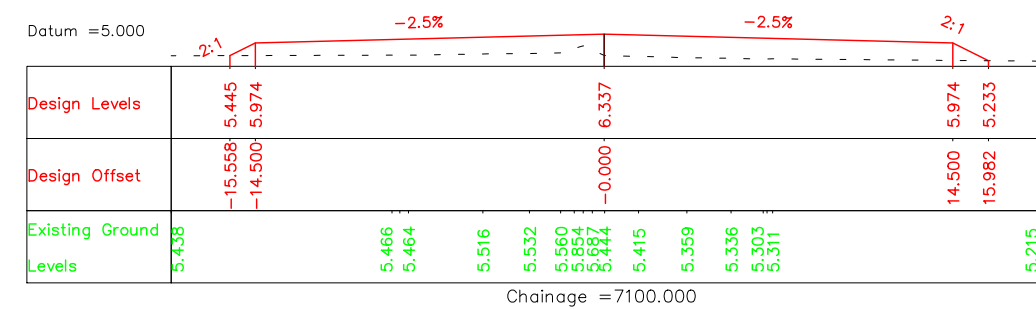
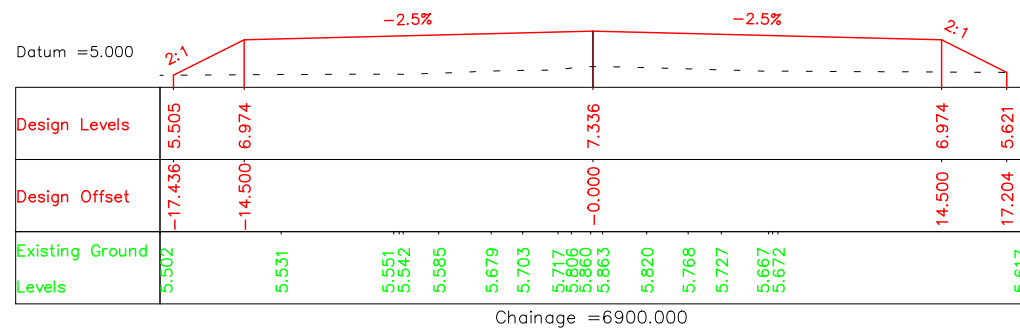
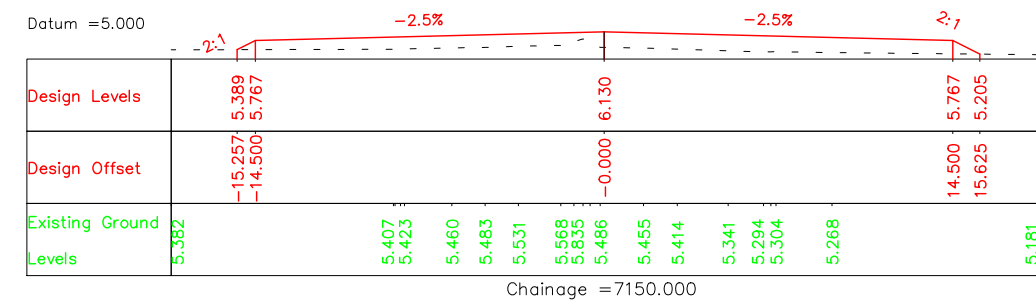
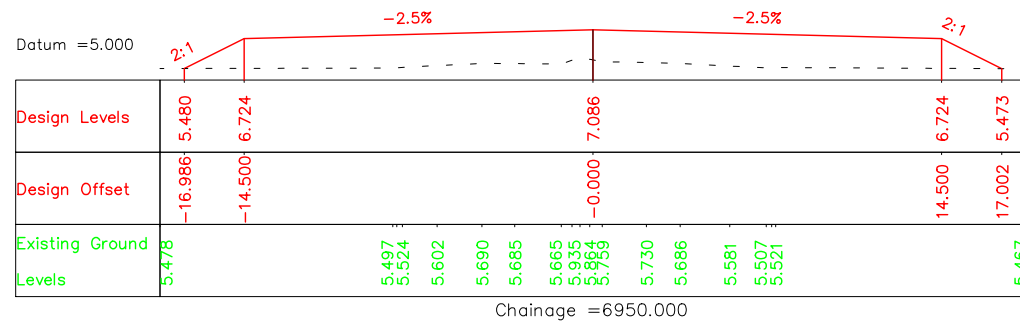


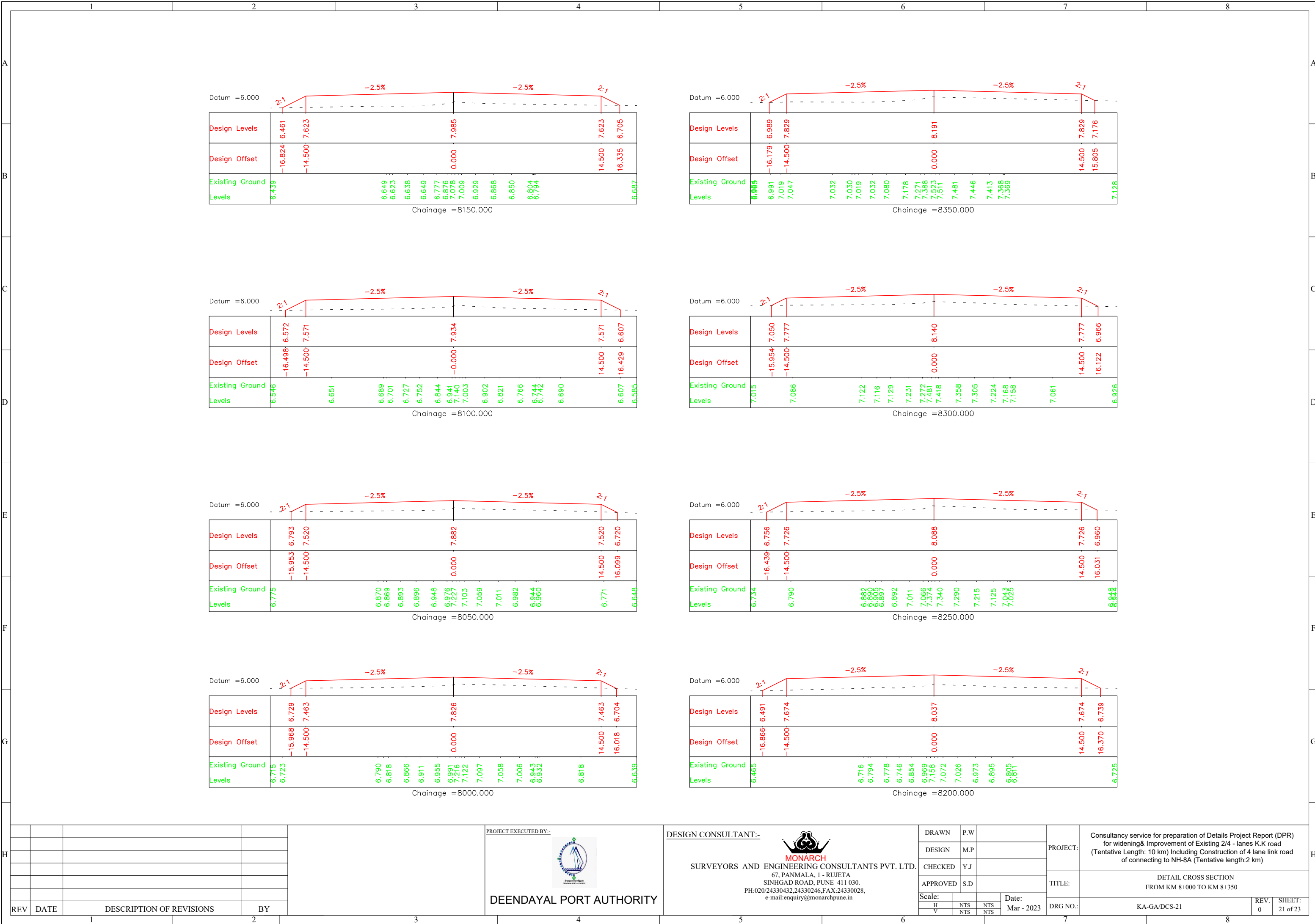
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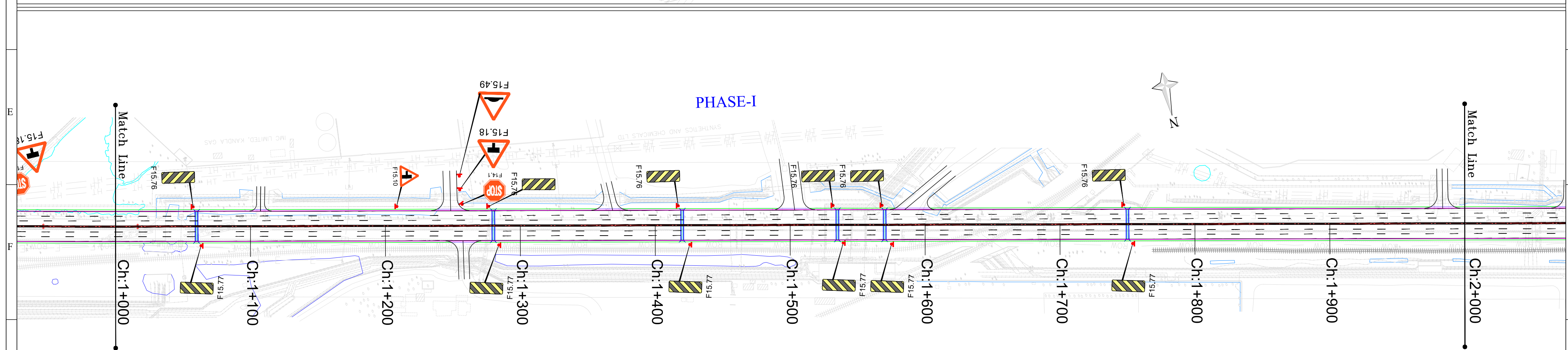
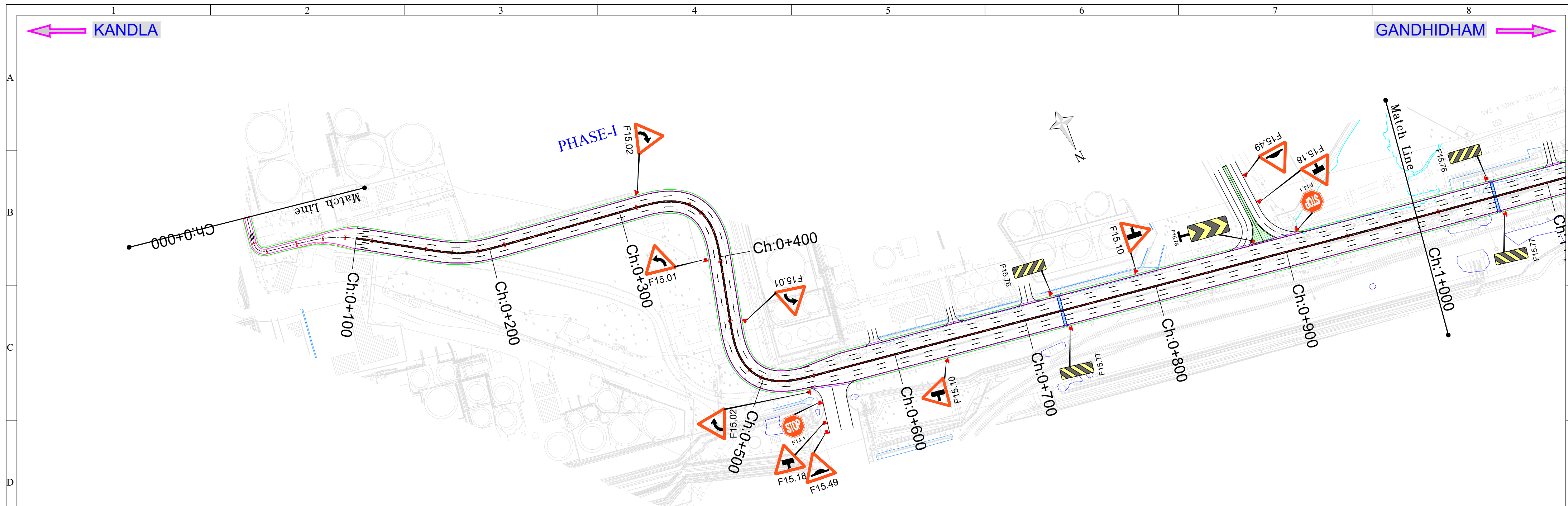




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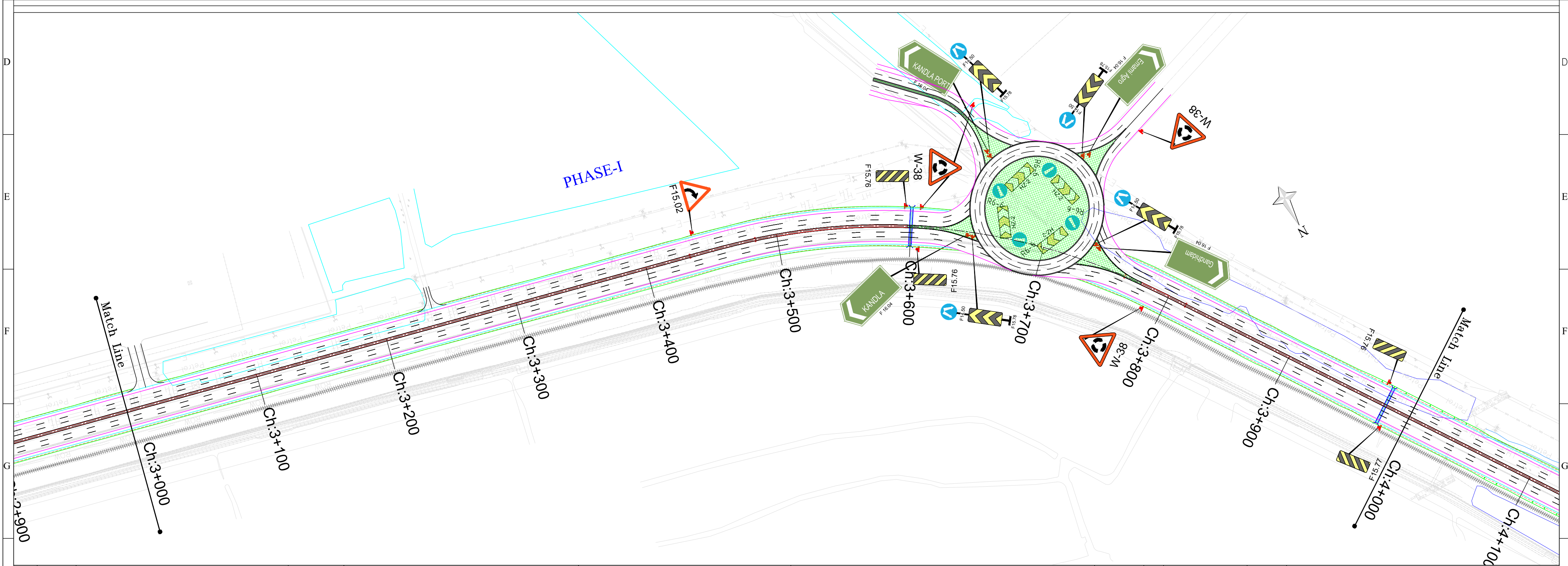
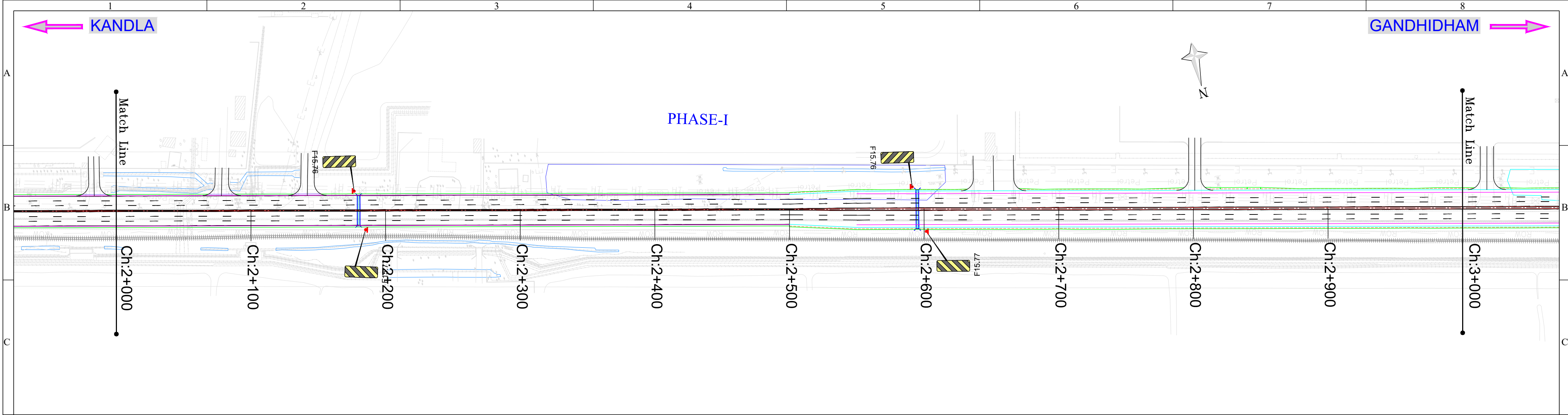
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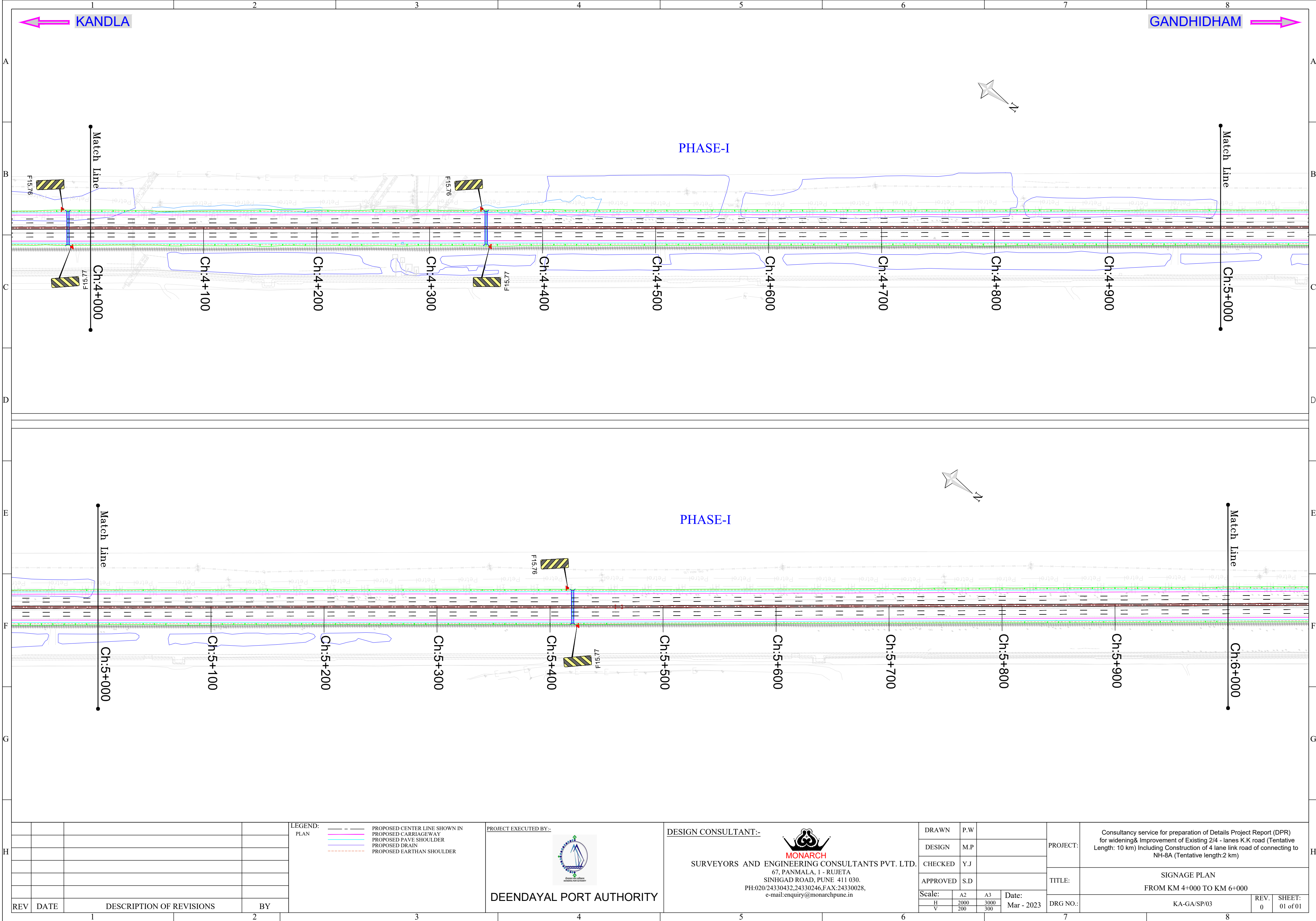
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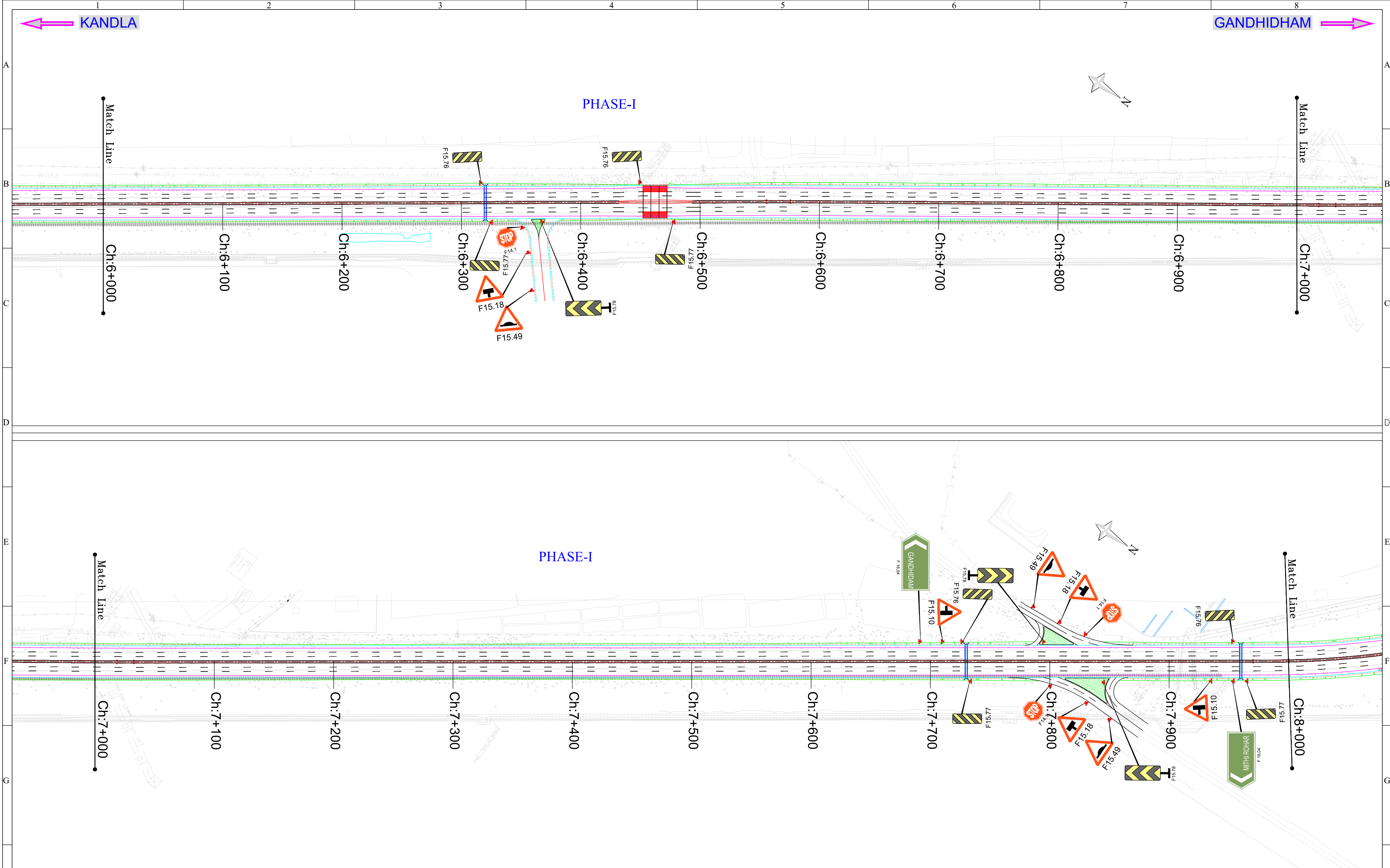
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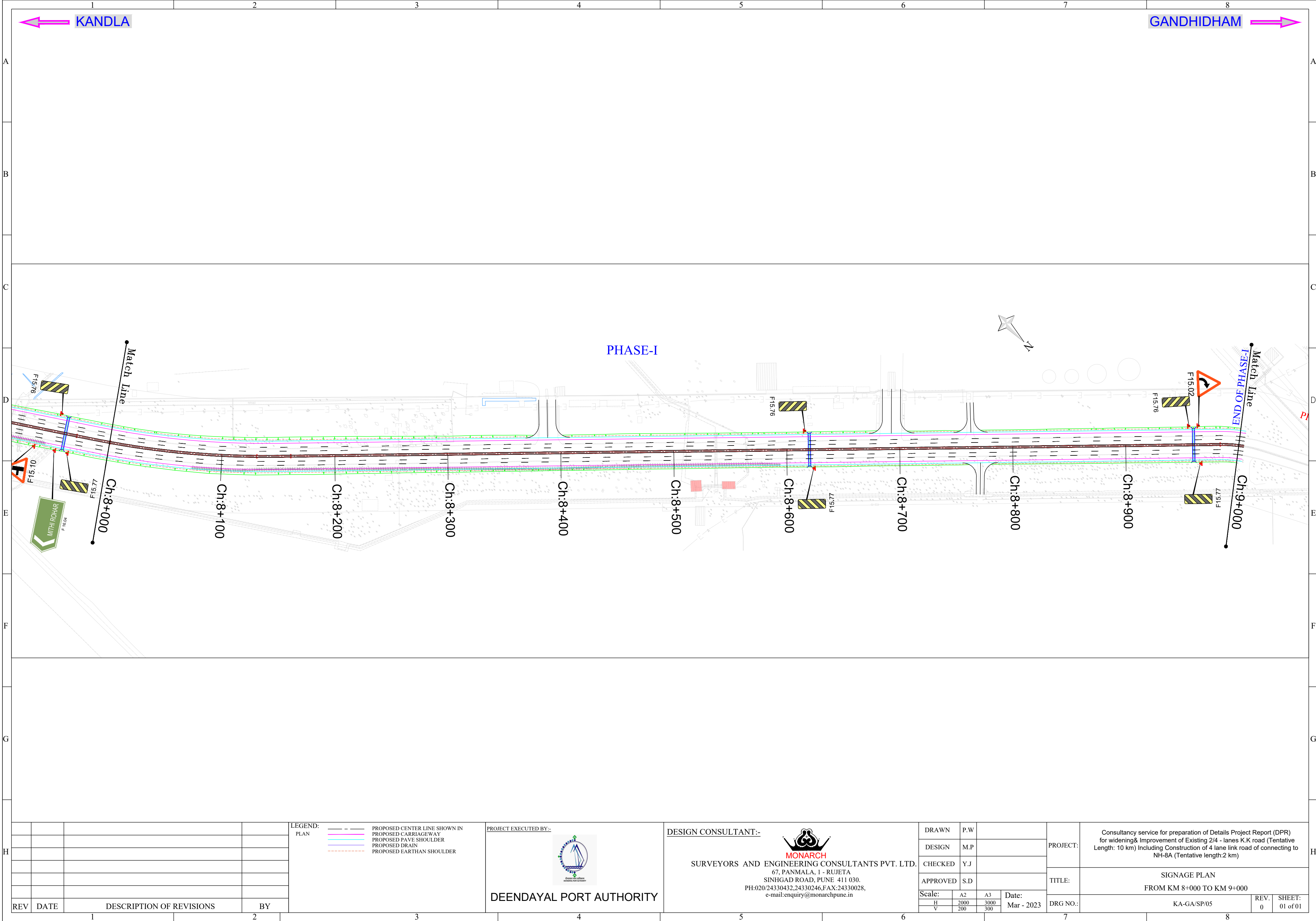
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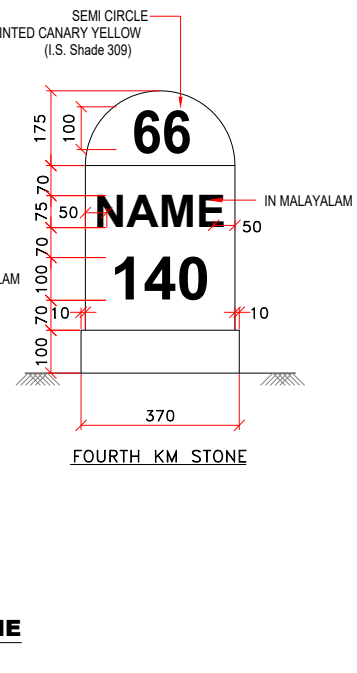
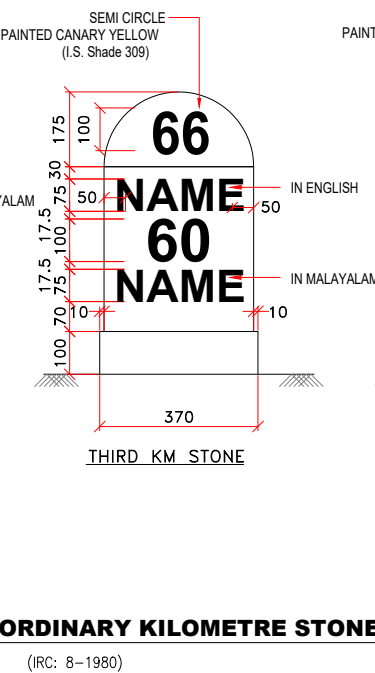
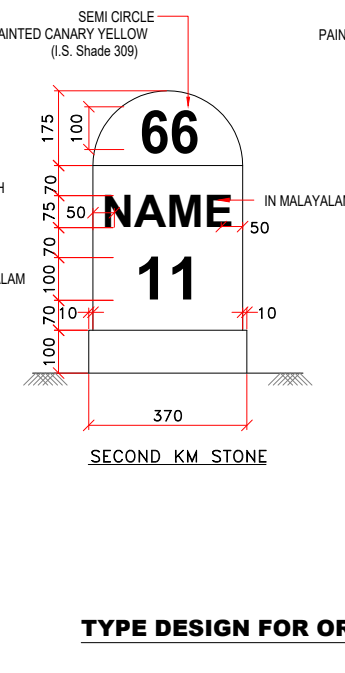
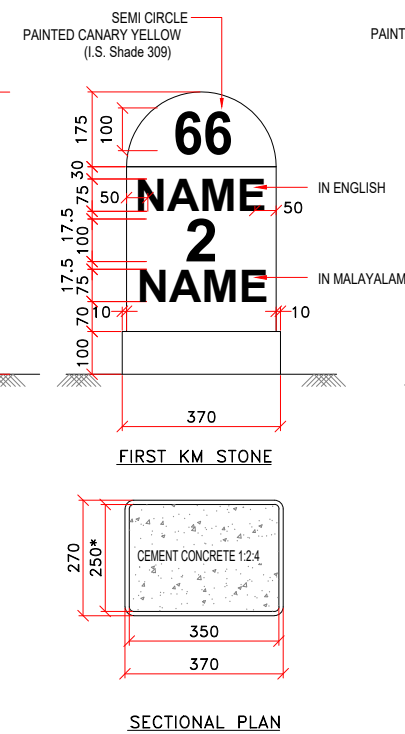
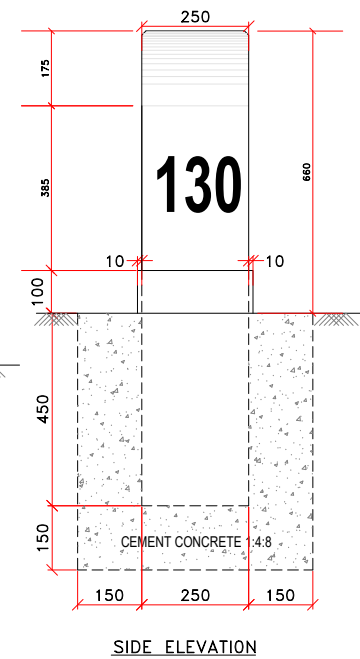
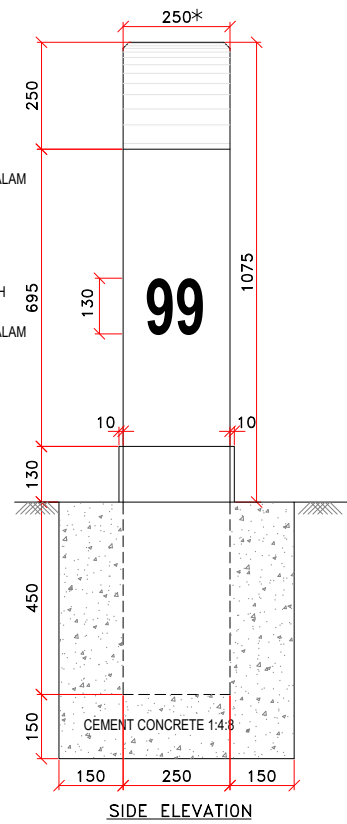
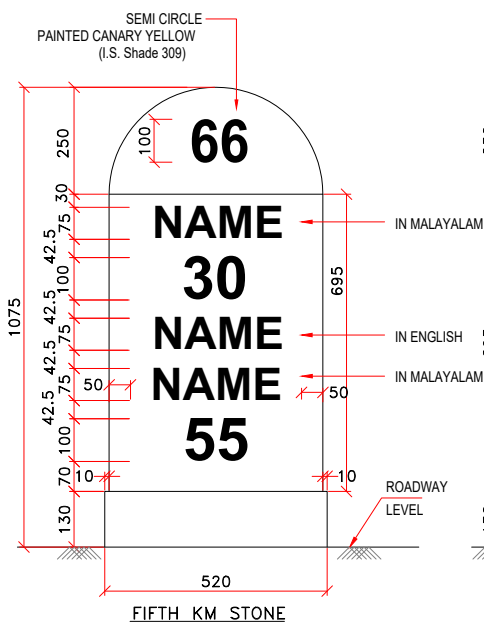
H					<div>LEGEND: PLAN</div> <div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div></div> <div>PROPOSED CENTER LINE SHOWN IN</div> <div>PROPOSED CARRIAGEWAY</div> <div>PROPOSED PAVE SHOULDER</div> <div>PROPOSED DRAIN</div> <div>PROPOSED EARTHAN SHOULDER</div>	<div>PROJECT EXECUTED BY:-</div> <div><div><div></div></div><div>DEENDAYAL PORT AUTHORITY</div></div>	<div>DESIGN CONSULTANT:-</div> <div><div><div></div></div><div>MONARCH</div><div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div><div>67, PANMALA, 1 - RUJETA</div><div>SINHGAD ROAD, PUNE 411 030.</div><div>PH:020/24330432,24330246,FAX:24330028,</div><div>e-mail:enquiry@monarchpune.in</div></div>	DRAWN	P.W		PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)	H									
	DESIGN	M.P																				
	CHECKED	Y.J		TITLE:				SIGNAGE PLAN FROM KM 4+000 TO KM 6+000														
	APPROVED	S.D																				
	Scale:	A2	A3	Date:				DRG NO.:	KA-GA/SP/03	REV. 0	SHEET: 01 of 01											
	H V	2000 200	3000 300	Mar - 2023																		
	REV	DATE	DESCRIPTION OF REVISIONS			BY																
	1		2		3			4			5			6			7			8		



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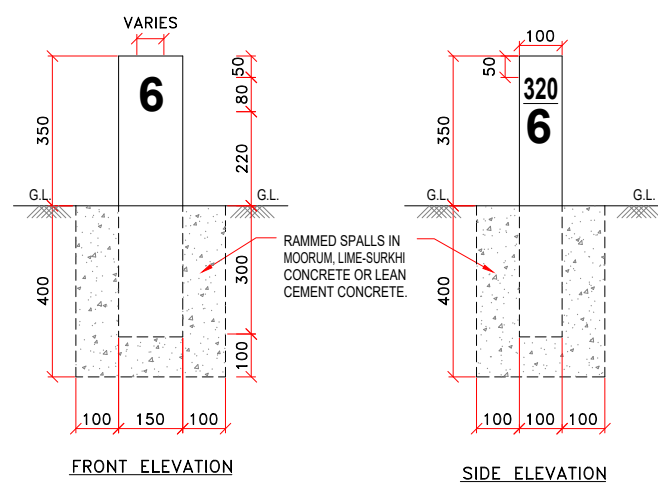


MISCELLANEOUS DETAILS

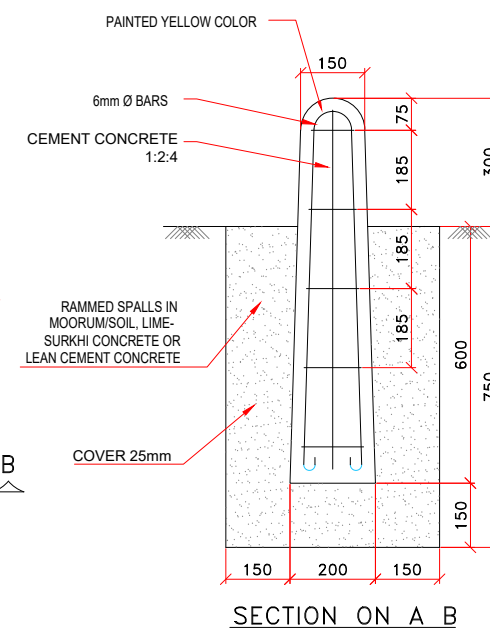
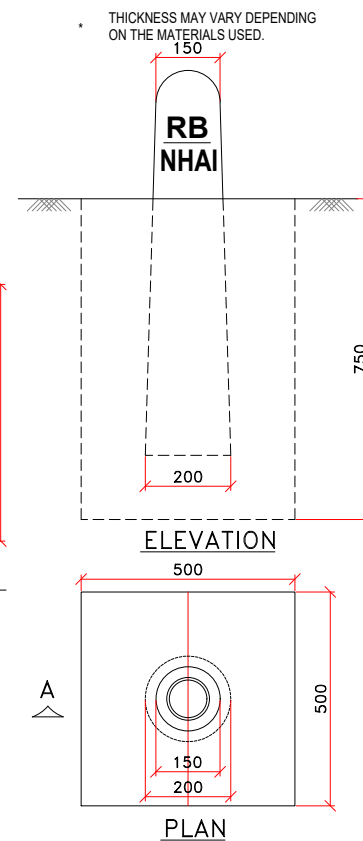
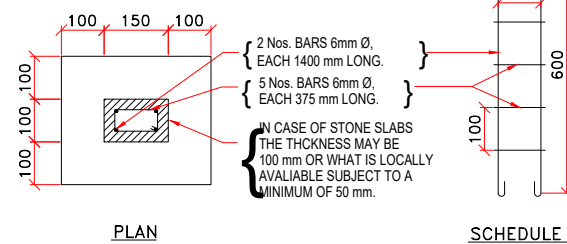


(IRC: 8-1980)

(IRC: 8-1980)



(IRC: 26-1967)



~~(MOST CIRCULAR DT 24)~~

(MOST CIRCULAR DT. 24-12-2004)		
Km. No.	Script and place names	Place to be shown
0	Local and Roman (English)	Terminal/startng station on top in Local language followed by kilometerage and then the name of terminal/startng station will be followed in Roman (English) and below this, the next important town in local language followed by kilometerage in symmetrical manner.
1	Malayalam and Local	Next important town IN ENGLISH on top and in local language on bottom and in between kilometerage in symmetrical manner.
2	Local language	Next important town followed by kilometerage.
3	Malayalam and Local	Terminal Station IN ENGLISH on top and in local language on bottom and in between kilometerage in symmetrical manner.
4	Local language	Terminal station followed by kilometerage.
5	Local and Roman (English)	Terminal station on top in Local language followed by kilometerage and then the name of terminal station will be followed in Roman (English) and below this, the next important town in local language followed by kilometerage in symmetrical manner.
6	Malayalam and Local	Next important town IN ENGLISH on top and in local language on bottom and in between kilometerage in symmetrical manner and so on, repeated in the same order.

PROJECT EXECUTED BY:-



DESIGN CONSULTANT:-



SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.
67, PANMALA, 1 - RUJETA
SINHGAD ROAD, PUNE 411 030.
PH:020/24330432,24330246.FAX:24330028,
e-mail:enquiry@monarchpune.in

D.	DRAWN		P.W		PROJECT:	CONSULTANCY SERVICE FOR PREPARATION OF DETAILS PROJECT REPORT (DPR) FOR WIDENING& IMPROVEMENT OF EXISTING 2/4 - LANES K.K ROAD (TENTATIVE LENGTH: 10 KM) INCLUDING CONSTRUCTION OF 4 LANE LINK ROAD OF CONNECTING TO NH-8A (TENTATIVE LENGTH:2 KM)					
	DESIGN		M.P			TITLE:	TYPICAL DETAILS OF KILOMETER STONE, HECTOMETER				
	CHECKED		Y.J				DRG NO.:	02		REV. 0	SHEET:
	APPROVED		S.D		Date: Mar - 2023						
	Scale:	A2	A3								
		H	2000	3000							
	V	200	300								

1		2		3		4		5		6		7		8					
REGULATORY/MANDATORY SIGNS																			
STOP & GIVE WAY SIGNS				PROHIBITORY SIGNS															
<div><div>R1-1</div><div>R1-2</div><div>R1-3</div></div>				<div><div>R2-1</div><div>R2-2</div><div>R2-3</div><div>R2-4</div><div>R2-5</div><div>R2-6</div><div>R2-7</div><div>R2-8</div><div>R2-9</div><div>R2-10L</div><div>R2-10R</div><div>R2-11</div><div>R2-12</div><div>R2-13</div><div>R2-14</div><div>R2-15</div><div>R2-16</div><div>R2-17</div><div>R2-18</div><div>R2-19</div><div>R2-20</div></div>												NO PARKING & STOPPING SIGNS			
SPEED LIMIT & VEHICLE CONTROL SIGNS								RESTRICTION ENDS SIGN				COMPULSORY DIRECTION CONTROL & OTHER SIGNS							
<div><div>R4-1</div><div>R4-2</div><div>R4-3</div><div>R4-4</div><div>R4-5</div><div>R4-6</div><div>R4-7</div></div>								<div><div>R5-0</div></div>				<div><div>R6-1</div><div>R6-2</div><div>R6-2L</div><div>R6-2R</div><div>R6-3</div><div>R6-4</div><div>R6-5</div><div>R6-6</div><div>R6-7</div><div>R6-8</div><div>R6-9</div><div>R6-10</div><div>R6-11</div><div>R7-0</div></div>							
CAUTIONARY WARNING SIGNS																			
<div><div>W-1</div><div>W-2</div><div>W-3</div><div>W-4</div><div>W-5</div><div>W-6</div><div>W-7</div><div>W-8</div><div>W-9</div><div>W-10</div><div>W-11</div><div>W-12</div><div>W-13</div><div>W-14</div><div>W-15</div><div>W-16</div><div>W-17a</div><div>W-17b</div><div>W-17c</div><div>W-17d</div><div>W-18a</div><div>W-18b</div><div>W-18c</div><div>W-19L</div><div>W-19R</div><div>W-20</div><div>W-21(a)</div><div>W-21(b)</div><div>W-22</div><div>W-23</div><div>W-24</div><div>W-25</div><div>W-26</div><div>W-27</div><div>W-28</div><div>W-29</div><div>W-30</div><div>W-31</div><div>W-32l</div><div>W-32r</div><div>W-33r</div><div>W-33l</div><div>W-34R</div><div>W-34L</div><div>W-36</div><div>W-37</div><div>W-38</div><div>W-39</div><div>W-40</div><div>W-41</div><div>W-42</div><div>W-43</div><div>W-44</div><div>W-45</div><div>W-46</div><div>W-47</div><div>W-48a</div><div>W-48b</div><div>W-51</div><div>W-52</div><div>W-49 (a)</div><div>W-49 (b)</div><div>W-50a</div><div>W-50b</div><div>W-53</div><div>W-54</div><div>W-55</div><div>W-56</div><div>W-57</div><div>W-58</div><div>W-59</div><div>W-60</div><div>W-60L</div><div>W-60R</div><div>W-60L (d)</div><div>W-61</div><div>W-61 (a)</div><div>W-61 (b)</div><div>S-61 (c)</div><div>W-61(e)</div><div>W-62L (a)</div><div>W-62R (b)</div><div>W-62L (c)</div><div>W-62R (d)</div><div>W-63R</div><div>W-63L</div></div>																			
FACILITY INFORMATION SIGNS				HAZARD MARKER SIGNS				OTHER USEFUL INFORMATION SIGNS											
<div><div>I2-0</div><div>I2-1</div><div>I2-2</div><div>I2-3</div><div>I2-4</div><div>I2-5</div><div>I2-6</div></div>				<div><div>OM-1</div><div>HZ-1L</div><div>HZ-1R</div><div>HZ-2</div><div>HZ-3</div></div>				<div><div>I3-1</div><div>I3-2</div><div>I3-3</div><div>I3-4</div><div>I3-5</div><div>I3-6</div><div>I3-7</div><div>I3-8</div><div>I3-9</div><div>I3-10</div><div>I3-11</div><div>I3-12</div><div>I3-13</div><div>I3-14</div><div>I3-15</div><div>I3-16</div><div>I3-17</div><div>I3-18</div><div>I3-19</div><div>I3-20</div><div>I3-21</div><div>I3-22</div><div>I3-23</div><div>I3-24</div><div>I3-25</div><div>I3-26</div><div>I3-27</div><div>I3-28</div><div>I3-29</div><div>I3-30</div><div>I3-31</div><div>I3-32</div><div>I3-33</div><div>I3-34</div><div>I3-35</div><div>I3-36</div><div>I3-37</div></div>											
ROUTE MARKER SIGN				PARKING SIGNS				SIGNS FOR DISABLED PERSONS											
<div><div>I8-1</div><div>I8-2</div></div>				<div><div>I4-1</div><div>I4-2</div><div>I4-3</div><div>I4-5</div><div>I4-6</div><div>I4-7</div><div>I4-8</div><div>I4-9</div><div>I5-0</div><div>I6-0</div></div>				<div><div>I7-1</div><div>I7-2</div><div>I7-3a</div><div>I7-3b</div><div>I7-3c</div><div>I7-4a</div><div>I7-4b</div><div>I7-5a</div><div>I7-5b</div><div>I7-6a</div><div>I7-6b</div><div>I7-6c</div><div>I7-7</div></div>											

INFORAMATORY SIGNS

DIRECTION & PLACE IDENTIFICATION SIGNS



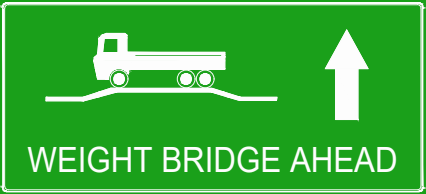
I1 - 0R



I1 - 0 (a)



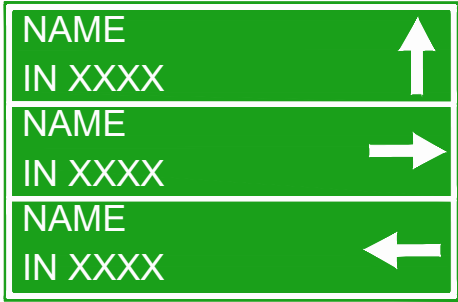
I1-4R



I1-9
Weigh Bridge Ahead



I1 - 0L



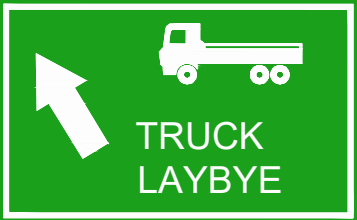
I1 - 1



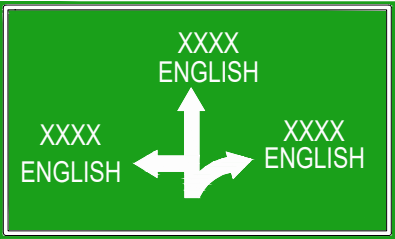
I1-4L



I1-10



I1-7
Truck Lay Bye



SP - 25

DIRECTION SIGN



I1-8

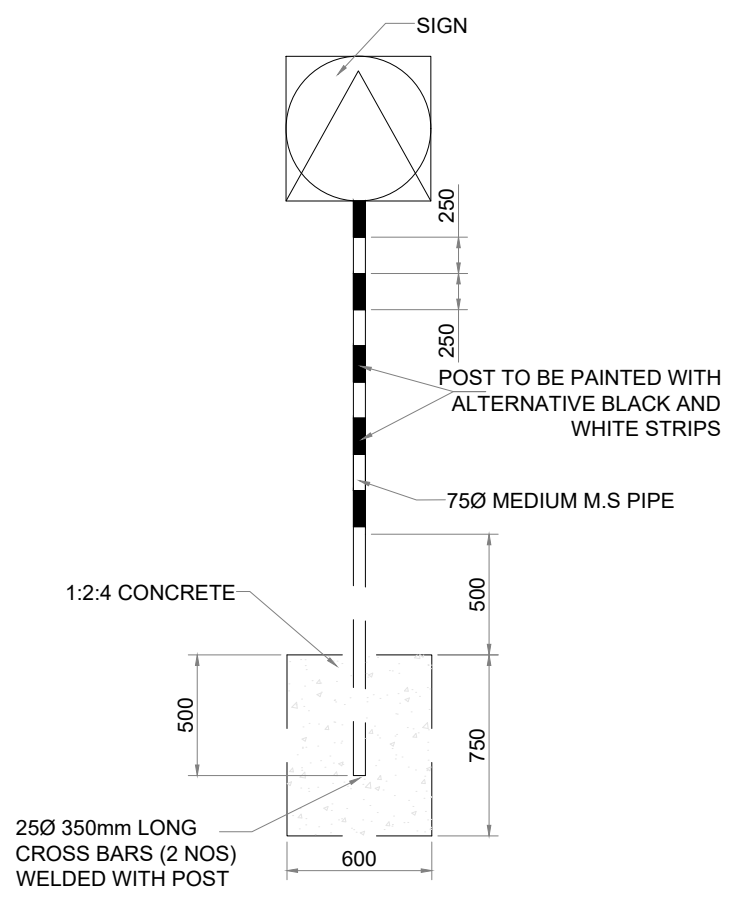


I1-11

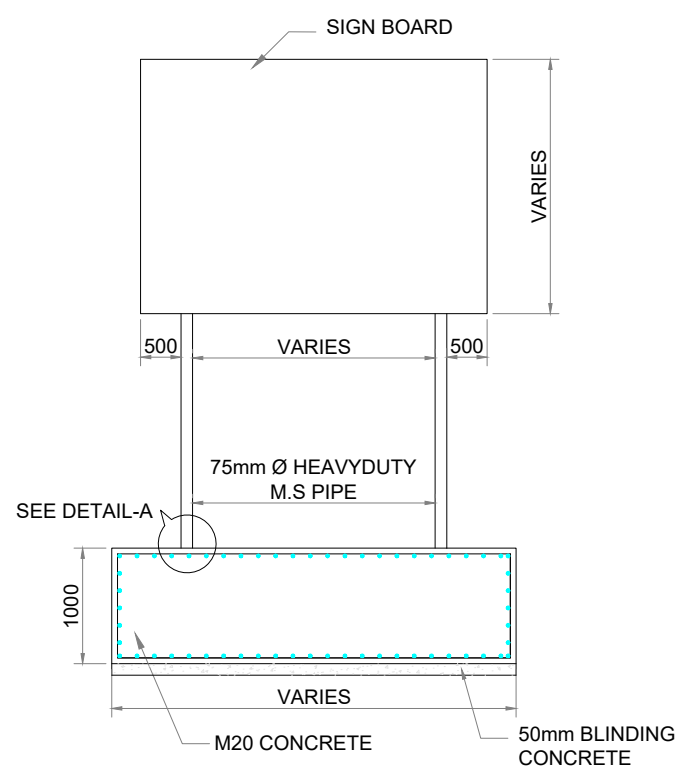
Notes :

1. ALL THE DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE SPECIFIED
2. ALL ROAD SIGNS SHALL BE WITH HIGH INTENSITY MICRO PRISMATIC GRADE SHEETING. (TYPE IV) AS PER ASTM STANDARD.
3. NAME OF THE PLACES SHALL BE WRITTEN IN BOTH ENGLISH AND LOCAL LANGUAGE
4. COLOR, DIMENSIONS OF SIGNS & LETTER SHALL BE AS PER IRC:67-2012.
5. XXXX = LOCAL LANGUAGE

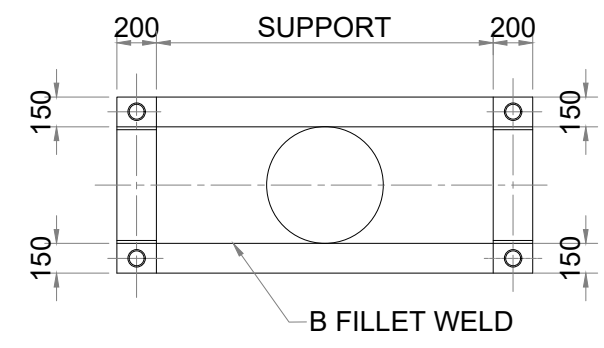
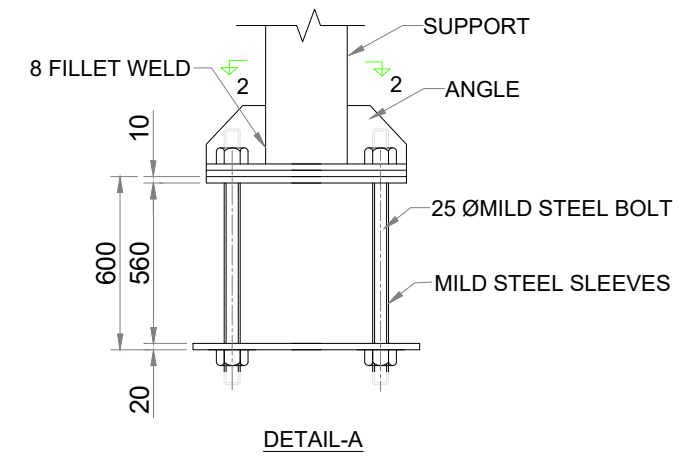
					PROJECT EXECUTED BY:-  DEENDAYAL PORT AUTHORITY	DESIGN CONSULTANT:-  SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD. 67, PANMALA, 1 - RUJETA SINHGAD ROAD, PUNE 411 030. PH:020/24330432,24330246,FAX:24330028, e-mail:enquiry@monarchpune.in	DRAWN P.W			PROJECT:	CONSULTANCY SERVICE FOR PREPARATION OF DETAILS PROJECT REPORT (DPR) FOR WIDENING& IMPROVEMENT OF EXISTING 2/4 - LANES K.K ROAD (TENTATIVE LENGTH: 10 KM) INCLUDING CONSTRUCTION OF 4 LANE LINK ROAD OF CONNECTING TO NH-8A (TENTATIVE LENGTH:2 KM)
							DESIGN M.P			TITLE:	DETAILS OF TRAFFIC SIGNS
							CHECKED Y.J			DRG NO.:	04
							APPROVED S.D			REV.	0
REV	DATE	DESCRIPTION OF REVISIONS	BY				Scale: H 2000 V 200	A2 3000 300	Date: Mar - 2023	SHEET:	



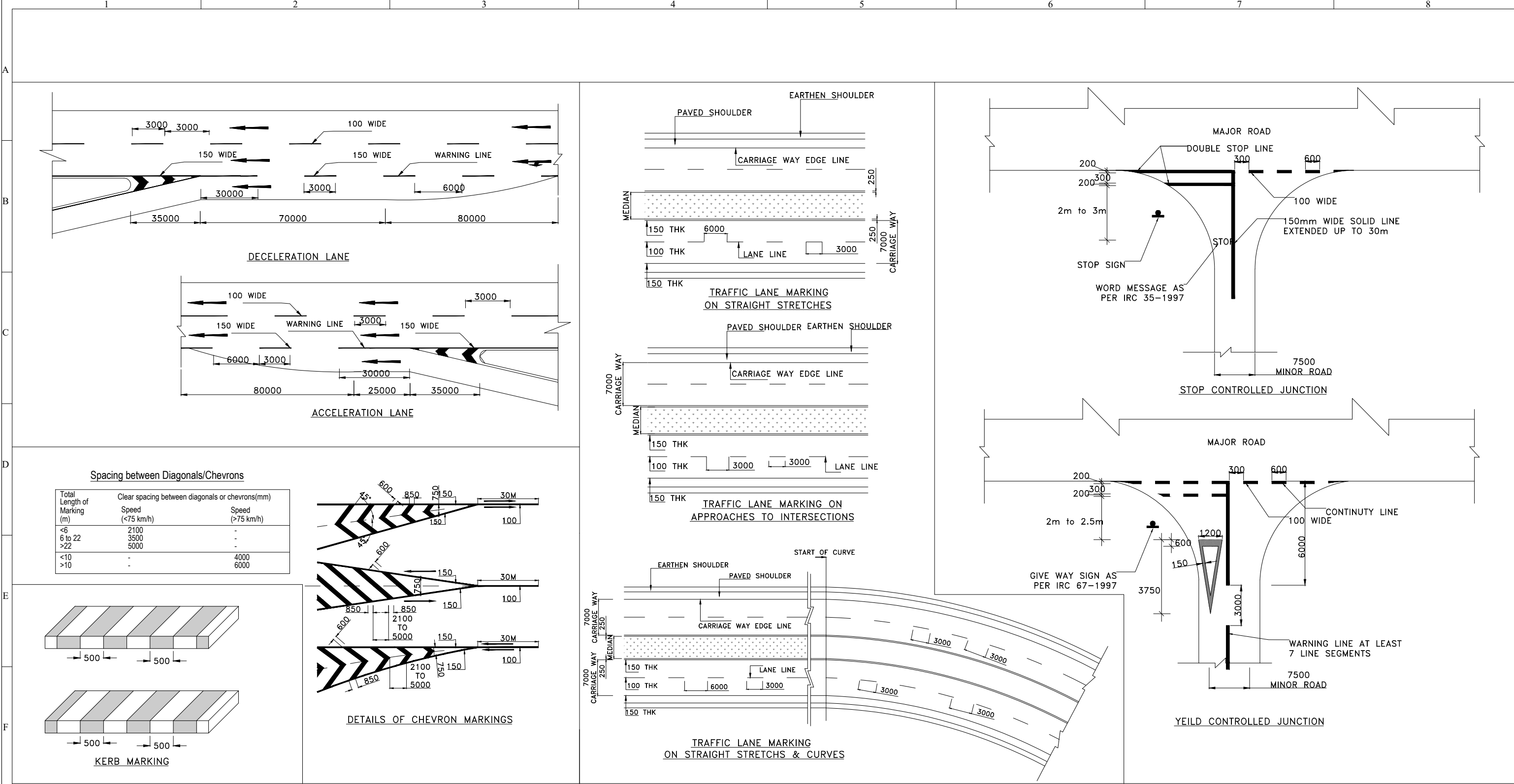
DETAILS FOR SIGN WITH SINGLE SUPPORT





DETAILS FOR SIGN WITH DOUBLE SUPPORT

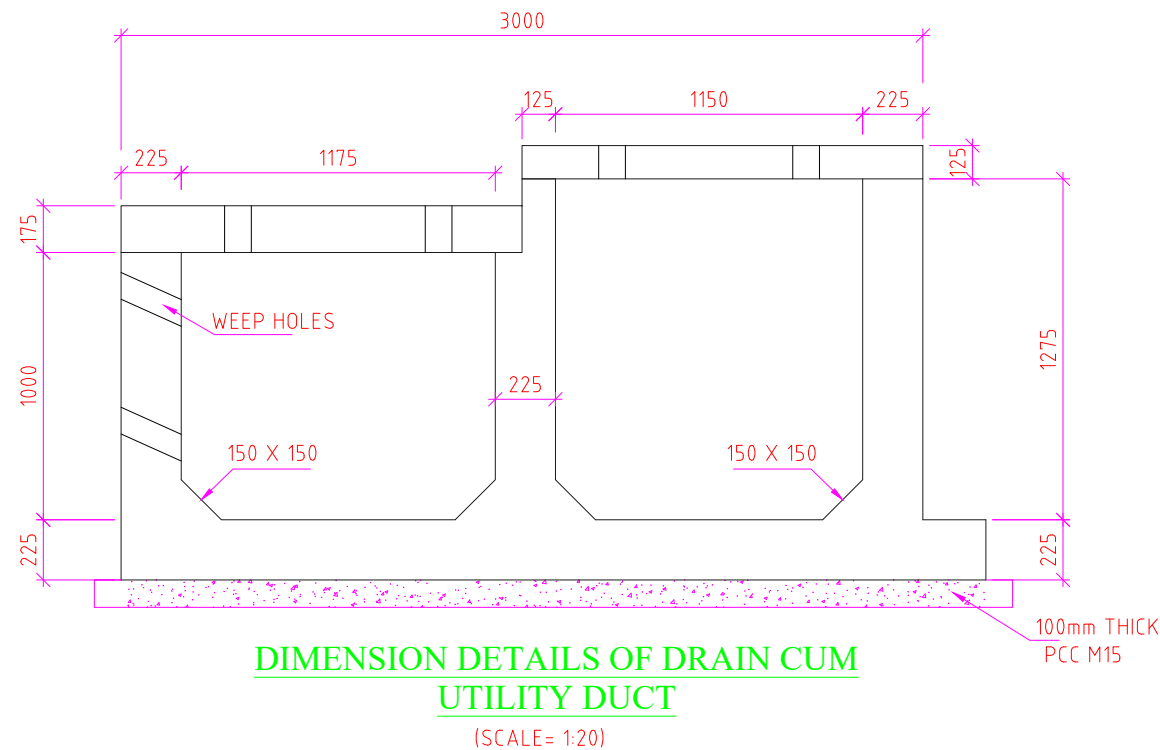
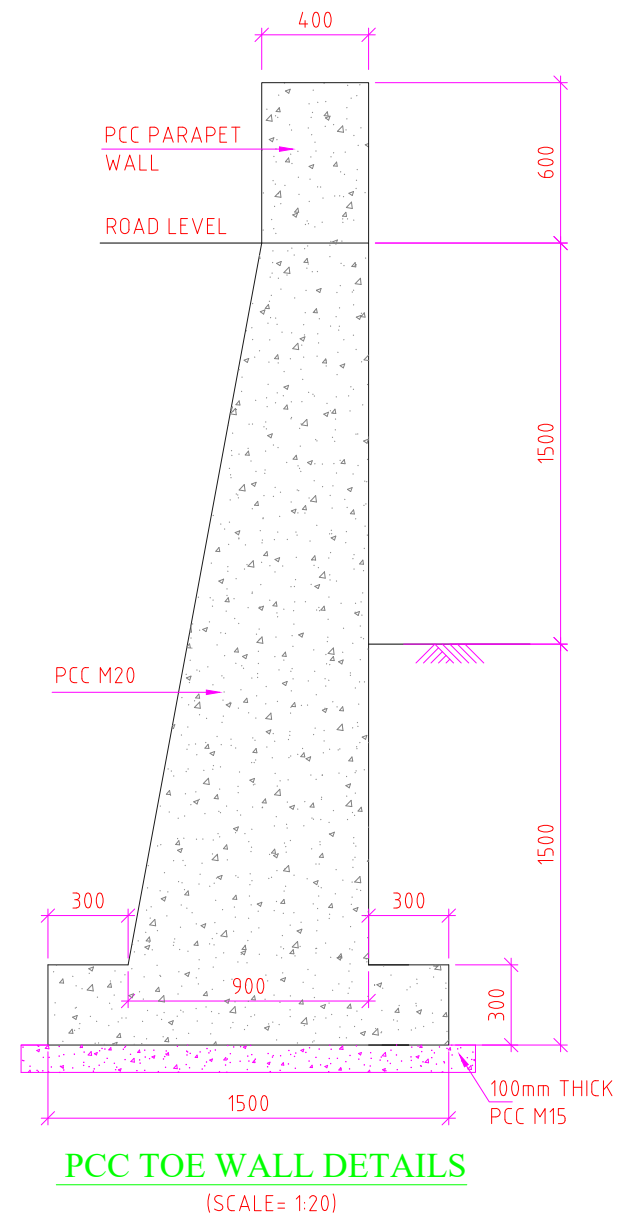
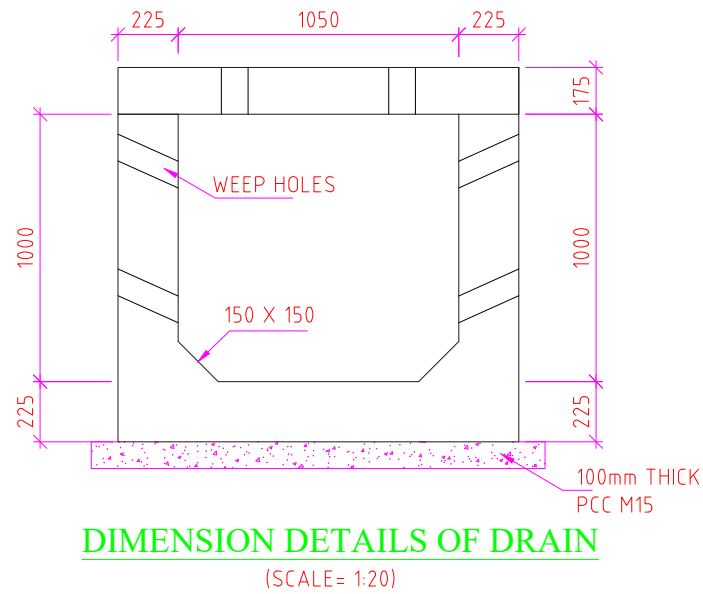
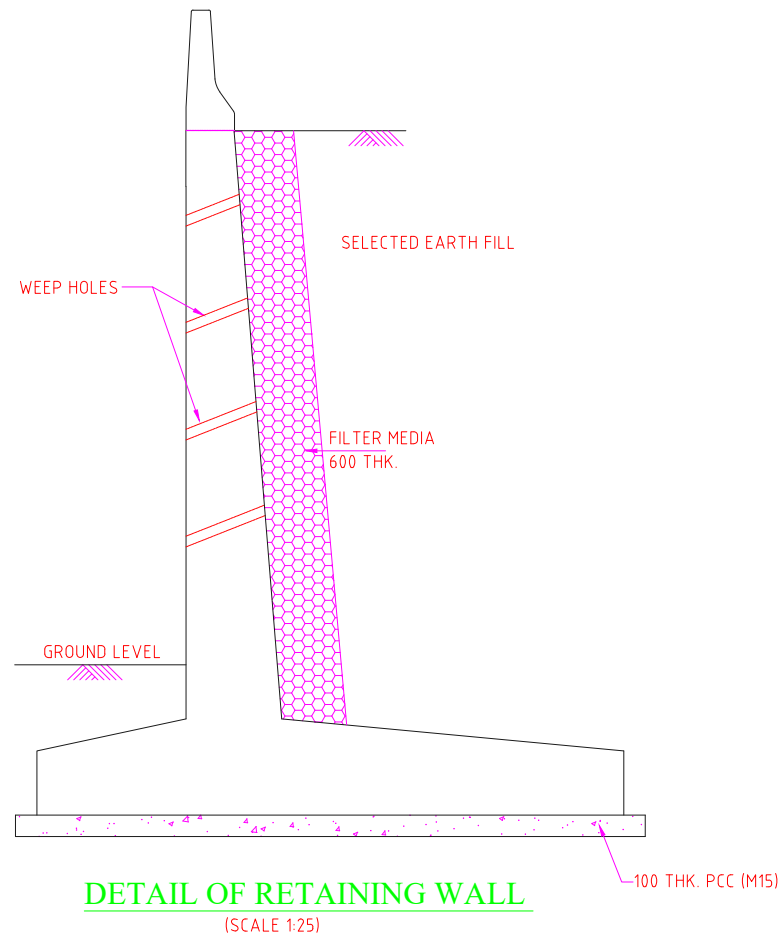


SIGN	MARK	SHAPE	COLOUR			DIMENSION
			BORDER	BACKGROUND	SYMBOL	
WARNING	CS	Equilateral Triangle with apex pointing Upwards	Red Reflective	White Reflective	Black	Side = 900 mm Corner = 45 mm Radius Border = 70 mm
MANDATORY / REGULATORY	RS	Generally Circular but for Stop Sign octagonal and Traingular for Give Way Sign	Red Reflective	White Reflective	Arrows : Black Band : Red	Dia = 600 mm Border = 65 mm Bend = 60 mm Dia = 900 mm Border = 65 mm Bend = 70 mm Octagon Side = 370 mm Border = 30 mm Triangular Side= 900 mm Border = 70 mm
INFORMATORY	OIS	Rectangular with longer side vertical	Blue Reflective	White Reflective	Black or Red Reflective	Over all = 800x600 mm Central Square = 400x600mm
DIRECTION	IS	Rectangular with longer side Horizontal	White Reflective	Green Reflective	White	Size Varies Border = 50 mm



- NOTES:-
1. All Road marking details are as per IRC 35:2015.
 2. All lengths and spacings of diagonals/chevrons are measured parallel to road center line.
 3. First diagonal/chevron is to be so located that it is at least equal to its width.
 4. Width of all diagonal/chevrons measured at right angles to the diagonals/chevrons is 600 mm.
 5. Additional reference: Type Designs for Intersections on National Highways, 1995, MOST.

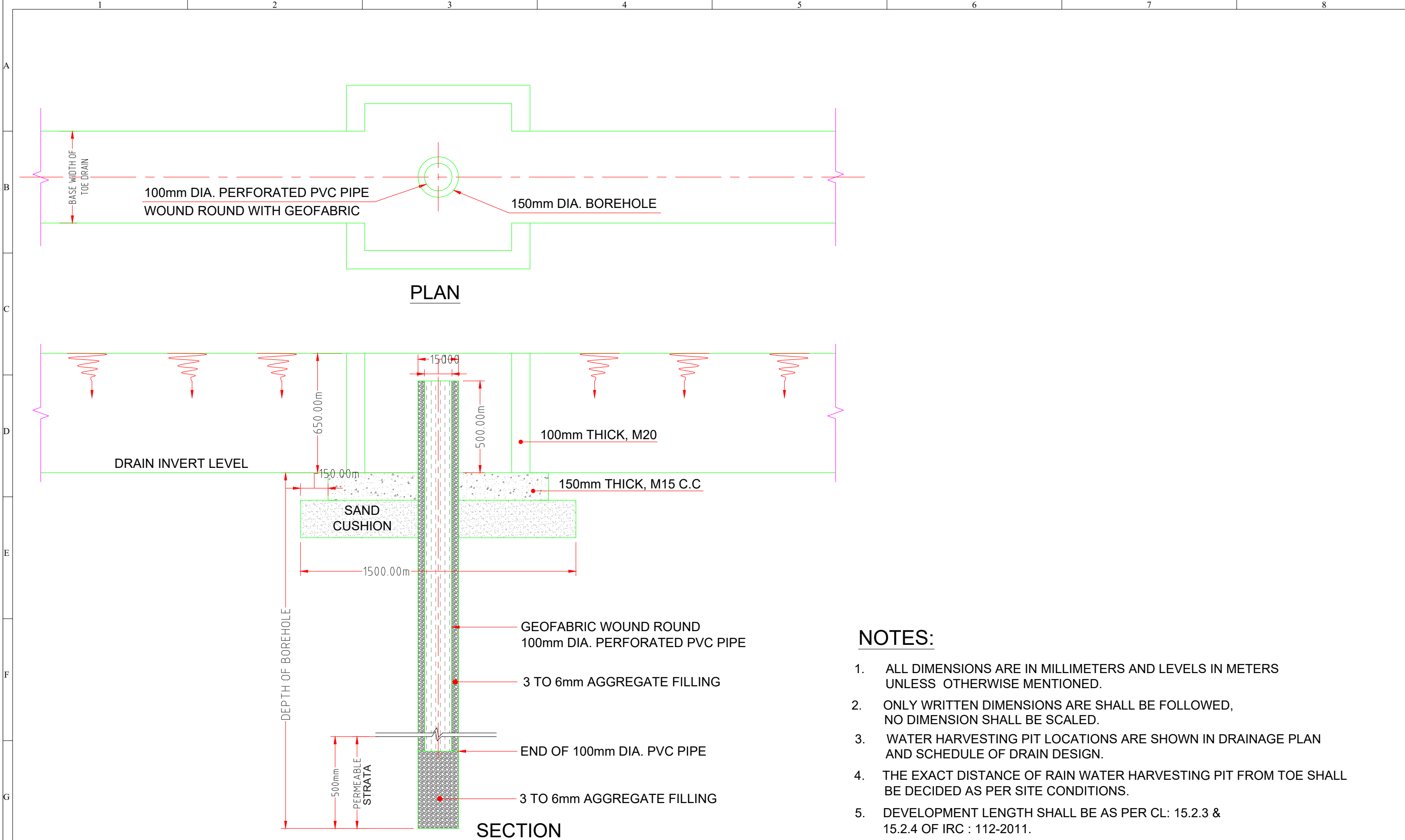
H					<div>PROJECT EXECUTED BY:-</div> <div></div> <div>DEENDAYAL PORT AUTHORITY</div>	<div>DESIGN CONSULTANT:-</div> <div></div> <div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div> <div>67, PANMALA, 1 - RUJETA</div> <div>SINHGAD ROAD, PUNE 411 030.</div> <div>PH:020/24330432,24330246,FAX:24330028,</div> <div>e-mail:enquiry@monarchpune.in</div>	DRAWN	P.W		PROJECT:	CONSULTANCY SERVICE FOR PREPARATION OF DETAILS PROJECT REPORT (DPR) FOR WIDENING& IMPROVEMENT OF EXISTING 2/4 - LANES K.K ROAD (TENTATIVE LENGTH: 10 KM) INCLUDING CONSTRUCTION OF 4 LANE LINK ROAD OF CONNECTING TO NH-8A (TENTATIVE LENGTH:2 KM)			
	DESIGN	M.P												
								CHECKED	Y.J		TITLE:	TYPICAL DETAILS OF ROAD MARKING & KERB PAINTING		
								APPROVED	S.D					
								Scale:	A2	A3	Date:	DRG NO.:	06	
					H	2000	3000	Mar - 2023						
					V	200	300							
REV	DATE	DESCRIPTION OF REVISIONS			BY									



NOTES:-

- ALL DIMENSIONS ARE IN mm, UNLESS SPECIFIED OTHERWISE.
- DO NOT MEASURE THE DRAWING FOLLOW WRITTEN DIMENSIONS ONLY.
- GRADE OF CONCRETE :-M30
- REINFORCEMENT SHALL BE H.Y.S.D BARS OF Fe 500 GRADE CONFORMING TO IS:1786.
- SBC OF 25 T/SQM HAS BEEN CONSIDERED IN THE DESIGN SAME SHALL BE VERIFIED AT SITE.
- 600mm THICK FILTER MATERIAL BEHIND RCC ABUTMENT/RETAINING WALL SHALL BE AS PER APPENDIX 6 OF IRC:78-2000.
- 100MM DIA P.V.C. PIPE AT SPACING 1000 C/C IN HORIZONTAL/VERTICAL DIRECTION SHALL BE PROVIDED UP TO 150MM ABOVE GROUND LEVEL FOR WEEP HOLES IN VERTICAL WALL.
- MINIMUM DEVELOPMENT LENGTH = 58D
WHERE 'D' IS DIA OF BAR
LAP LENGTH SHALL BE (58 x DIA OF BAR x k)
WHERE k = 1.0 IF UP TO 25% OF BARS ARE LAPPED
k = 1.15 IF 25% TO 33% OF BARS ARE LAPPED
k = 1.4 IF 33% TO 50% OF BARS ARE LAPPED
k = 1.5 IF MORE THAN 50% OF BARS ARE LAPPED
- CLEAR COVER
FOOTING ---75mm.
EARTH FACE ---75mm.
FOR OTHERS ---40mm.

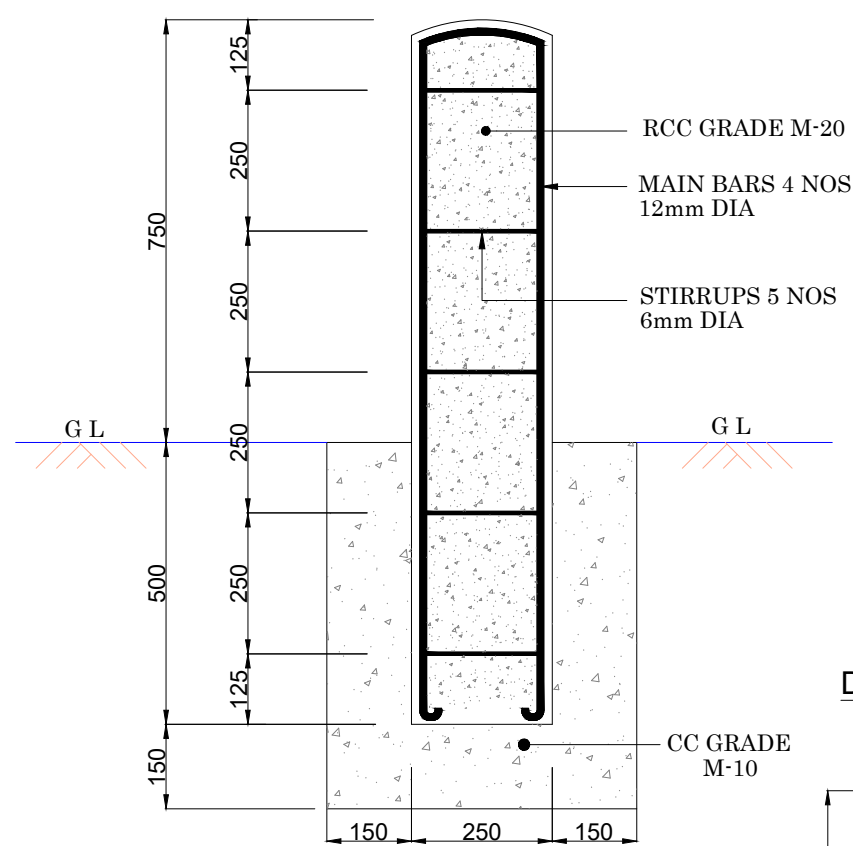
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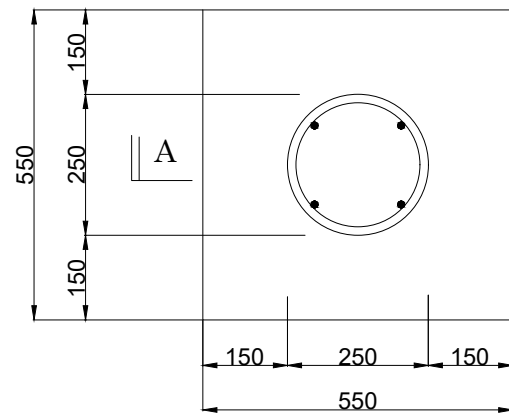
NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS IN METERS UNLESS OTHERWISE MENTIONED.
- ONLY WRITTEN DIMENSIONS ARE SHALL BE FOLLOWED, NO DIMENSION SHALL BE SCALED.
- WATER HARVESTING PIT LOCATIONS ARE SHOWN IN DRAINAGE PLAN AND SCHEDULE OF DRAIN DESIGN.
- THE EXACT DISTANCE OF RAIN WATER HARVESTING PIT FROM TOE SHALL BE DECIDED AS PER SITE CONDITIONS.
- DEVELOPMENT LENGTH SHALL BE AS PER CL: 15.2.3 & 15.2.4 OF IRC : 112-2011.

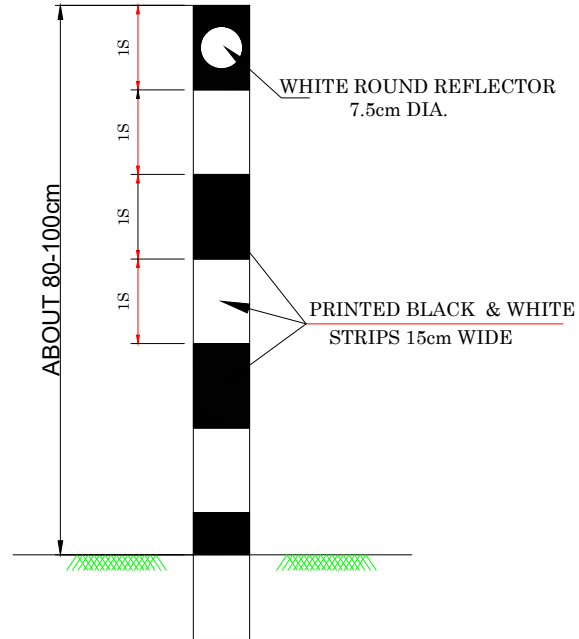
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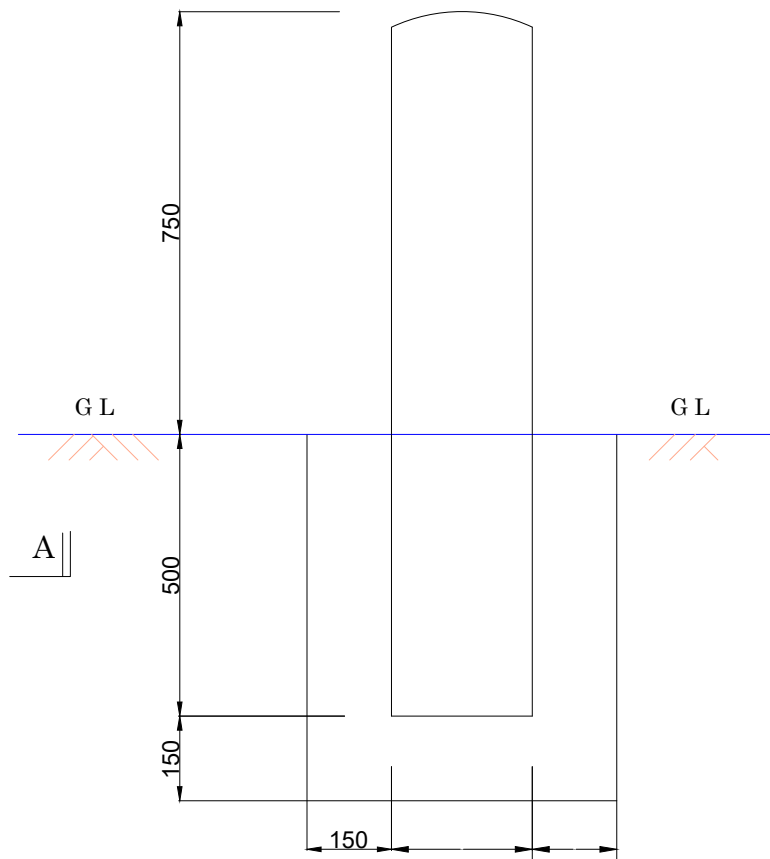
SECTION-A A



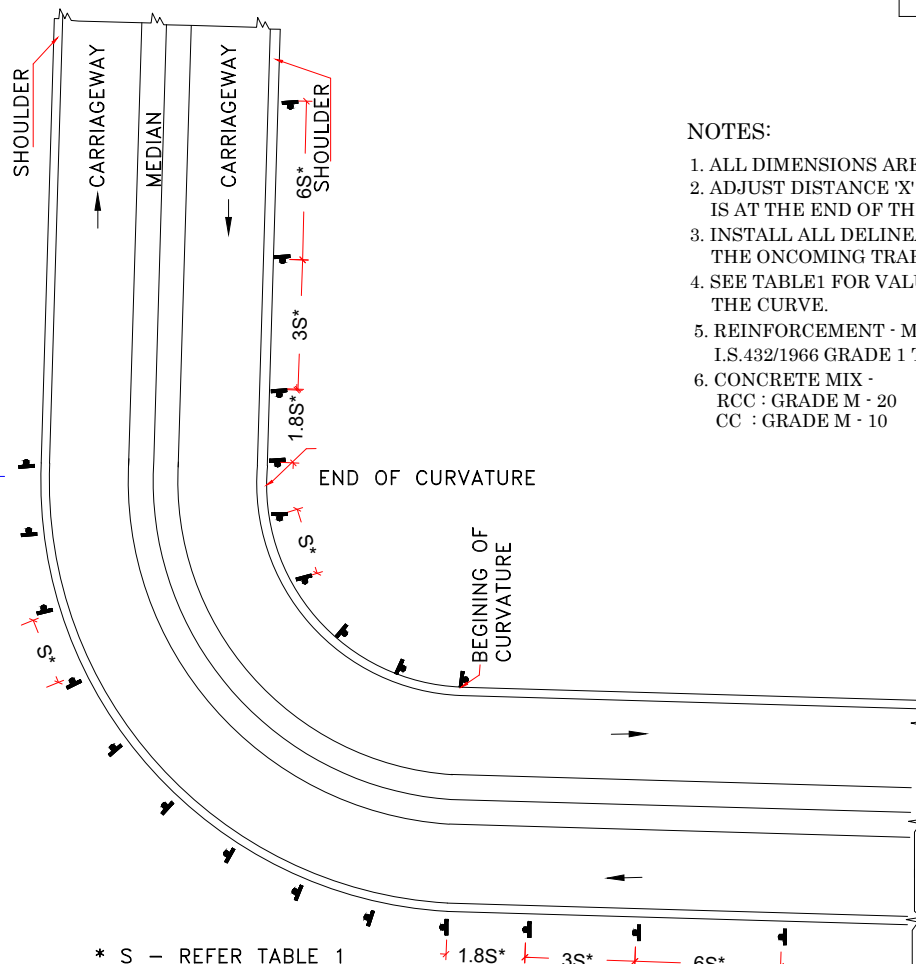
PLAN



DELINEATOR WITH CIRCULAR REFLECTOR



ELEVATION





* S - REFER TABLE 1
ROADWAY DELINEATOR SPACING ON CURVES

TABLE
RECOMMENDED SPACING FOR
ROADWAY INDICATORS
ON HORIZONTAL CURVES

Radius of curve (Metres)	Spacing on curve, S (Metres)
30	6
50	8
100	12
200	20
300	25
400	30
500	35
600	38
700	42
800	45
900	48
1000	50

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS SPECIFIED OTHERWISE.
2. ADJUST DISTANCE 'X' SUITABLY SO THAT THE LAST ROADWAY DELINEATOR IS AT THE END OF THE CURVE.
3. INSTALL ALL DELINEATORS AT EDGE OF THE ROADWAY PERPENDICULAR TO THE ONCOMING TRAFFIC.
4. SEE TABLE1 FOR VALUE OF 'S' i.e. SPACING OF DELINEATORS ON THE CURVE.
5. REINFORCEMENT - MILD STEEL BARS CONFORMING TO I.S.432/1966 GRADE 1 TESTED STEEL
6. CONCRETE MIX -
RCC : GRADE M - 20
CC : GRADE M - 10

REV	DATE	DESCRIPTION OF REVISIONS	BY	PROJECT EXECUTED BY:-  DEENDAYAL PORT AUTHORITY	DESIGN CONSULTANT:-  MONARCH SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD. 67, PANMALA, 1 - RUJETA SINHGAD ROAD, PUNE 411 030. PH:020/24330432,24330246,FAX:24330028, e-mail:enquiry@monarchpune.in	DRAWN DESIGN CHECKED APPROVED Scale: H 2000 V 200	P.W M.P Y.J S.D A2 3000 A3 300	Date: Mar - 2023	PROJECT: CONSULTANCY SERVICE FOR PREPARATION OF DETAILS PROJECT REPORT (DPR) FOR WIDENING& IMPROVEMENT OF EXISTING 2/4 - LANES K.K ROAD (TENTATIVE LENGTH: 10 KM) INCLUDING CONSTRUCTION OF 4 LANE LINK ROAD OF CONNECTING TO NH-8A (TENTATIVE LENGTH:2 KM)	TITLE: TYPICAL DETAIL OF GUARD CAM & DELINEATOR	DRG NO.: 14	REV. 0	SHEET: 0

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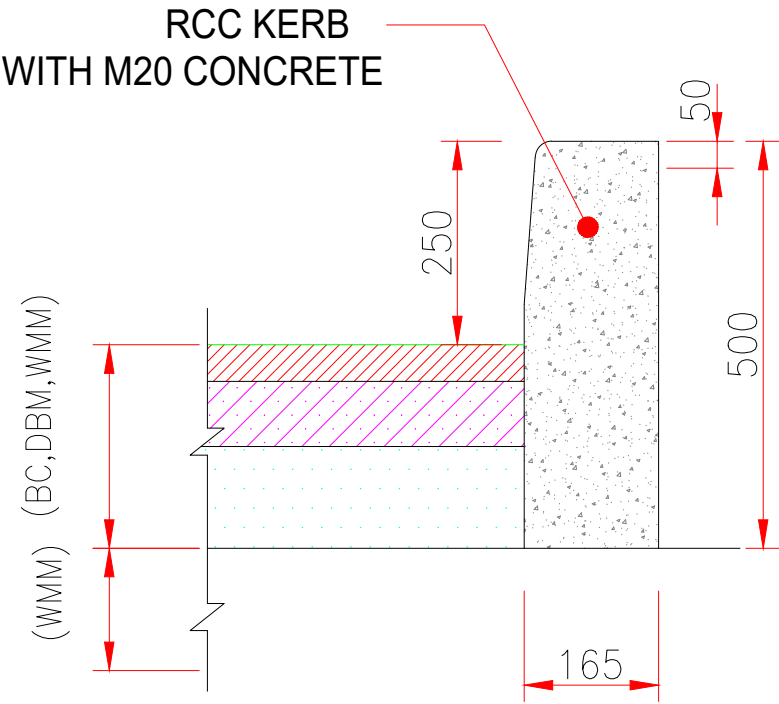
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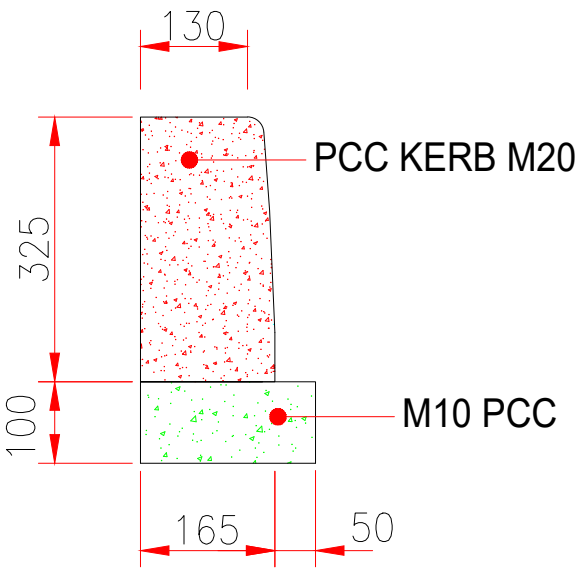
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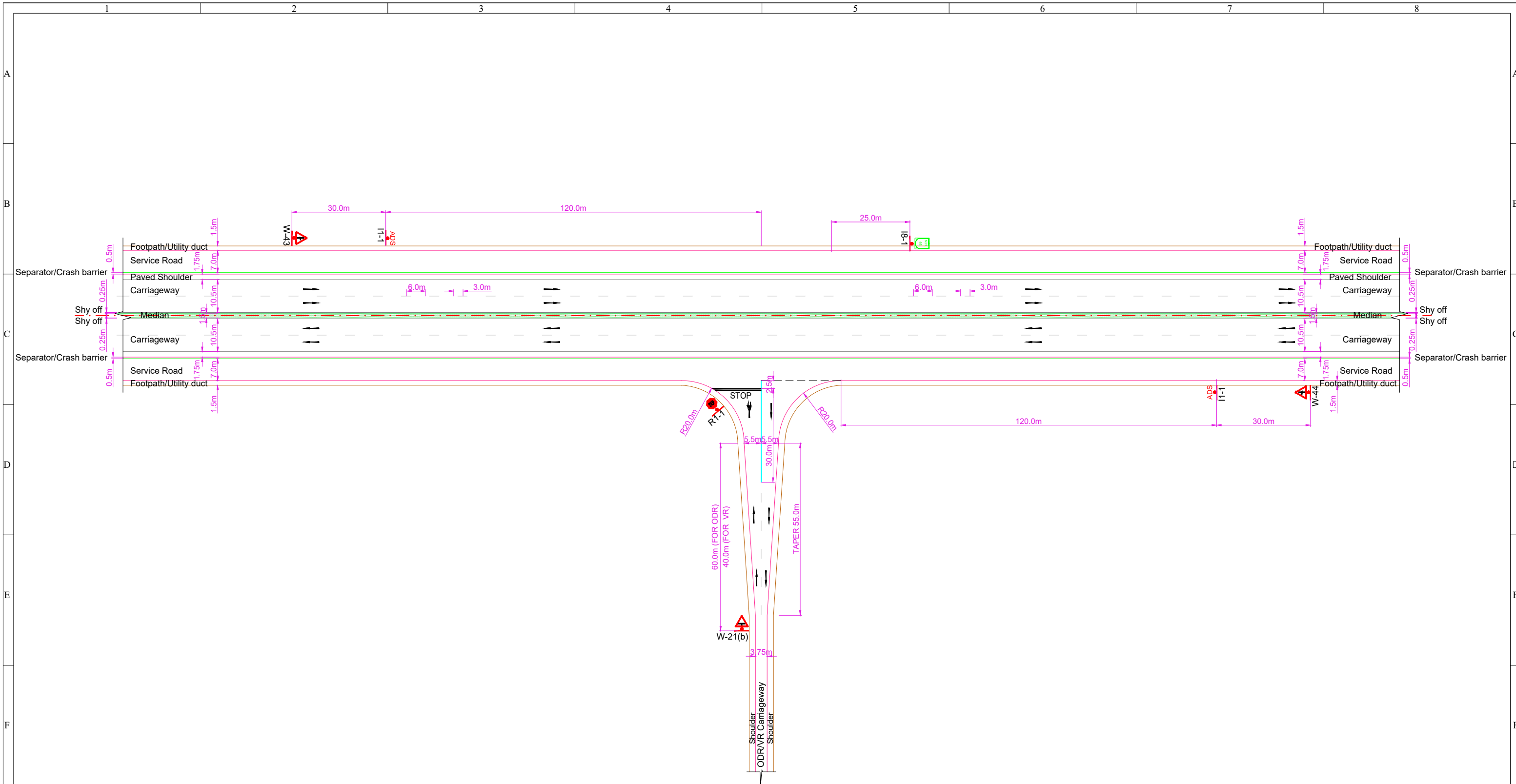




KERB DETAILS

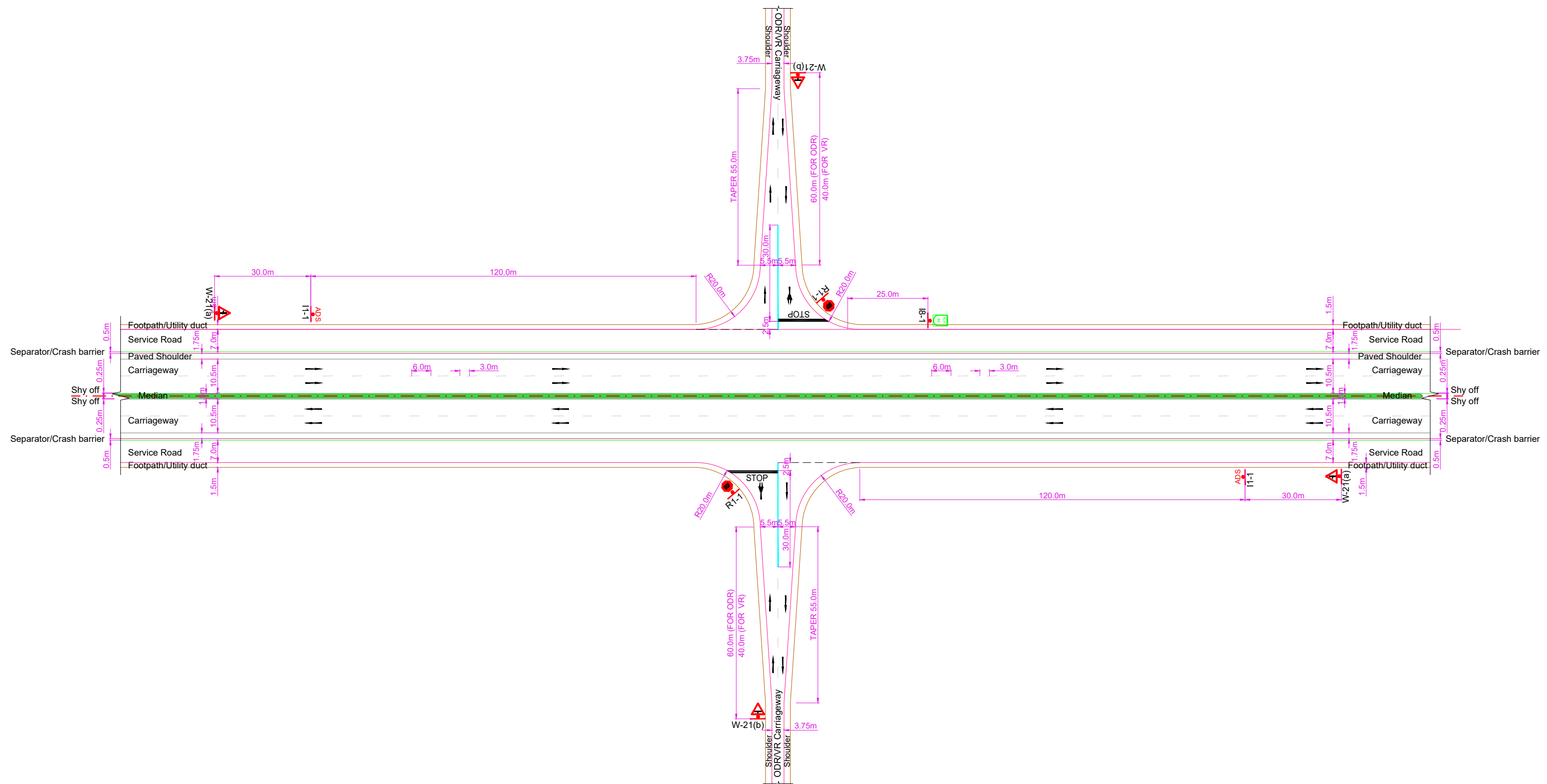
NOTES:



1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES UNLESS MENTIONED OTHERWISE.
2. GRADE OF CONCRETE SHALL BE AS FOLLOWS :
BLINDING CONCRETE - M15
P.C.C TOE WALL - M20
3. NET BEARING CAPACITY REQUIRED FOR SOIL AT FOUNDING LEVEL
SHALL NOT BE LESS THAN THE MAXIMUM PRESSURE SHOWN
4. GRANULAR BACK FILL MATERIAL CONFORMING TO IRC:78-2014 SHALL BE USED.
RETAINED SOIL SLOPE CONSIDERED =0° AND THE BACKFILL MATERIAL
SHOULD HAVE Ø=35°
5. FOR SOILS HAVING LOWER BEARING CAPACITY A LAYER OF 230mm THICK ADDITIONAL
SOLING OVER WELL COMPACTED SELECTED MURRAM (500mmTHK) SHALL BE PROVIDED AFTER
REMOVING THE EXISTING UNSUITABLE SOIL BELOW THE TOE WALL.
6. SKIN REINFORCEMENT SHALL BE PROVIDED AT THE RATE OF 5KG/SQM FOR THE PCC HEAD WALL

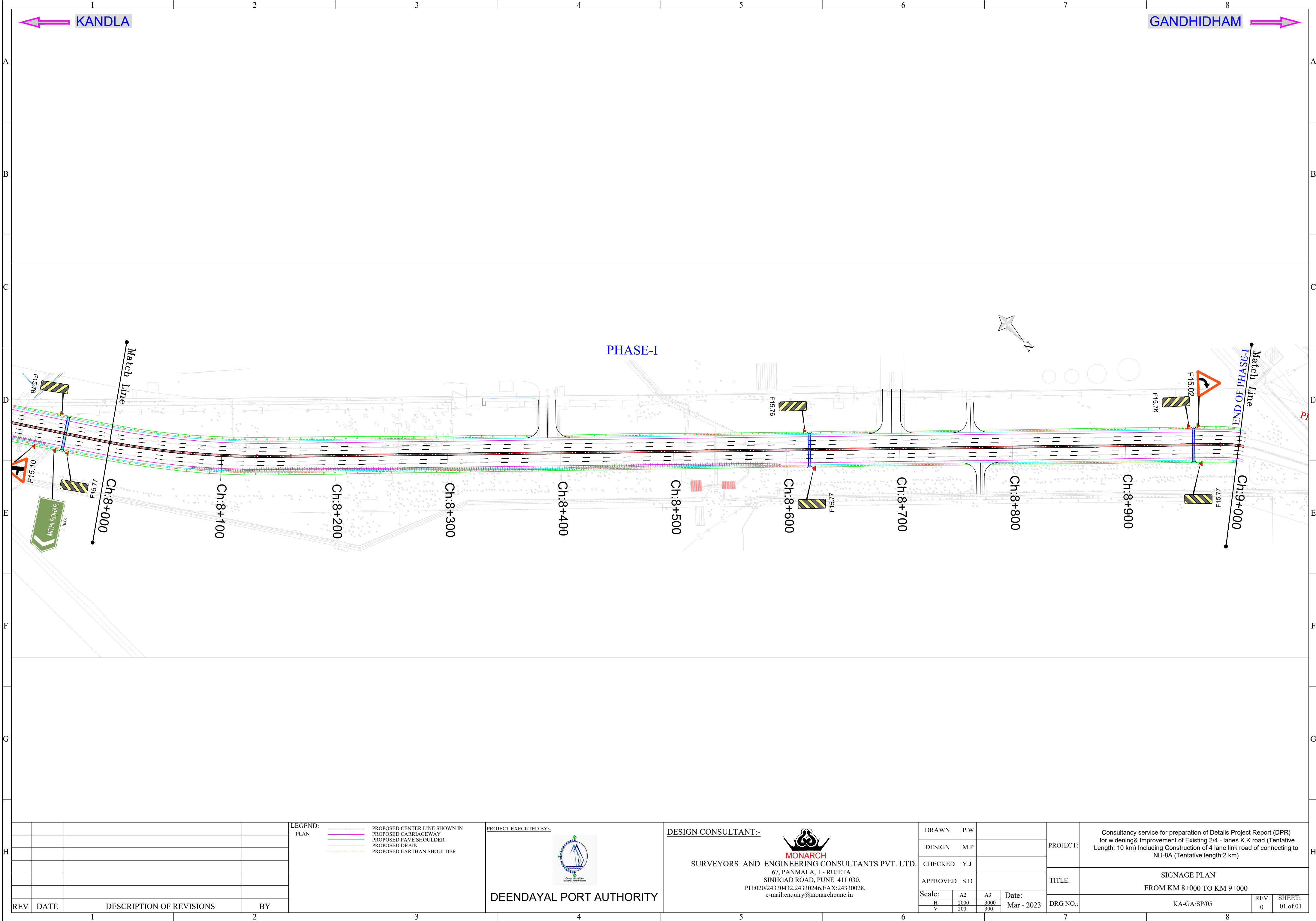
					PROJECT EXECUTED BY:-	DESIGN CONSULTANT:-	DRAWN	P.W		PROJECT:	CONSULTANCY SERVICE FOR PREPARATION OF DETAILS PROJECT REPORT (DPR) FOR WIDENING& IMPROVEMENT OF EXISTING 2/4 - LANES K.K ROAD (TENTATIVE LENGTH: 10 KM) INCLUDING CONSTRUCTION OF 4 LANE LINK ROAD OF CONNECTING TO NH-8A (TENTATIVE LENGTH:2 KM)		
							DESIGN	M.P					
							CHECKED	Y.J		TITLE:	TYPICAL DETAIL OF KERB STONE		
							APPROVED	S.D		DRG NO.:	15	REV.	SHEET:
REV	DATE	DESCRIPTION OF REVISIONS	BY		DEENDAYAL PORT AUTHORITY		Scale:	A2	A3	Date:			
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							V	200	300				



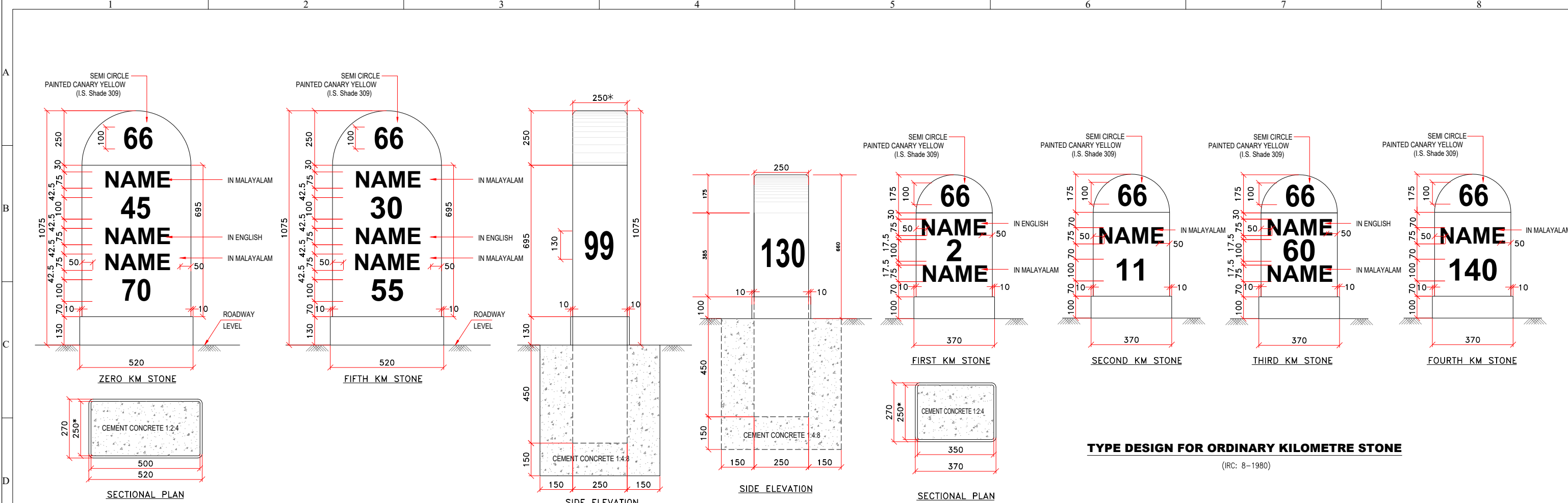
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	DESIGN	M.P	TITLE:	TYPICAL T-INTERSECTION MINOR JUNCTION									
	CHECKED	Y.J		DRG NO.:			17A			REV: 0	SHEET:		
	APPROVED	S.D											
	Scale:	A2	A3				Date:						
H	2000	3000	Mar - 2023										
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REV	DATE	DESCRIPTION OF REVISIONS			BY								



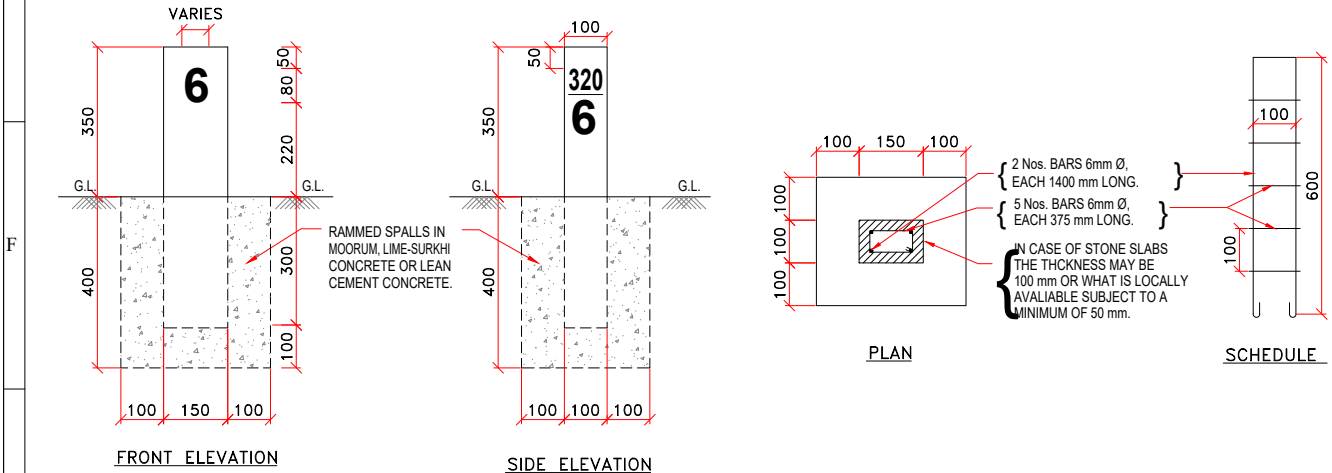
H					<div>PROJECT EXECUTED BY:-  DEENDAYAL PORT AUTHORITY</div>	<div>DESIGN CONSULTANT:-  MONARCH SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD. 67, PANMALA, 1 - RUJETA SINHGAD ROAD, PUNE 411 030. PH:020/24330432,24330246,FAX:24330028, e-mail:enquiry@monarchpune.in</div>	DRAWN	P.W	PROJECT:	CONSULTANCY SERVICE FOR PREPARATION OF DETAILS PROJECT REPORT (DPR) FOR WIDENING& IMPROVEMENT OF EXISTING 2/4 - LANES K.K ROAD (TENTATIVE LENGTH: 10 KM) INCLUDING CONSTRUCTION OF 4 LANE LINK ROAD OF CONNECTING TO NH-8A (TENTATIVE LENGTH:2 KM)		
	DESIGN	M.P	TITLE:	TYPICAL T-INTERSECTION MINOR JUNCTION								
	CHECKED	Y.J		DRG NO.:	17C	REV. 0	SHEET:					
	APPROVED	S.D										
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V	200	300										
REV	DATE	DESCRIPTION OF REVISIONS			BY							



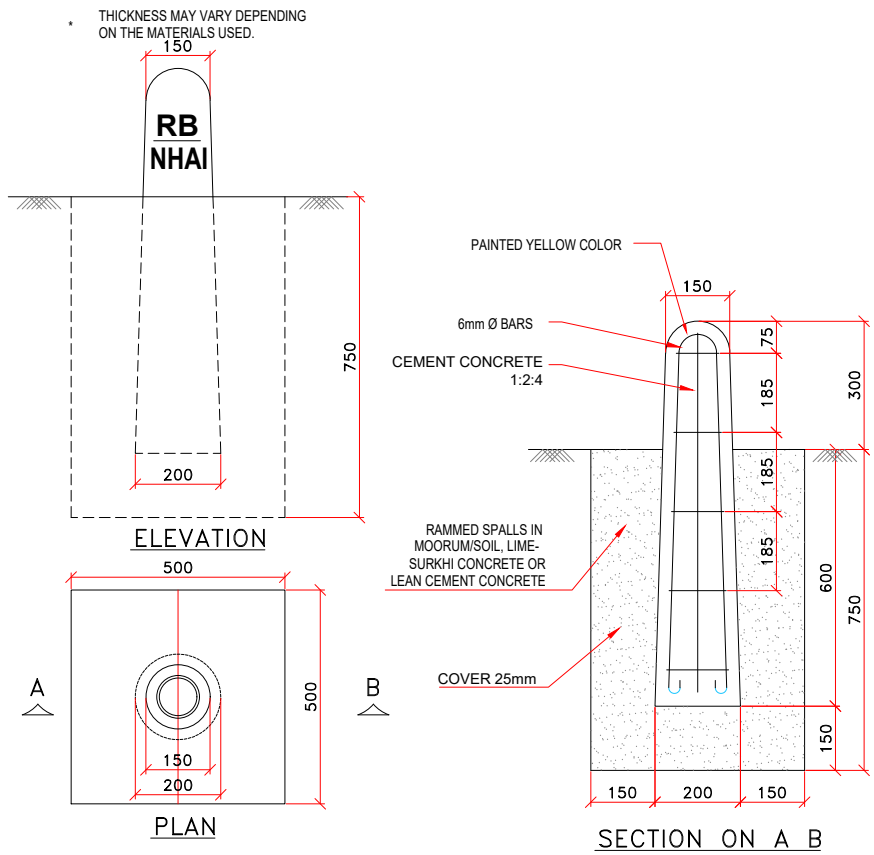
MISCELLANEOUS DETAILS



TYPE DESIGN FOR ZERO & FIFTH KILOMETRE STONE
(IRC: 8-1980)



TYPE DESIGN FOR 200 METRE STONE
(IRC: 26-1967)



TYPE DESIGN FOR BOUNDARY STONES

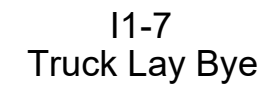
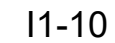
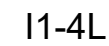
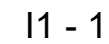
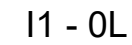
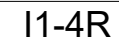
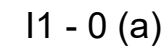
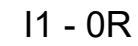
TABLE 1 : DETAILS OF INSCRIPTIONS ON KILOMETRE STONE
(MOST CIRCULAR DT. 24-12-2004)

Km. No.	Script and place names	Place to be shown
0	Local and Roman (English)	Terminal/starting station on top in Local language followed by kilometrage and then the name of terminal/starting station will be followed in Roman (English) and below this, the next important town in local language followed by kilometrage in symmetrical manner.
1	Malayalam and Local	Next important town IN ENGLISH on top and in local language on bottom and in between kilometrage in symmetrical manner.
2	Local language	Next important town followed by kilometrage.
3	Malayalam and Local	Terminal Station IN ENGLISH on top and in local language on bottom and in between kilometrage in symmetrical manner.
4	Local language	Terminal station followed by kilometrage.
5	Local and Roman (English)	Terminal station on top in Local language followed by kilometrage and then the name of terminal station will be followed in Roman (English) and below this, the next important town in local language followed by kilometrage in symmetrical manner.
6	Malayalam and Local	Next important town IN ENGLISH on top and in local language on bottom and in between kilometrage in symmetrical manner and so on, repeated in the same order.

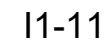
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<div><div>R1-1</div><div>R1-2</div><div>R1-3</div></div>				<div><div>R2-1</div><div>R2-2</div><div>R2-3</div><div>R2-4</div><div>R2-5</div><div>R2-6</div><div>R2-7</div><div>R2-8</div><div>R2-9</div><div>R2-10L</div><div>R2-10R</div><div>R2-11</div><div>R2-12</div><div>R2-13</div><div>R2-14</div><div>R2-15</div><div>R2-16</div><div>R2-17</div><div>R2-18</div><div>R2-19</div><div>R2-20</div></div>												NO PARKING & STOPPING SIGNS			
SPEED LIMIT & VEHICLE CONTROL SIGNS								RESTRICTION ENDS SIGN				COMPULSORY DIRECTION CONTROL & OTHER SIGNS							
<div><div>R4-1</div><div>R4-2</div><div>R4-3</div><div>R4-4</div><div>R4-5</div><div>R4-6</div><div>R4-7</div></div>								<div><div>R5-0</div></div>				<div><div>R6-1</div><div>R6-2</div><div>R6-2L</div><div>R6-2R</div><div>R6-3</div><div>R6-4</div><div>R6-5</div><div>R6-6</div><div>R6-7</div><div>R6-8</div><div>R6-9</div><div>R6-10</div><div>R6-11</div><div>R7-0</div></div>							
CAUTIONARY WARNING SIGNS																			
<div><div>W-1</div><div>W-2</div><div>W-3</div><div>W-4</div><div>W-5</div><div>W-6</div><div>W-7</div><div>W-8</div><div>W-9</div><div>W-10</div><div>W-11</div><div>W-12</div><div>W-13</div><div>W-14</div><div>W-15</div><div>W-16</div><div>W-17a</div><div>W-17b</div><div>W-17c</div><div>W-17d</div><div>W-18a</div><div>W-18b</div><div>W-18c</div><div>W-19L</div><div>W-19R</div><div>W-20</div><div>W-21(a)</div><div>W-21(b)</div><div>W-22</div><div>W-23</div><div>W-24</div><div>W-25</div><div>W-26</div><div>W-27</div><div>W-28</div><div>W-29</div><div>W-30</div><div>W-31</div><div>W-32l</div><div>W-32r</div><div>W-33r</div><div>W-33l</div><div>W-34R</div><div>W-34L</div><div>W-36</div><div>W-37</div><div>W-38</div><div>W-39</div><div>W-40</div><div>W-41</div><div>W-42</div><div>W-43</div><div>W-44</div><div>W-45</div><div>W-46</div><div>W-47</div><div>W-48a</div><div>W-48b</div><div>W-51</div><div>W-52</div><div>W-49 (a)</div><div>W-49 (b)</div><div>W-50a</div><div>W-50b</div><div>W-53</div><div>W-54</div><div>W-55</div><div>W-56</div><div>W-57</div><div>W-58</div><div>W-59</div><div>W-60</div><div>W-60L</div><div>W-60R</div><div>W-60L (d)</div><div>W-61</div><div>W-61 (a)</div><div>W-61 (b)</div><div>S-61 (c)</div><div>W-61(e)</div><div>W-62L (a)</div><div>W-62R (b)</div><div>W-62L (c)</div><div>W-62R (d)</div><div>W-63R</div><div>W-63L</div></div>																			
FACILITY INFORMATION SIGNS				HAZARD MARKER SIGNS				OTHER USEFUL INFORMATION SIGNS											
<div><div>I2-0</div><div>I2-1</div><div>I2-2</div><div>I2-3</div><div>I2-4</div><div>I2-5</div><div>I2-6</div></div>				<div><div>OM-1</div><div>HZ-1L</div><div>HZ-1R</div><div>HZ-2</div><div>HZ-3</div></div>				<div><div>I3-1</div><div>I3-2</div><div>I3-3</div><div>I3-4</div><div>I3-5</div><div>I3-6</div><div>I3-7</div><div>I3-8</div><div>I3-9</div><div>I3-10</div><div>I3-11</div><div>I3-12</div><div>I3-13</div><div>I3-14</div><div>I3-15</div><div>I3-16</div><div>I3-17</div><div>I3-18</div><div>I3-19</div><div>I3-20</div><div>I3-21</div><div>I3-22</div><div>I3-23</div><div>I3-24</div><div>I3-25</div><div>I3-26</div><div>I3-27</div><div>I3-28</div><div>I3-29</div><div>I3-30</div><div>I3-31</div><div>I3-32</div><div>I3-33</div><div>I3-34</div><div>I3-35</div><div>I3-36</div><div>I3-37</div></div>											
ROUTE MARKER SIGN				PARKING SIGNS				SIGNS FOR DISABLED PERSONS											
<div><div>I8-1</div><div>I8-2</div></div>				<div><div>I4-1</div><div>I4-2</div><div>I4-3</div><div>I4-5</div><div>I4-6</div><div>I4-7</div><div>I4-8</div><div>I4-9</div><div>I5-0</div><div>I6-0</div></div>				<div><div>I7-1</div><div>I7-2</div><div>I7-3a</div><div>I7-3b</div><div>I7-3c</div><div>I7-4a</div><div>I7-4b</div><div>I7-5a</div><div>I7-5b</div><div>I7-6a</div><div>I7-6b</div><div>I7-6c</div><div>I7-7</div></div>											

DIRECTION & PLACE IDENTIFICATION SIGNS

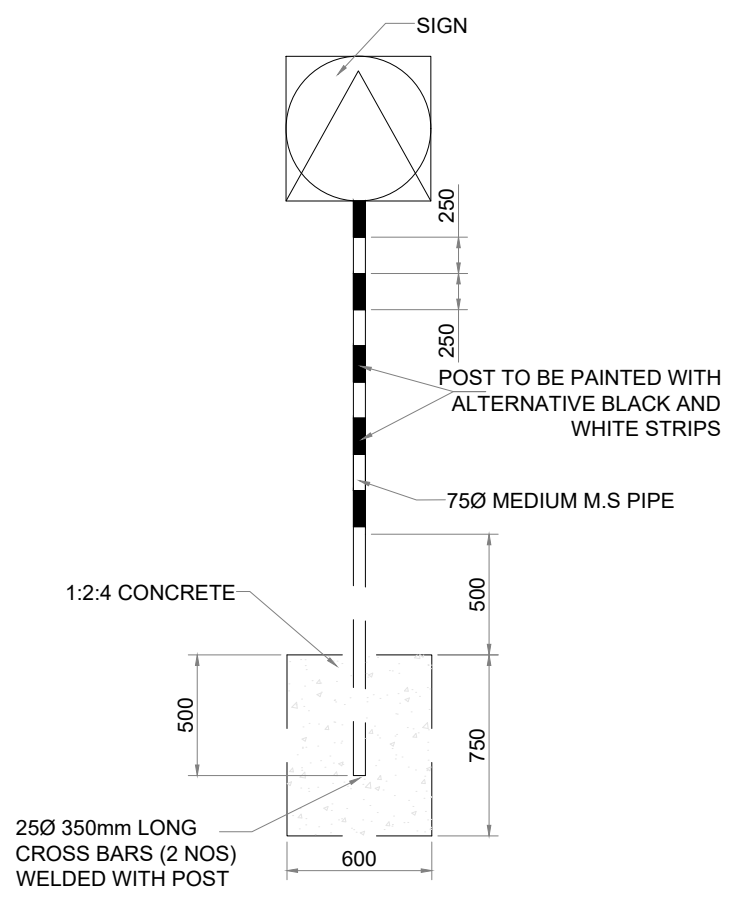


DIRECTION SIGN

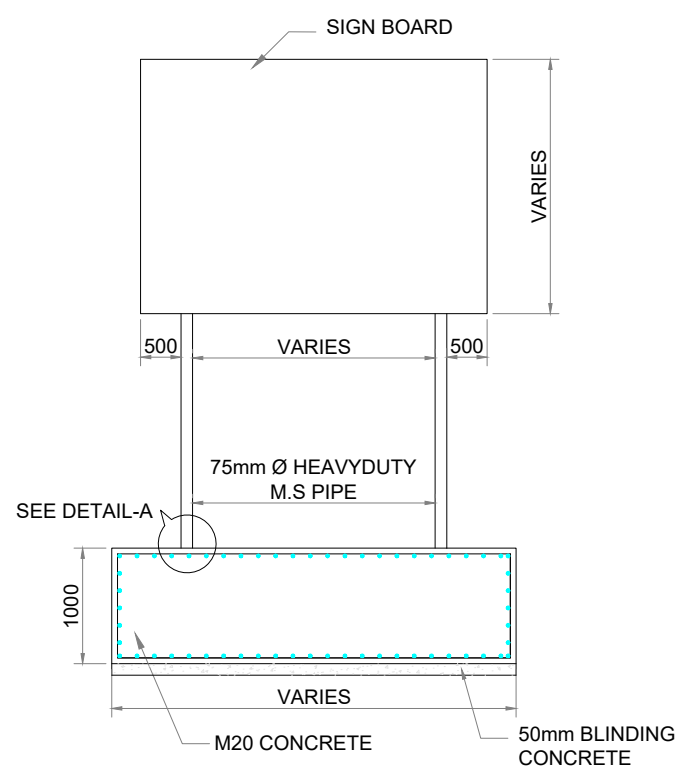


1. ALL THE DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE SPECIFIED
2. ALL ROAD SIGNS SHALL BE WITH HIGH INTENSITY MICRO PRISMATIC GRADE SHEETING. (TYPE IV) AS PER ASTM STANDARD.
3. NAME OF THE PLACES SHALL BE WRITTEN IN BOTH ENGLISH AND LOCAL LANGUAGE
4. COLOR, DIMENSIONS OF SIGNS & LETTER SHALL BE AS PER IRC:67-2012.
5. XXXX = LOCAL LANGUAGE

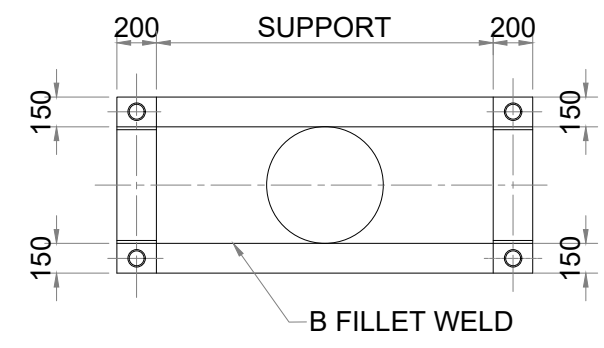
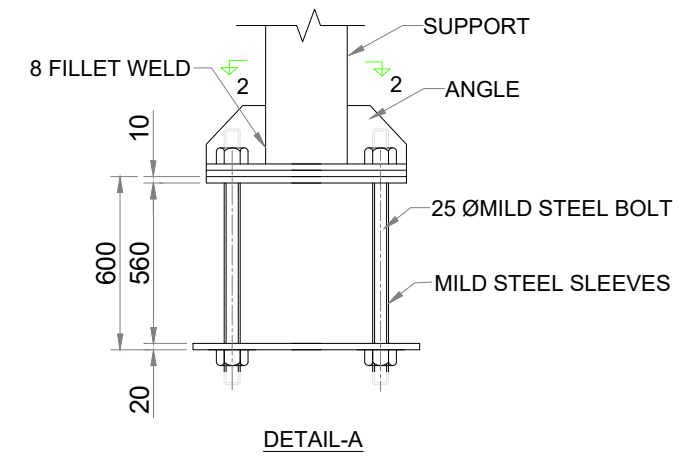
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DETAILS FOR SIGN WITH SINGLE SUPPORT

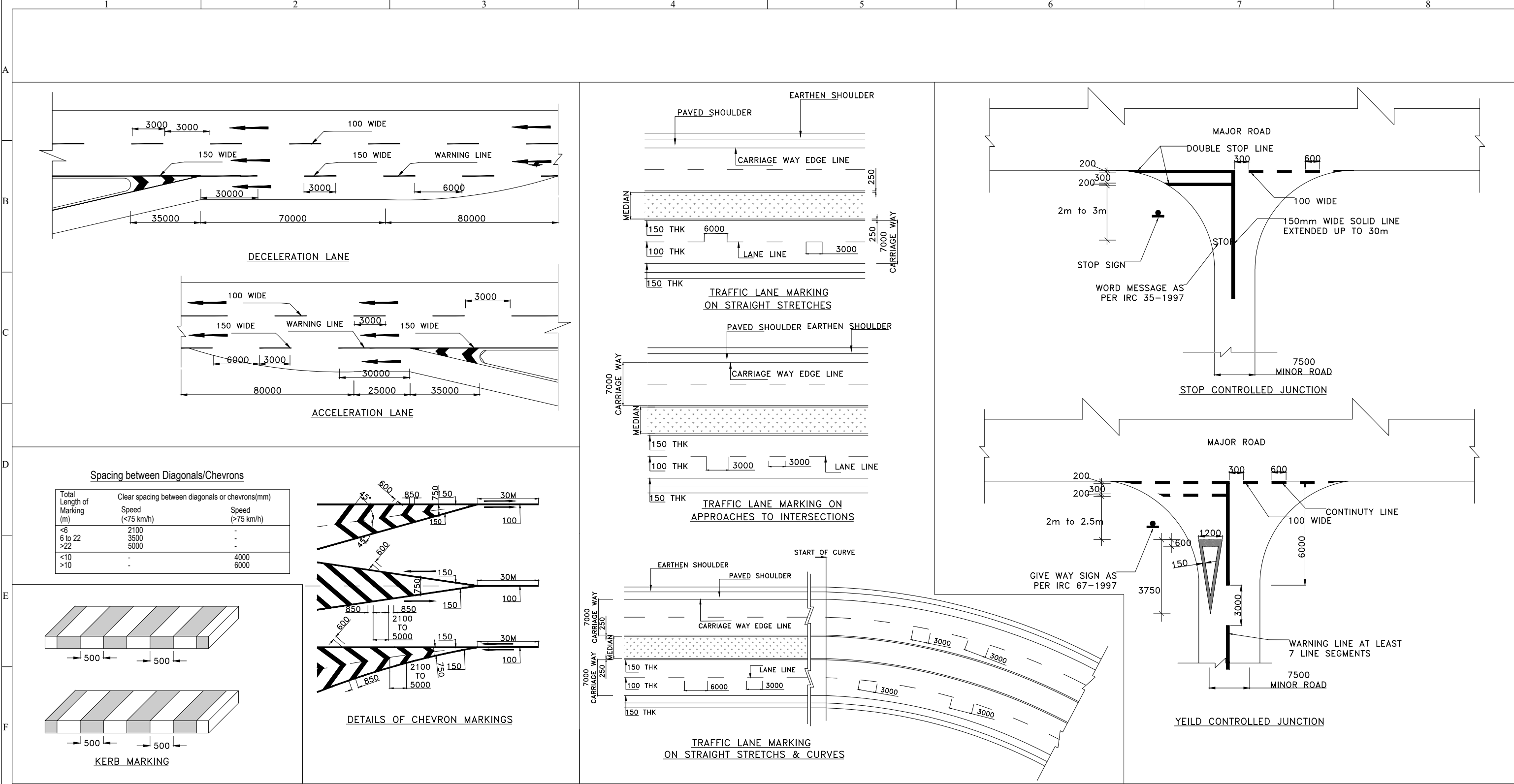


DETAILS FOR SIGN WITH DOUBLE SUPPORT



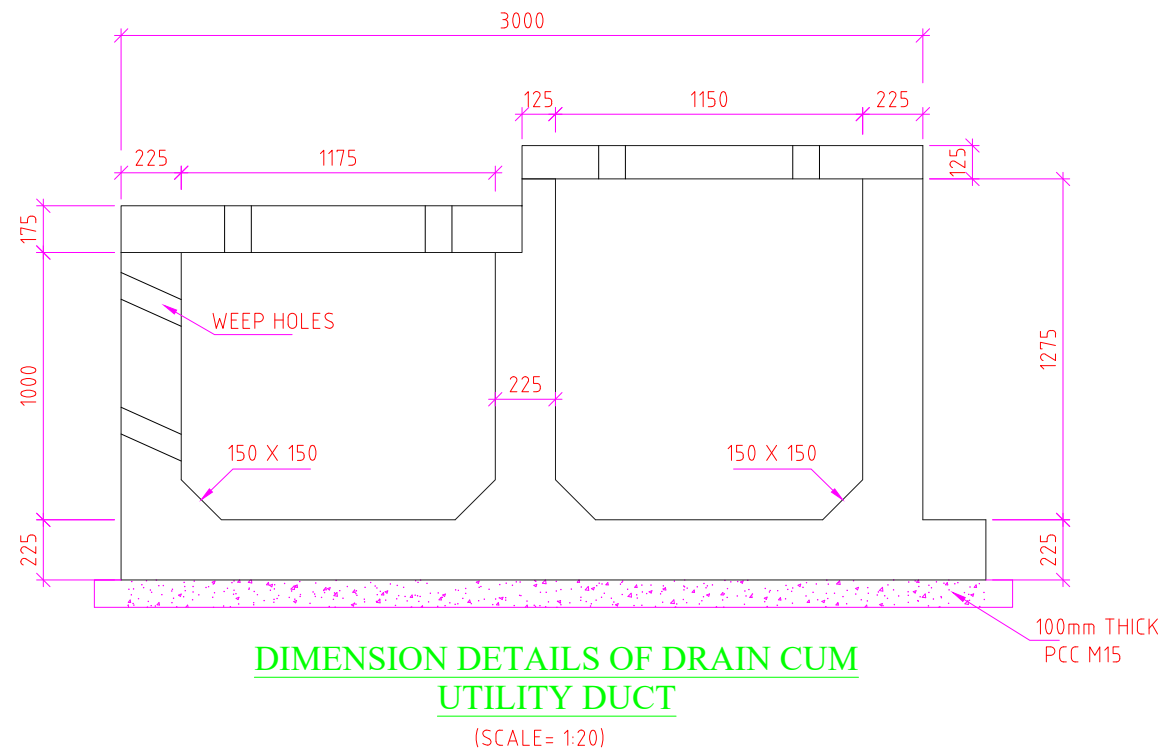
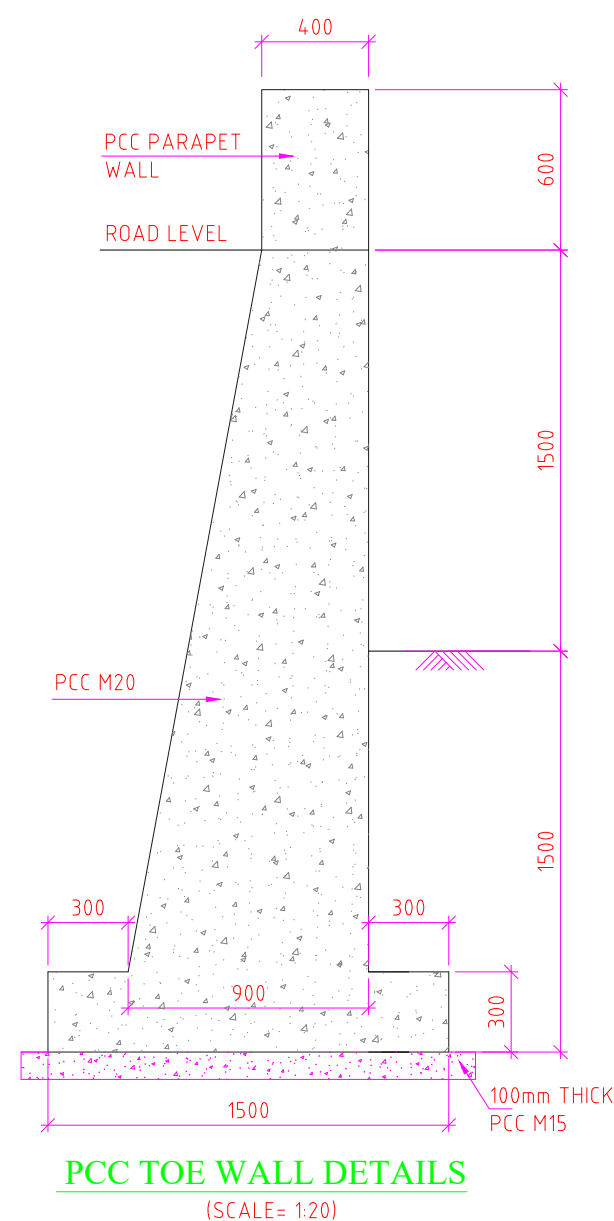
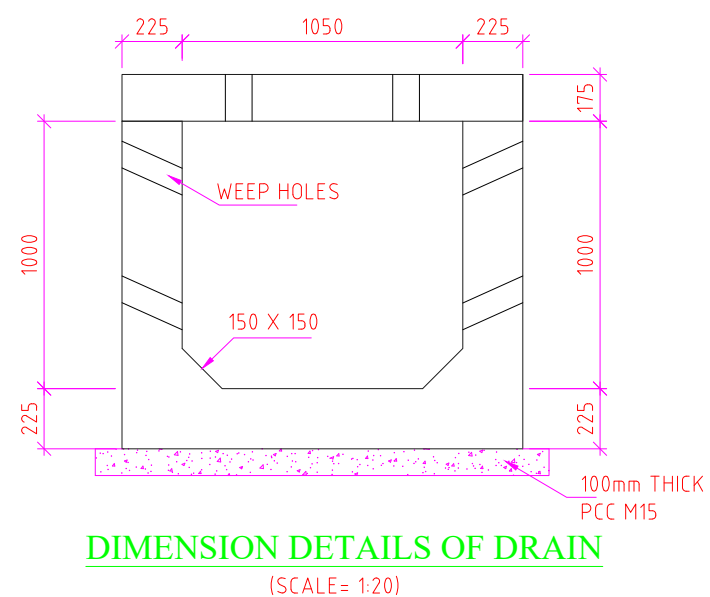
SECTION 2-2

SIGN	MARK	SHAPE	COLOUR			DIMENSION
			BORDER	BACKGROUND	SYMBOL	
WARNING	CS	Equilateral Triangle with apex pointing Upwards	Red Reflective	White Reflective	Black	Side = 900 mm Corner = 45 mm Radius Border = 70 mm
MANDATORY / REGULATORY	RS	Generally Circular but for Stop Sign octagonal and Traingular for Give Way Sign	Red Reflective	White Reflective	Arrows : Black Band : Red	Dia = 600 mm Border = 65 mm Bend = 60 mm Dia = 900 mm Border = 65 mm Bend = 70 mm Octagon Side = 370 mm Border = 30 mm Triangular Side = 900 mm Border = 70 mm
INFORMATORY	OIS	Rectangular with longer side vertical	Blue Reflective	White Reflective	Black or Red Reflective	Over all = 800x600 mm Central Square = 400x600mm
DIRECTION	IS	Rectangular with longer side Horizontal	White Reflective	Green Reflective	White	Size Varies Border = 50 mm



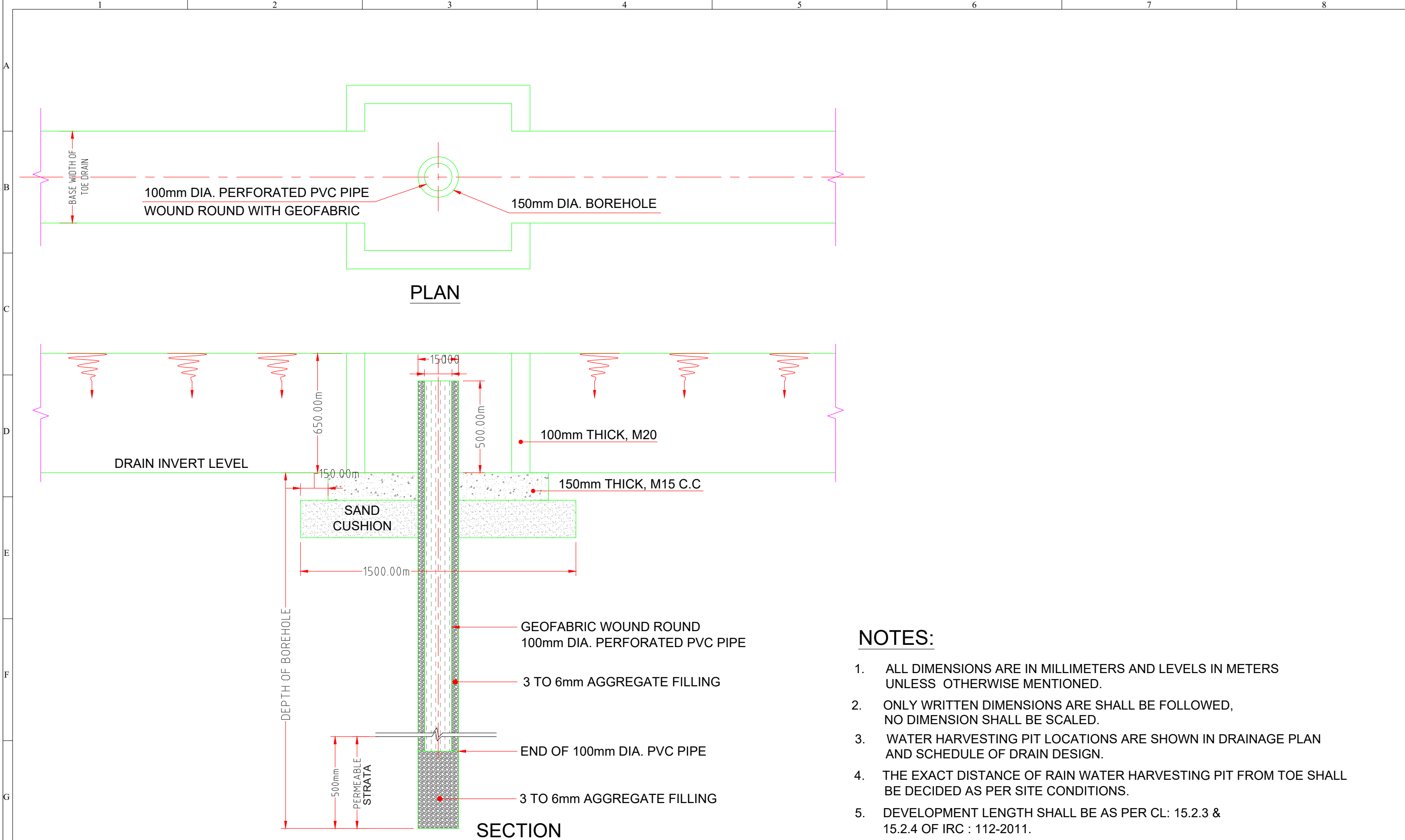
- NOTES:-
1. All Road marking details are as per IRC 35:2015.
 2. All lengths and spacings of diagonals/chevrons are measured parallel to road center line.
 3. First diagonal/chevron is to be so located that it is at least equal to its width.
 4. Width of all diagonal/chevrons measured at right angles to the diagonals/chevrons is 600 mm.
 5. Additional reference: Type Designs for Intersections on National Highways, 1995, MOST.

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1. ALL DIMENSIONS ARE IN mm, UNLESS SPECIFIED OTHERWISE.
2. DO NOT NEGLECT THE DRAWING FOLLOW WRITTEN DIMENSIONS ONLY.
3. GRADE OF CONCRETE :-M30
4. REINFORCEMENT SHALL BE H.Y.S.D BARS OF Fe 500 GRADE CONFORMING TO IS:1786.
5. SBC OF 25 T/SQM HAS BEEN CONSIDERED IN THE DESIGN SAME SHALL BE VERIFIED AT SITE.
6. 600mm THICK FILTER MATERIAL BEHIND RCC ABUTMENT/RETAINING WALL SHALL BE AS PER APPENDIX 6 OF IRC:78-2000.
7. 100MM DIA P.V.C. PIPE AT SPACING 1000 C/C IN HORIZONTAL/VERTICAL DIRECTION SHALL BE PROVIDED UP TO 150MM ABOVE GROUND LEVEL FOR WEEP HOLES IN VERTICAL WALL.
8. MINIMUM DEVELOPMENT LENGTH = 58D
WHERE 'D' IS DIA OF BAR
LAP LENGTH SHALL BE (58 x DIA OF BAR x k)
WHERE k = 1.0 IF UP TO 25% OF BARS ARE LAPPED
k = 1.15 IF 25% TO 33% OF BARS ARE LAPPED
k = 1.4 IF 33% TO 50% OF BARS ARE LAPPED
k = 1.5 IF MORE THAN 50% OF BARS ARE LAPPED
9. CLEAR COVER
FOOTING ---75mm.
EARTH FACE ---75mm.
FOR OTHERS ---40mm.

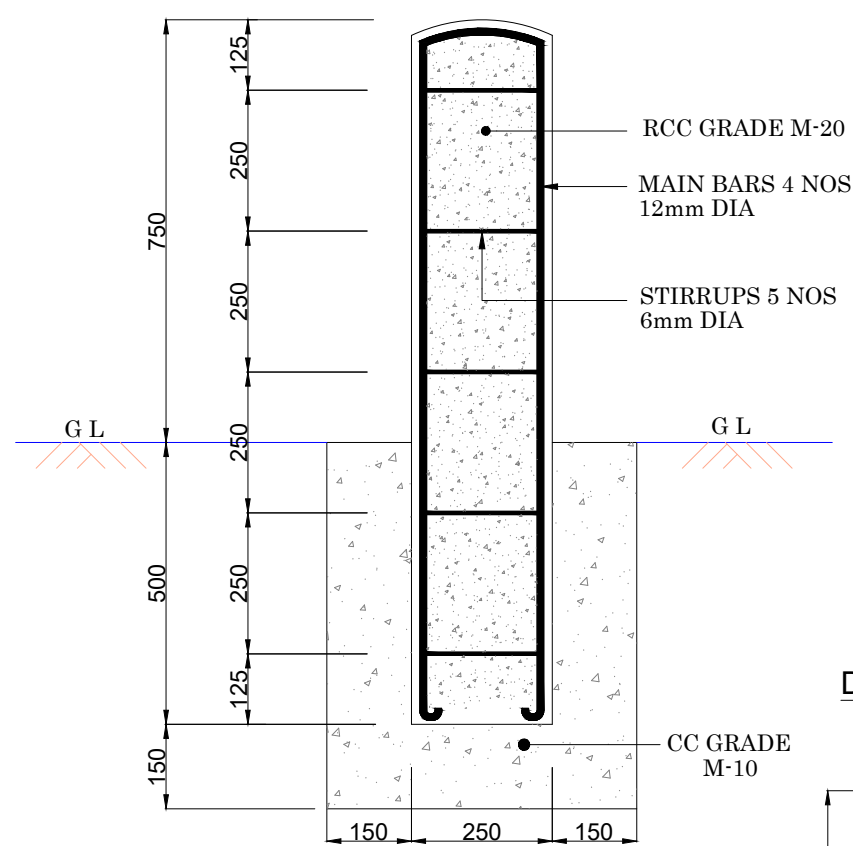
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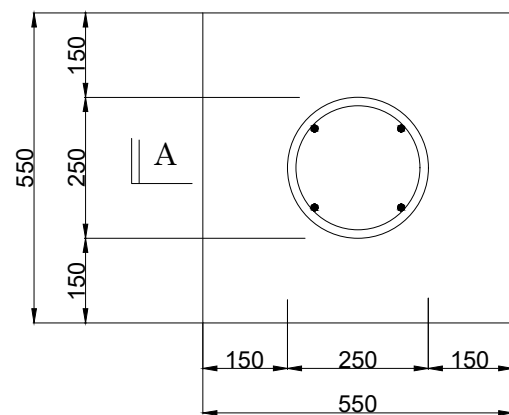
NOTES:

- 1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS IN METERS UNLESS OTHERWISE MENTIONED.
- 2. ONLY WRITTEN DIMENSIONS ARE SHALL BE FOLLOWED, NO DIMENSION SHALL BE SCALED.
- 3. WATER HARVESTING PIT LOCATIONS ARE SHOWN IN DRAINAGE PLAN AND SCHEDULE OF DRAIN DESIGN.
- 4. THE EXACT DISTANCE OF RAIN WATER HARVESTING PIT FROM TOE SHALL BE DECIDED AS PER SITE CONDITIONS.
- 5. DEVELOPMENT LENGTH SHALL BE AS PER CL: 15.2.3 & 15.2.4 OF IRC : 112-2011.

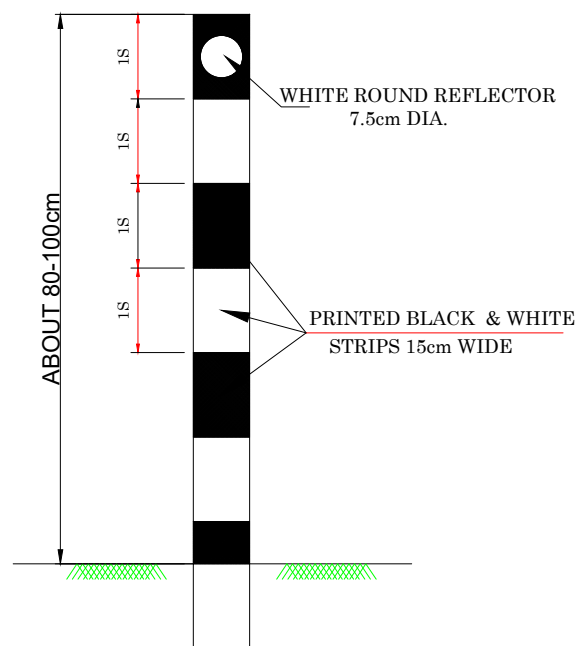
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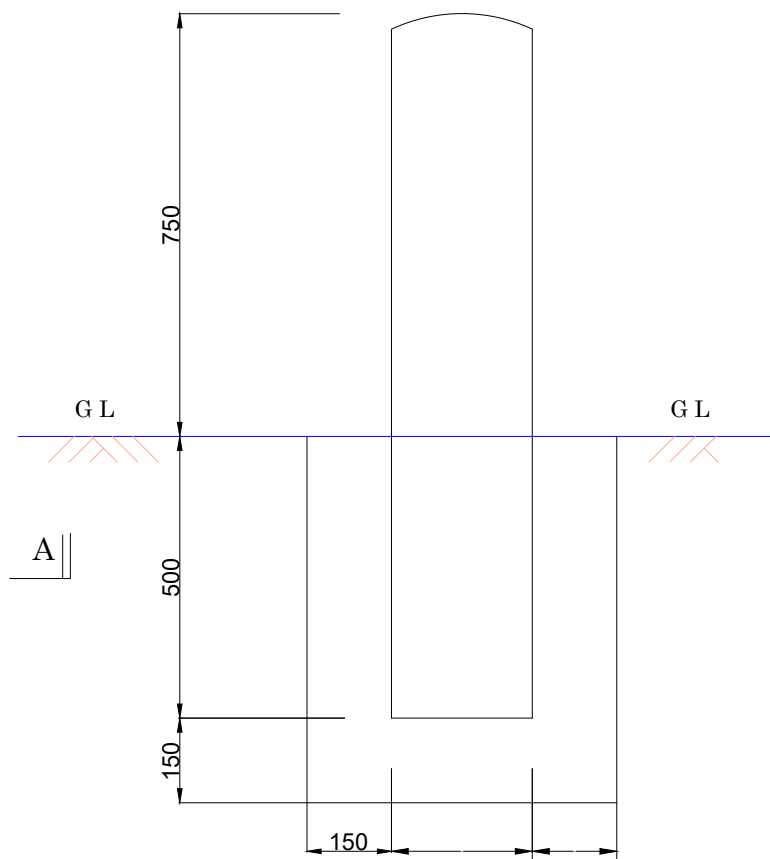
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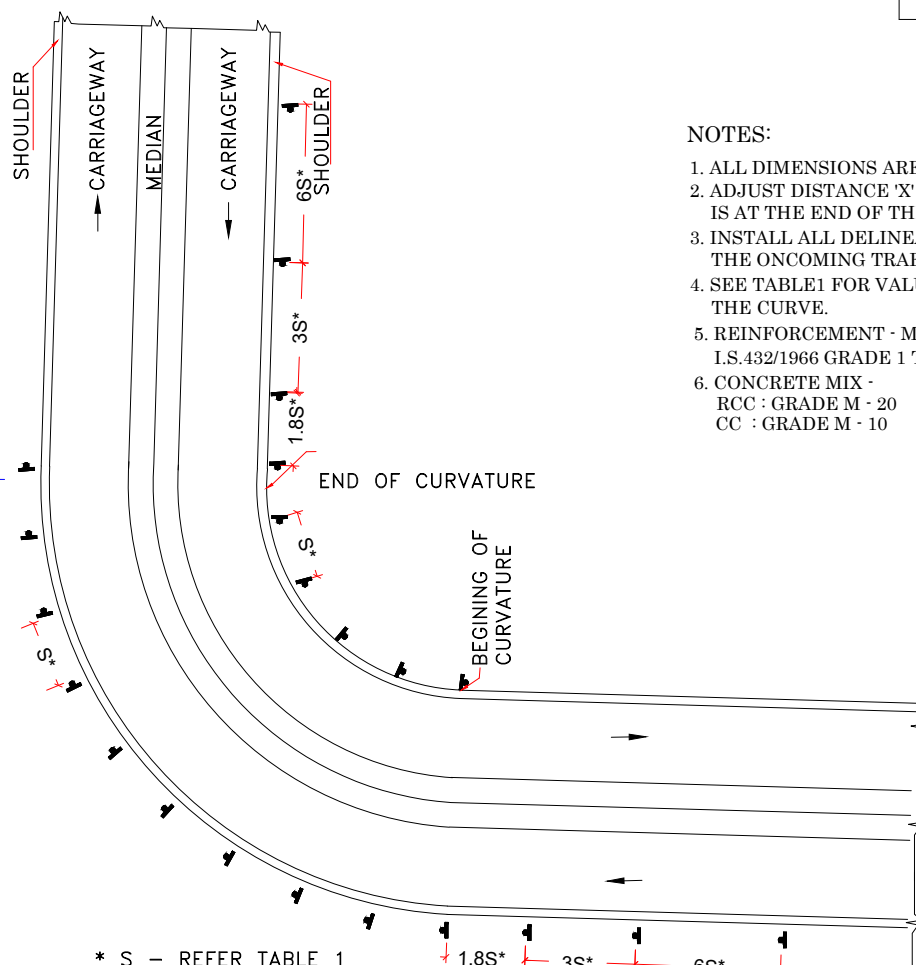
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DELINEATOR WITH CIRCULAR REFLECTOR



ELEVATION



* S - REFER TABLE 1
ROADWAY DELINEATOR SPACING ON CURVES

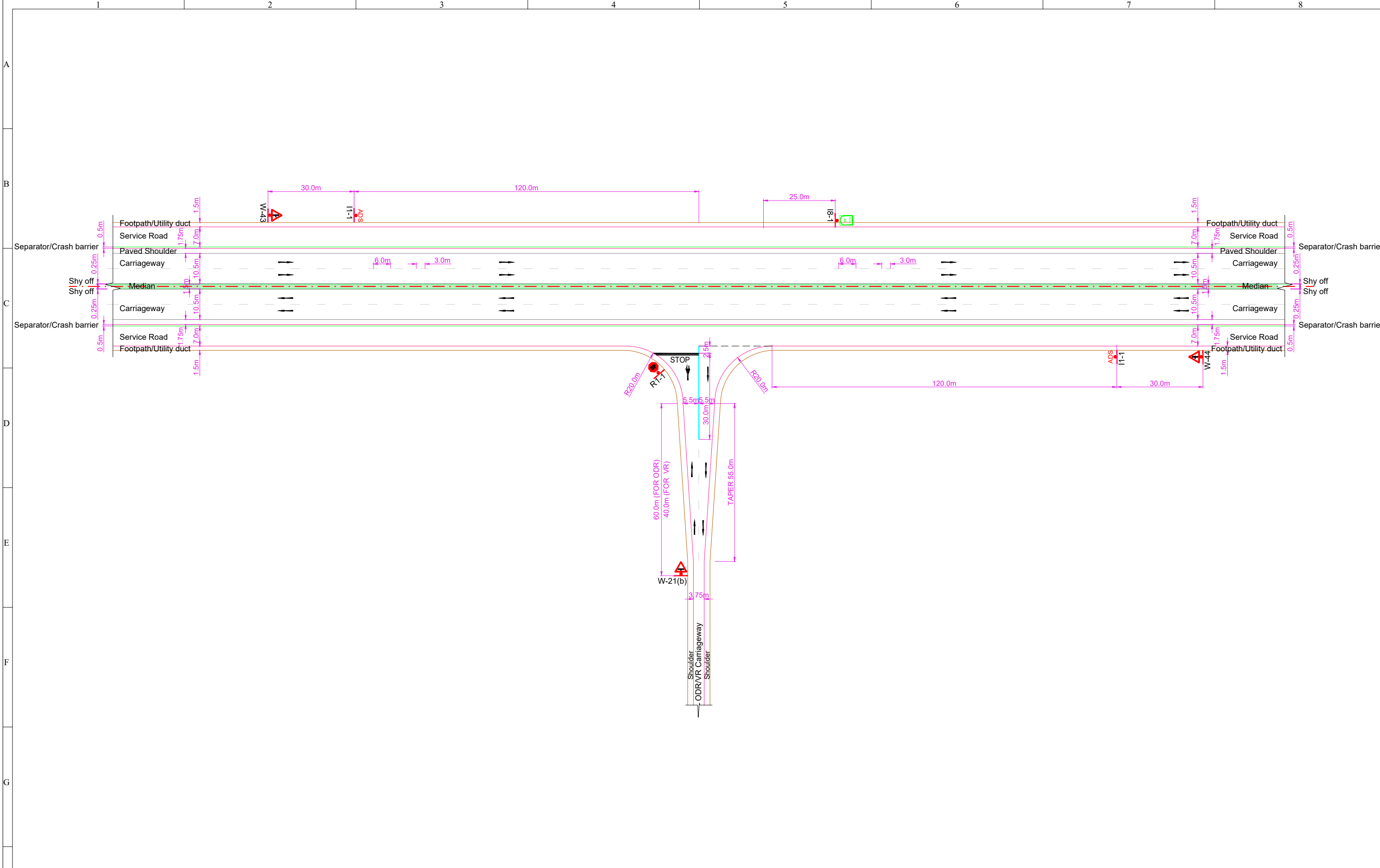
TABLE
RECOMMENDED SPACING FOR
ROADWAY INDICATORS
ON HORIZONTAL CURVES

Radius of curve (Metres)	Spacing on curve, S (Metres)
30	6
50	8
100	12
200	20
300	25
400	30
500	35
600	38
700	42
800	45
900	48
1000	50

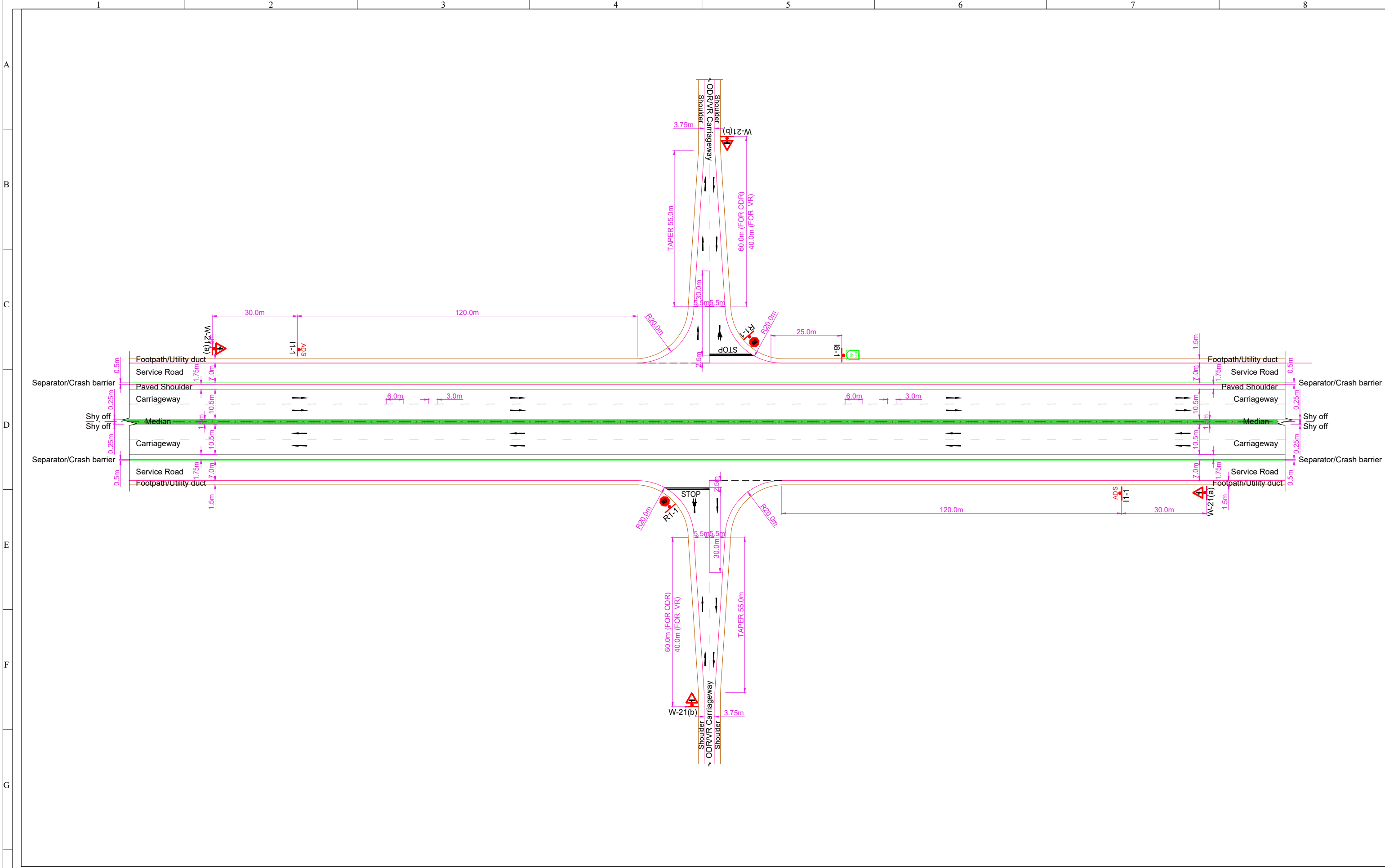
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS SPECIFIED OTHERWISE.
2. ADJUST DISTANCE 'X' SUITABLY SO THAT THE LAST ROADWAY DELINEATOR IS AT THE END OF THE CURVE.
3. INSTALL ALL DELINEATORS AT EDGE OF THE ROADWAY PERPENDICULAR TO THE ONCOMING TRAFFIC.
4. SEE TABLE1 FOR VALUE OF 'S' i.e. SPACING OF DELINEATORS ON THE CURVE.
5. REINFORCEMENT - MILD STEEL BARS CONFORMING TO I.S.432/1966 GRADE 1 TESTED STEEL
6. CONCRETE MIX -
RCC : GRADE M - 20
CC : GRADE M - 10

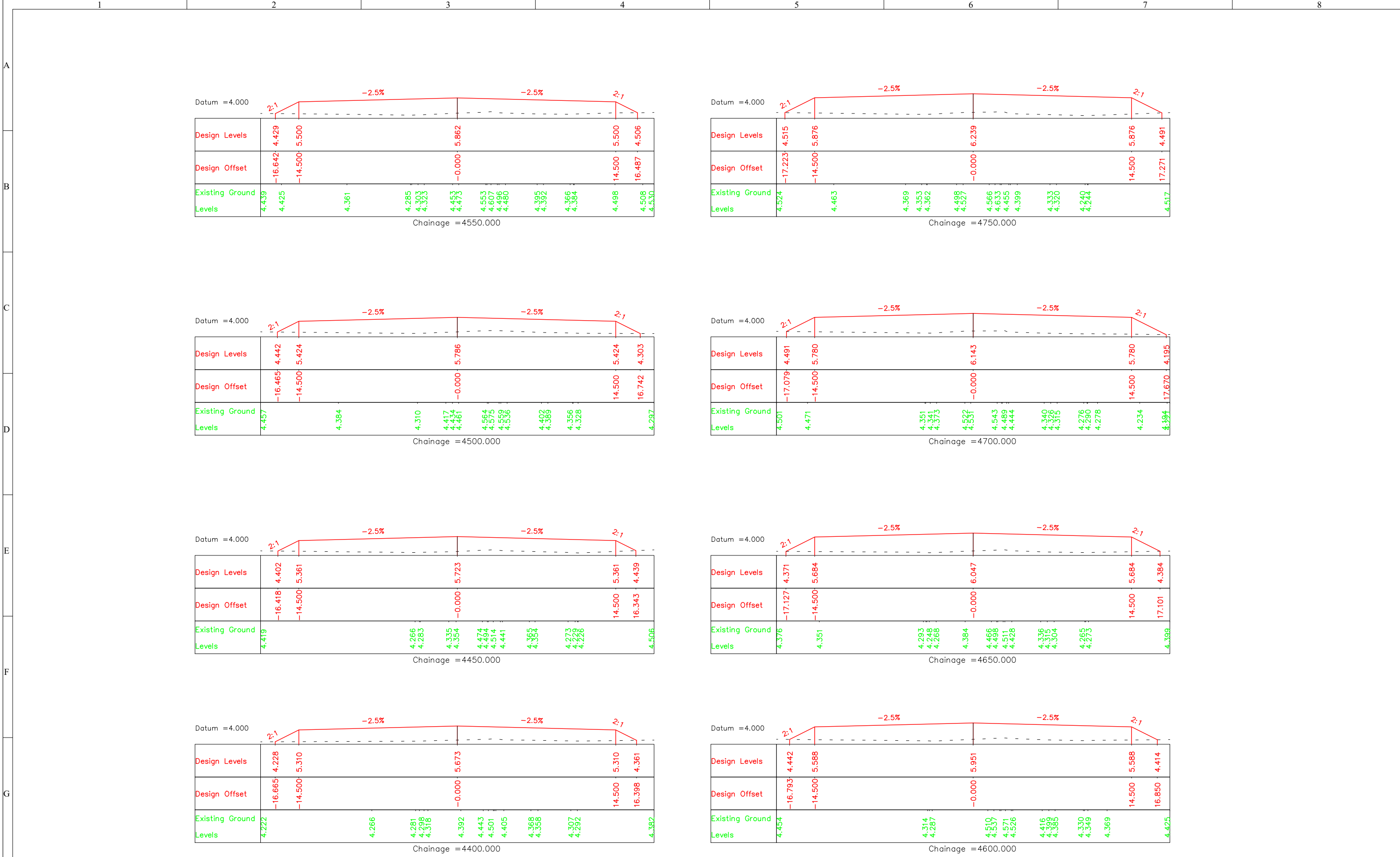
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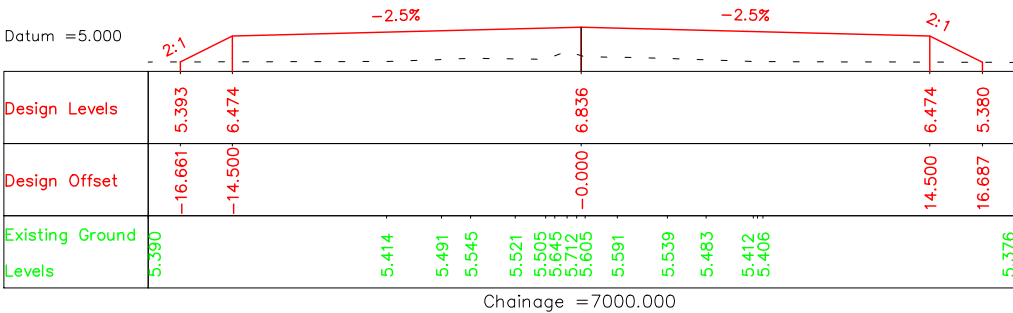
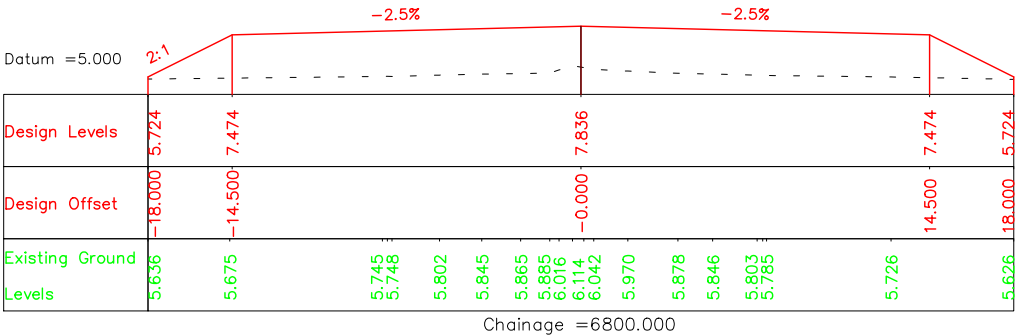
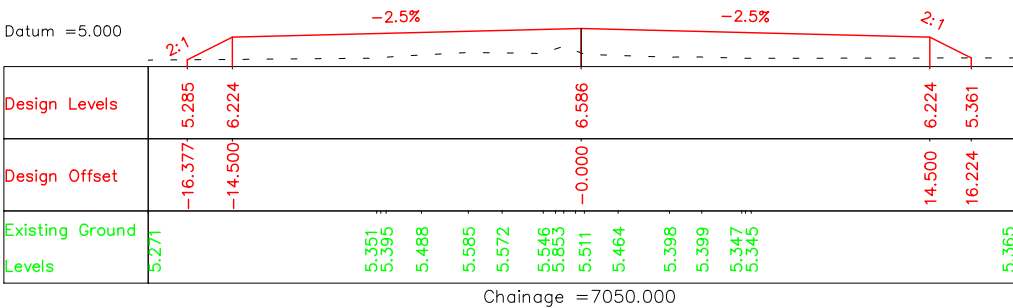
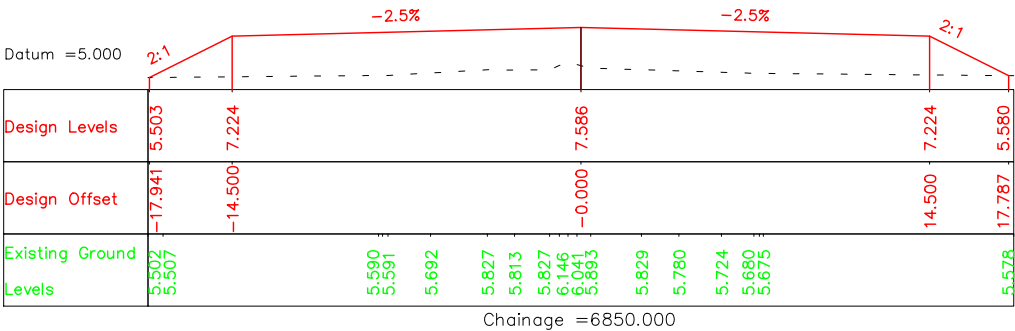
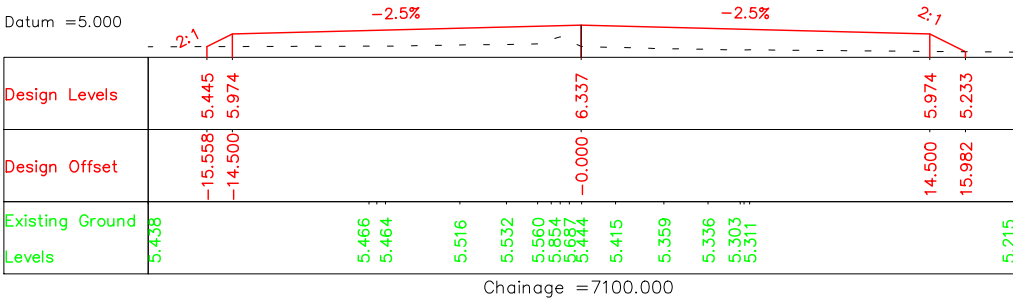
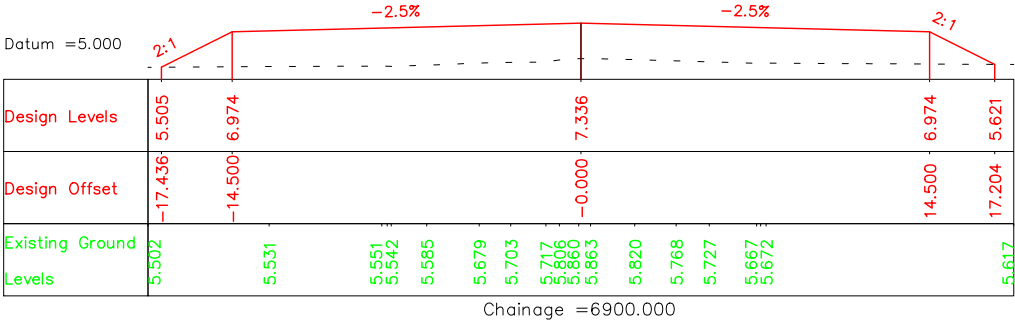
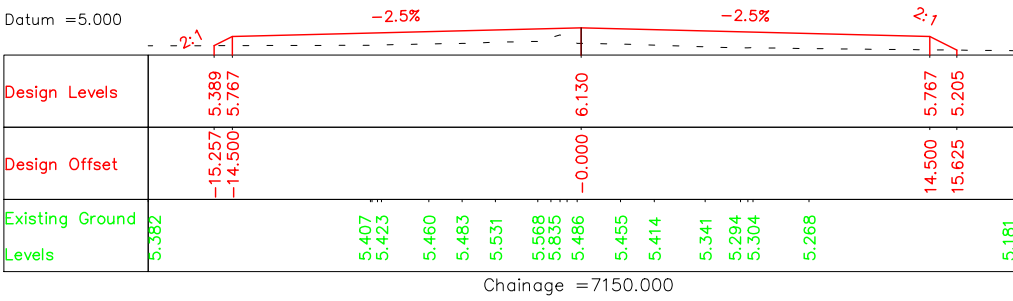
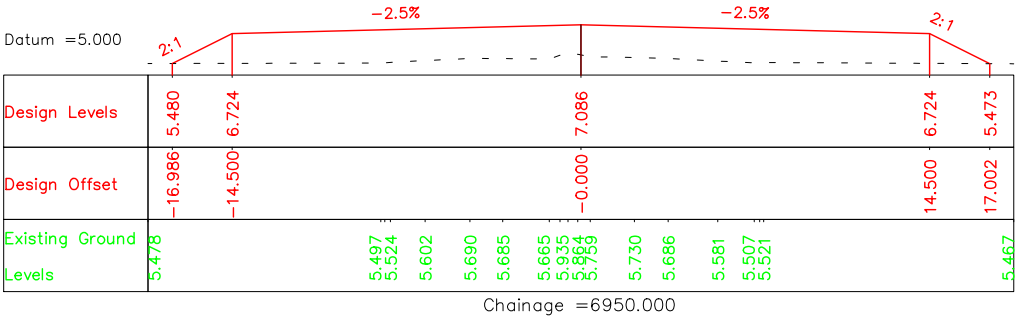
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REV	DATE	DESCRIPTION OF REVISIONS	BY

PROJECT EXECUTED BY:-



DEENDAYAL PORT AUTHORITY

DESIGN CONSULTANT:-

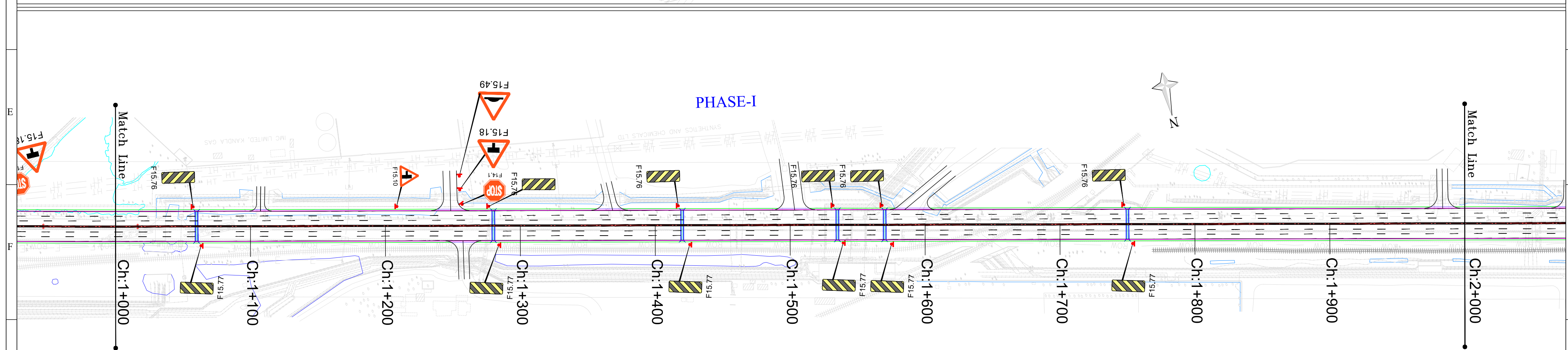
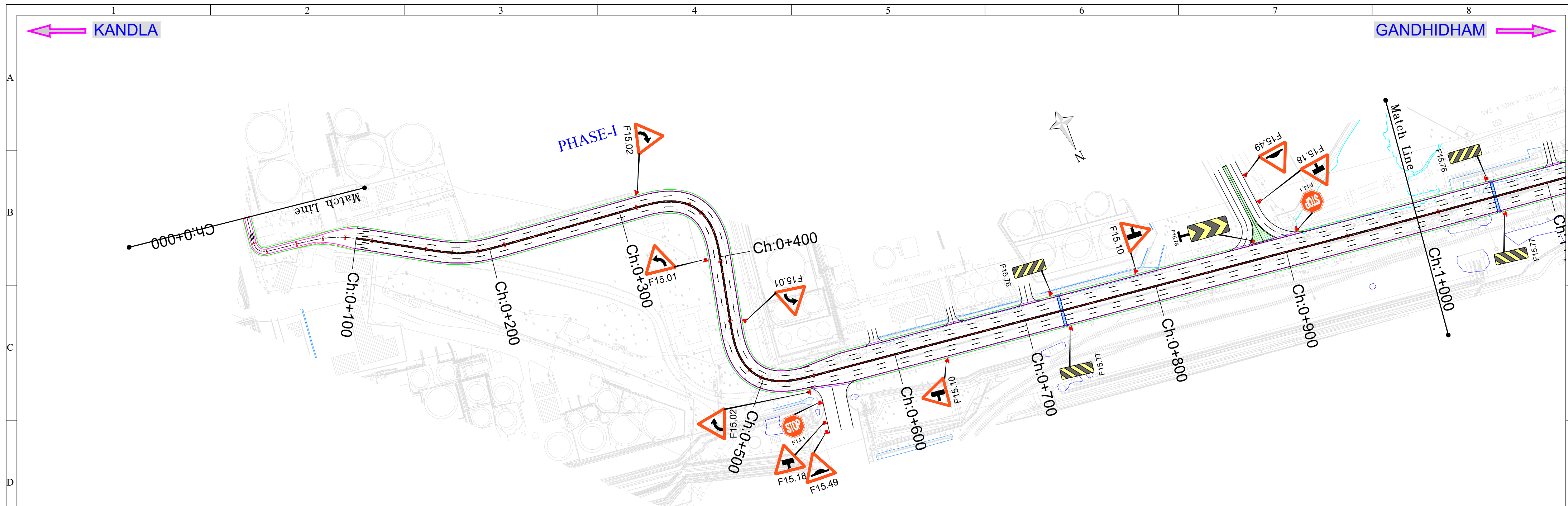


MONARCH
SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.
67, PANMALA, 1 - RUJETA
SINHGAD ROAD, PUNE 411 030.
PH:020/24330432,24330246,FAX:24330028,
e-mail:enquiry@monarchpune.in

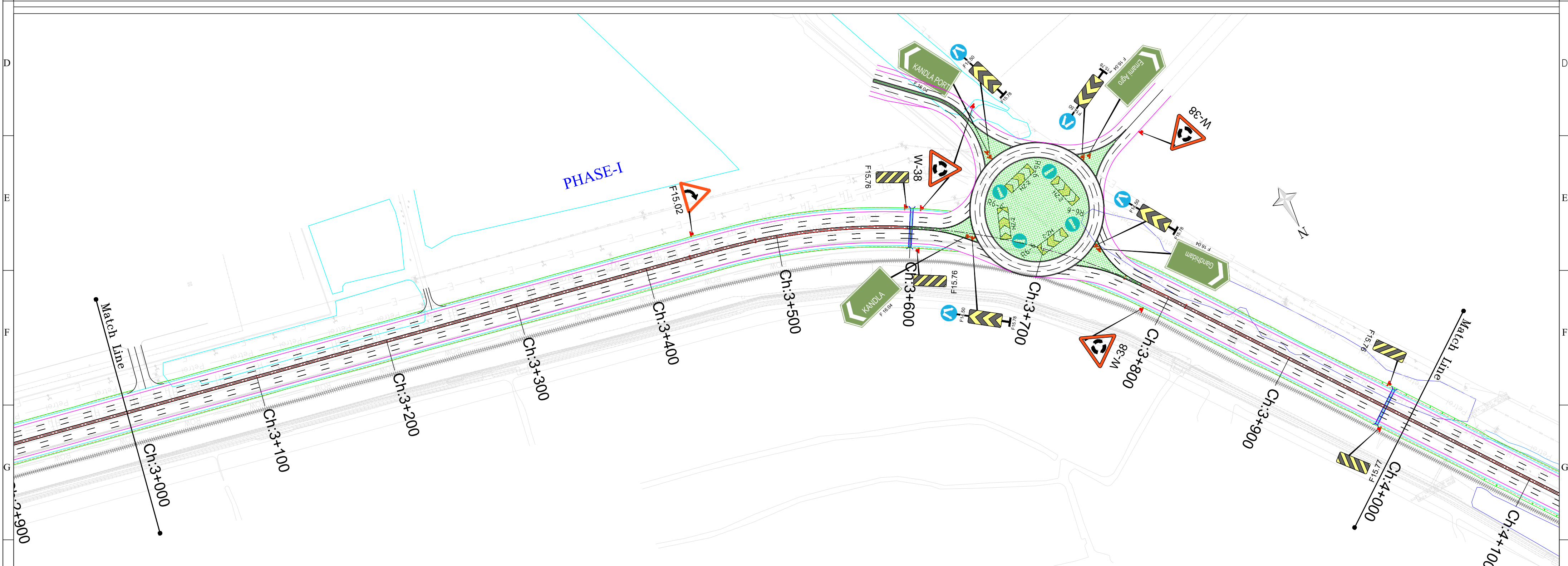
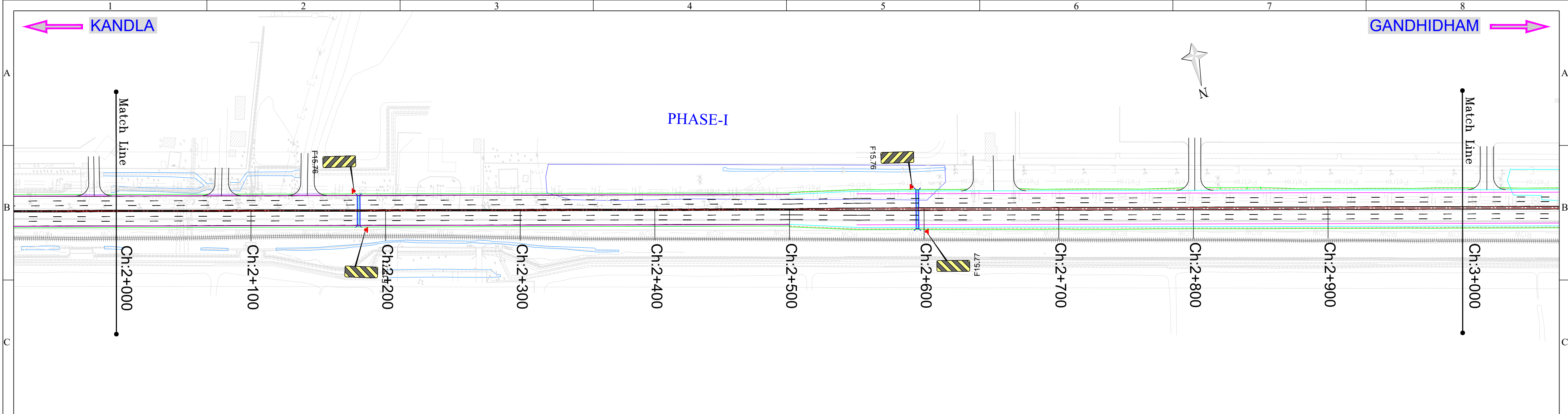
DRAWN	P.W	
DESIGN	M.P	
CHECKED	Y.J	
APPROVED	S.D	
Scale:		Date:
H	NTS	NTS
V	NTS	NTS
		Mar - 2023

PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)		
TITLE:	DETAIL CROSS SECTION FROM KM 6+800 TO KM 7+150		
DRG NO.:	KA-GA/DCS-18	REV. 0	SHEET: 18 of 23

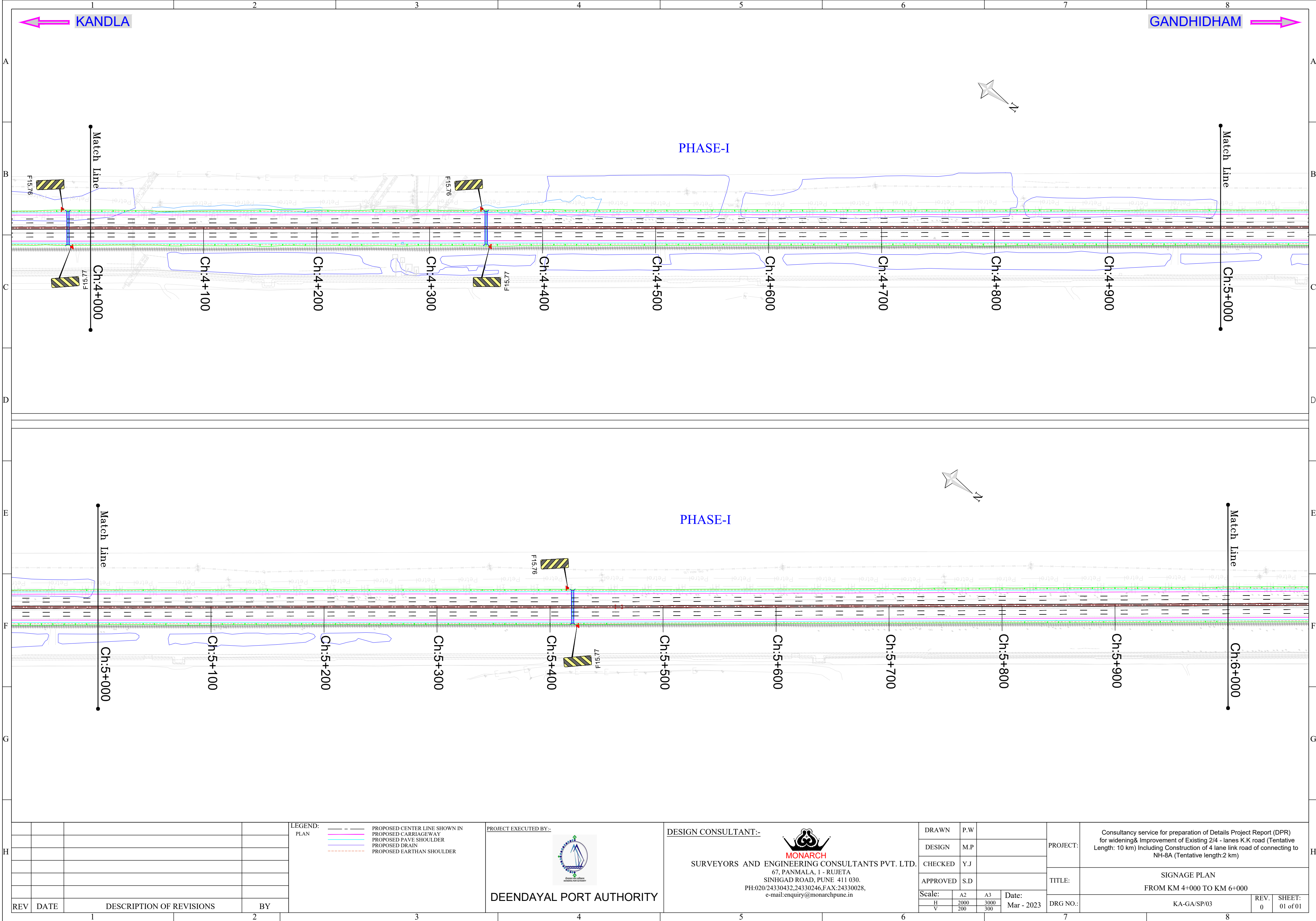
TRAFFIC SIGNAGE DETAILS



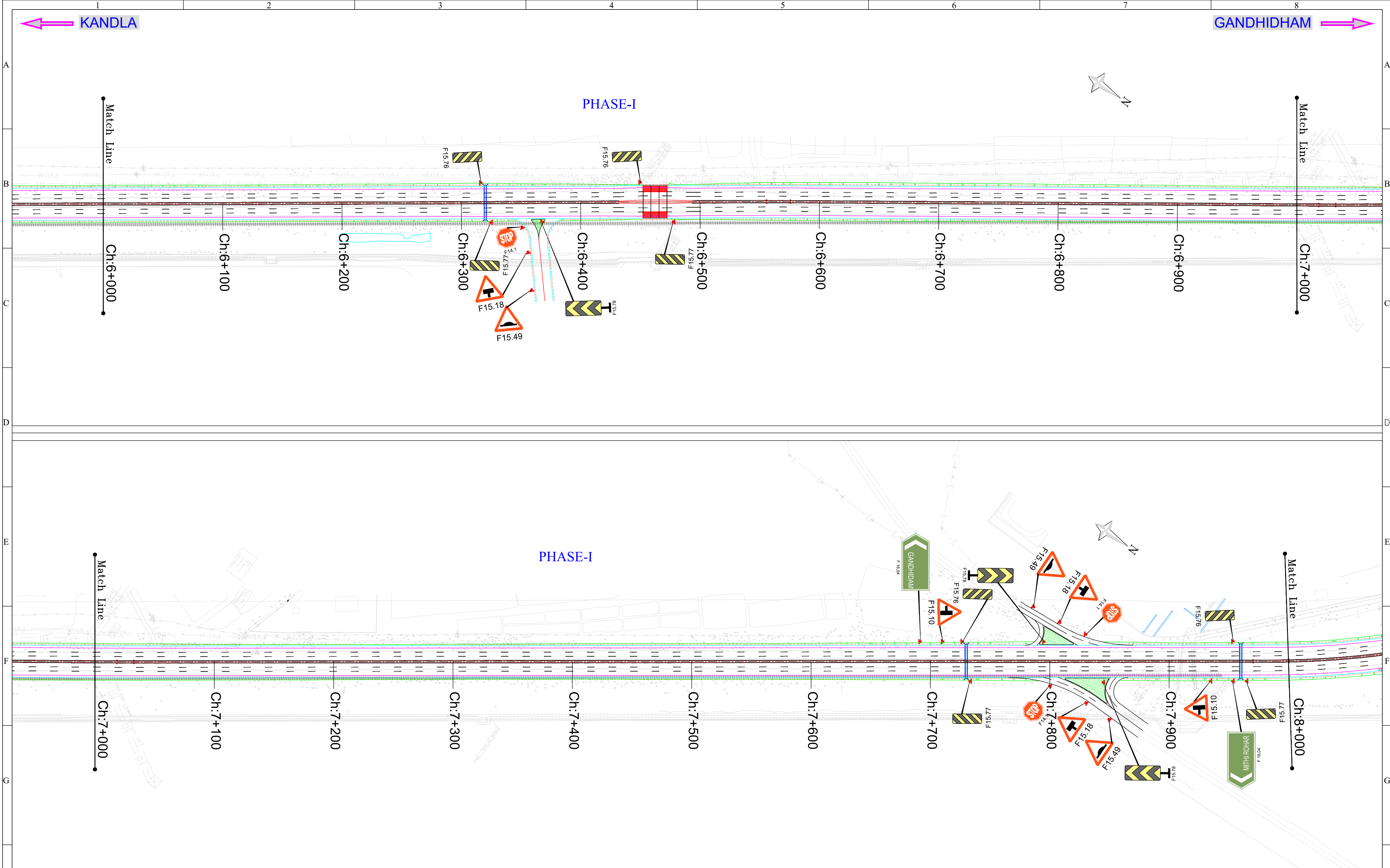
H				LEGEND: PLAN <div><div><div></div></div><div>PROPOSED CENTER LINE SHOWN IN</div><div><div></div></div><div>PROPOSED CARRIAGEWAY</div><div><div></div></div><div>PROPOSED PAVI. SHOULDER</div><div><div></div></div><div>PROPOSED DRAIN</div><div><div></div></div><div>PROPOSED EARTHAN SHOULDER</div></div>	PROJECT EXECUTED BY:- <div><div><div></div></div><div>DEENDAYAL PORT AUTHORITY</div></div>	DESIGN CONSULTANT:- <div><div><div></div></div><div>MONARCH</div><div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div><div>67, PANMALA, 1 - RUJETA</div><div>SINHGAD ROAD, PUNE 411 030.</div><div>PH:020/24330432,24330246.FAX:24330028,</div><div>e-mail:enquiry@monarchpune.in</div></div>	DRAWN	P.W	PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)		
	DESIGN	M.P										
	CHECKED	Y.J										
	APPROVED	S.D										
	Scale:		A2				A3	Date: Mar - 2023	TITLE:	SIGNAGE PLAN FROM KM 0+000 TO KM 2+000		
	<div><div>H</div><div>V</div></div> <div><div>2000</div><div>200</div></div> <div><div>3000</div><div>300</div></div>											
REV	DATE	DESCRIPTION OF REVISIONS	BY				DRG NO.:	KA-GA/SP/01	REV. 0	SHEET: 01 of 01		



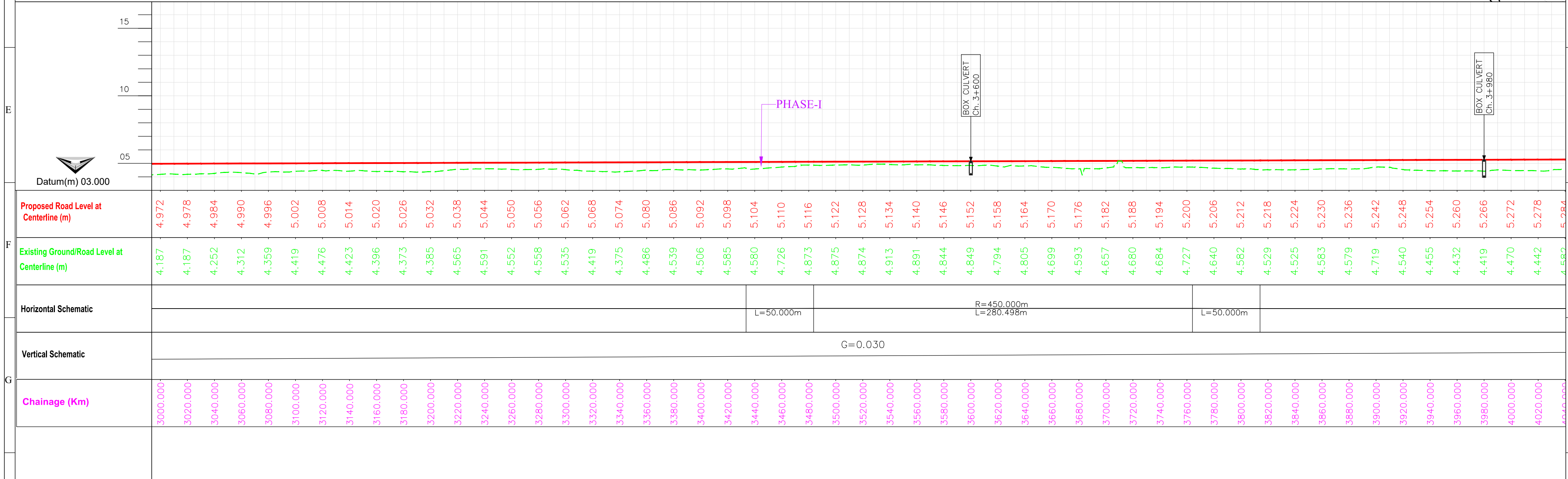
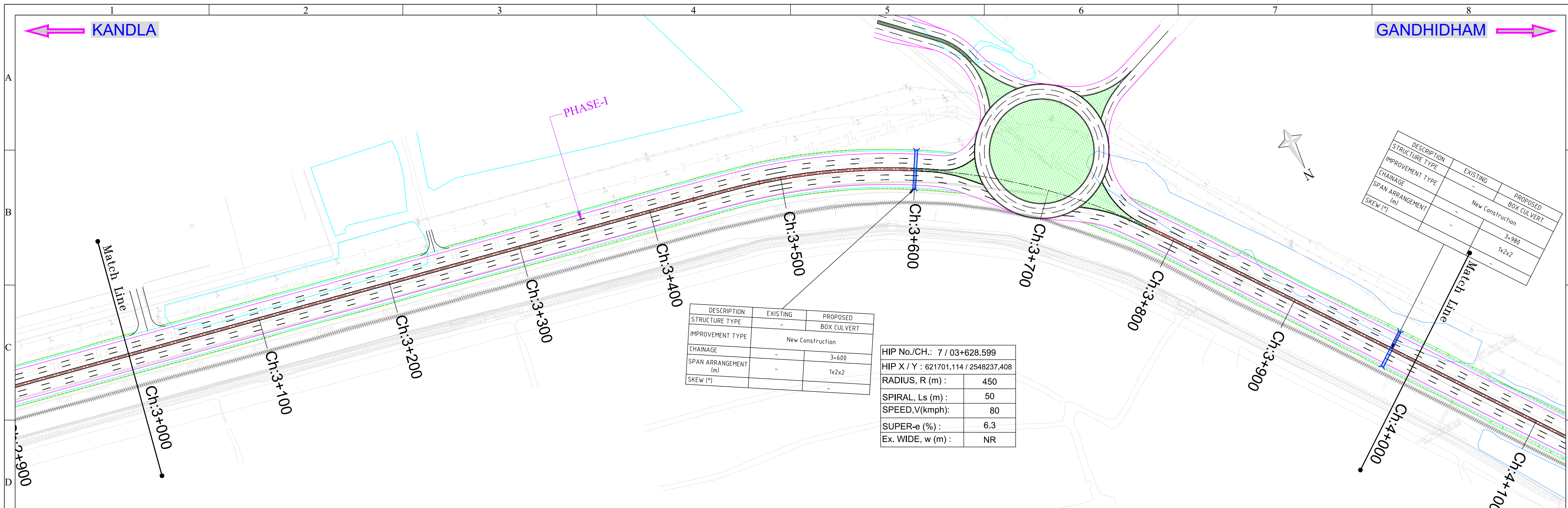
H					<div>LEGEND: PLAN</div> <div><div><div></div></div><div>PROPOSED CENTER LINE SHOWN IN</div><div><div></div></div><div>PROPOSED CARRIAGEWAY</div><div><div></div></div><div>PROPOSED PAVE SHOULDER</div><div><div></div></div><div>PROPOSED DRAIN</div><div><div></div></div><div>PROPOSED EARTHAN SHOULDER</div></div>	<div>PROJECT EXECUTED BY:-</div> <div><div><div></div></div><div>DEENDAYAL PORT AUTHORITY</div></div>	<div>DESIGN CONSULTANT:-</div> <div><div><div></div></div><div>MONARCH</div><div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div><div>67, PANMALA, 1 - RUJETA</div><div>SINHGAD ROAD, PUNE 411 030.</div><div>PH:020/24330432,24330246,FAX:24330028,</div><div>e-mail:enquiry@monarchpune.in</div></div>	DRAWN			P.W		PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)			
	DESIGN			M.P					TITLE:	SIGNAGE PLAN							
	CHECKED			Y.J						FROM KM 2+000 TO KM 4+000							
	APPROVED			S.D						DRG NO.:	KA-GA/SP/02			REV. 0	SHEET: 01 of 01		
	Scale:		A2	A3				Date:									
H	2000	3000	Mar - 2023														
V	200	300															
1		2		3		4		5		6		7		8			
REV	DATE	DESCRIPTION OF REVISIONS			BY												

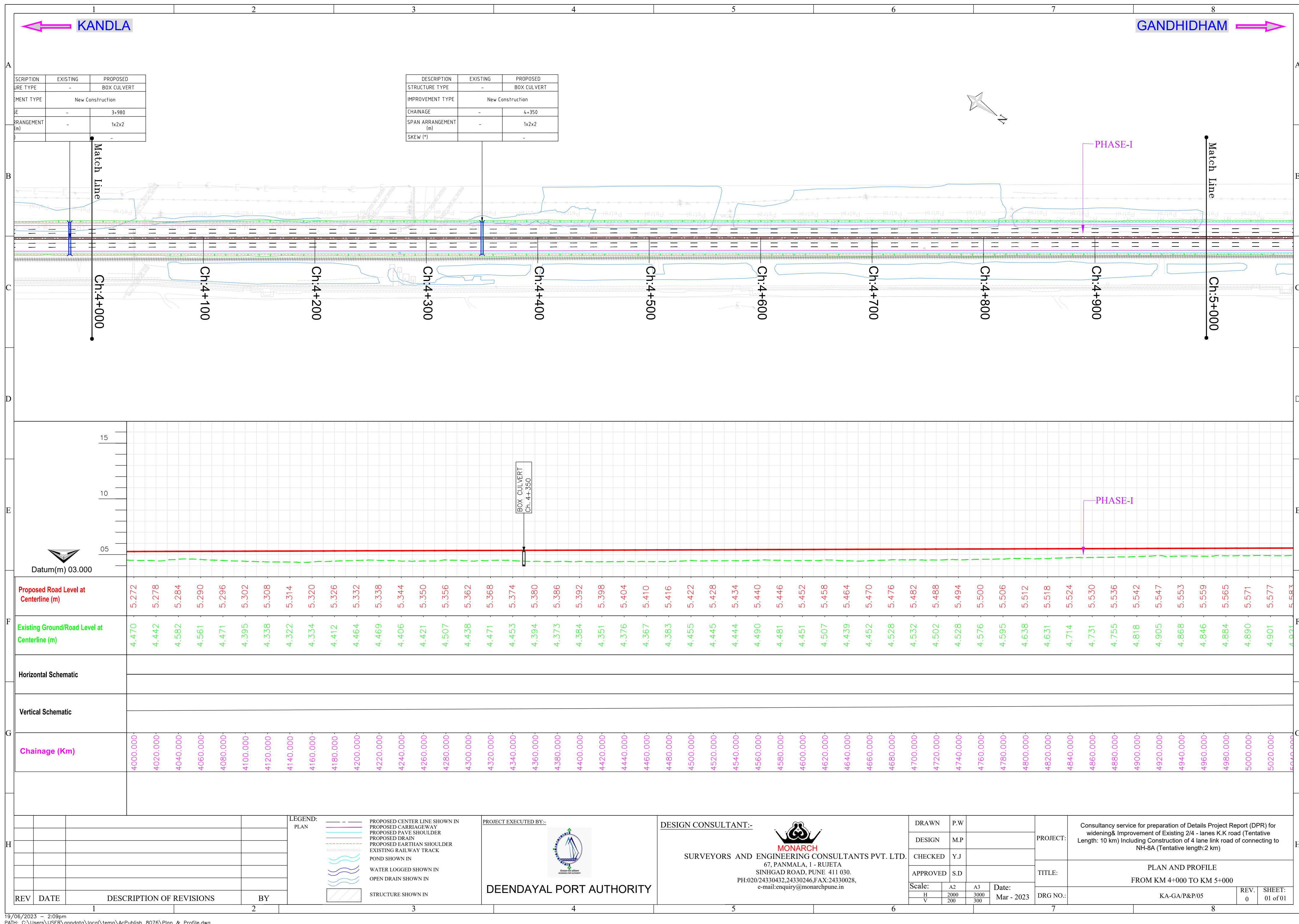


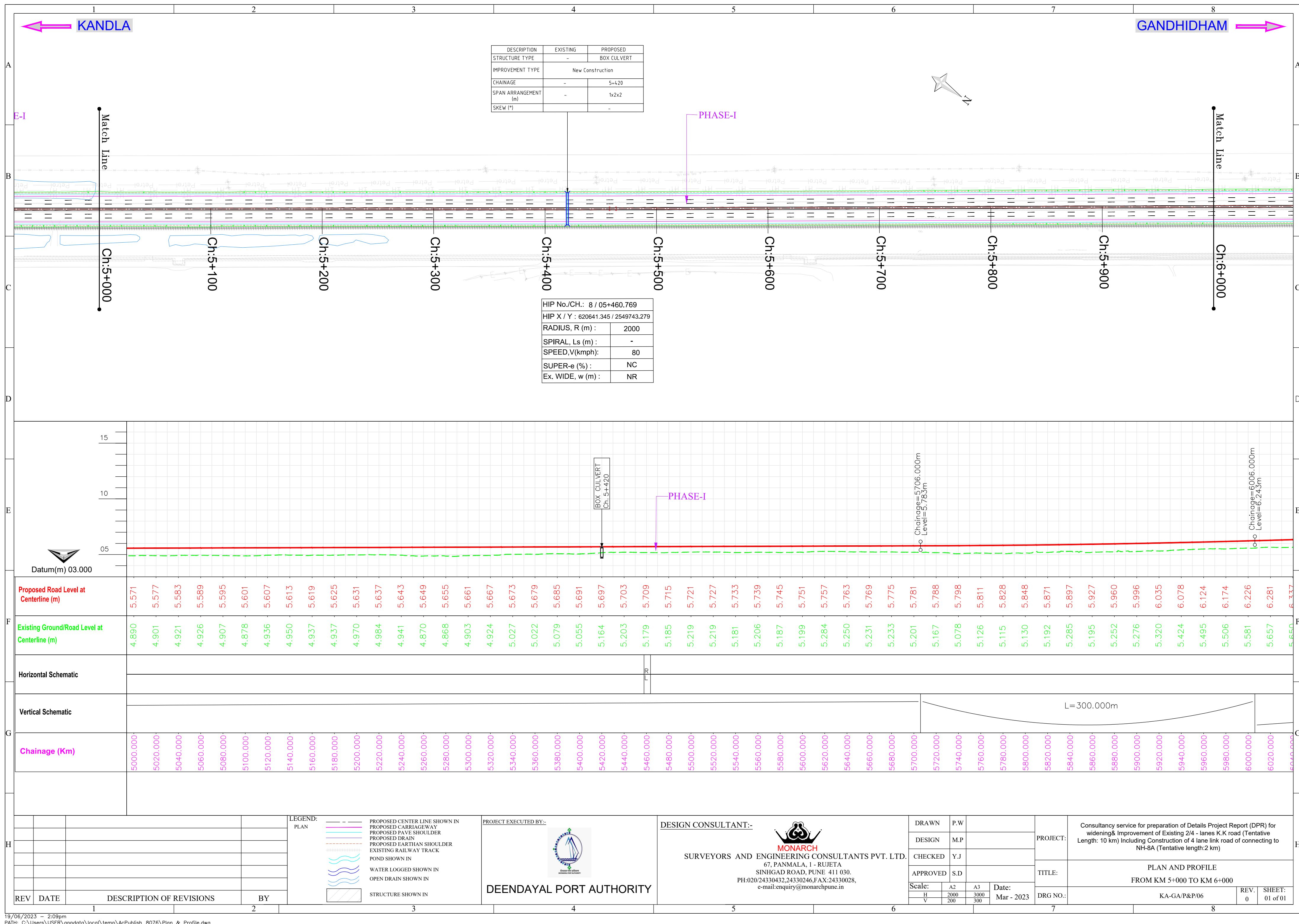
				<div>LEGEND:</div> <div>PLAN</div> <div><div><div></div></div><div>PROPOSED CENTER LINE SHOWN IN</div><div><div></div></div><div>PROPOSED CARRIAGEWAY</div><div><div></div></div><div>PROPOSED PAVE SHOULDER</div><div><div></div></div><div>PROPOSED DRAIN</div><div><div></div></div><div>PROPOSED EARTHAN SHOULDER</div></div>	<div>PROJECT EXECUTED BY:-</div> <div><div><div></div></div><div>DEENDAYAL PORT AUTHORITY</div></div>	<div>DESIGN CONSULTANT:-</div> <div><div><div></div></div><div>MONARCH</div><div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div><div>67, PANMALA, 1 - RUJETA</div><div>SINHGAD ROAD, PUNE 411 030.</div><div>PH:020/24330432,24330246,FAX:24330028,</div><div>e-mail:enquiry@monarchpune.in</div></div>	<div>DRAWN</div> <div>P.W</div> <div>DESIGN</div> <div>M.P</div> <div>CHECKED</div> <div>Y.J</div> <div>APPROVED</div> <div>S.D</div> <div>Scale:</div> <div><div>H</div><div>2000</div><div>V</div><div>200</div></div> <div><div>A2</div><div>3000</div><div>A3</div><div>300</div></div> <div>Date:</div> <div>Mar - 2023</div>	<div>PROJECT:</div> <div>TITLE:</div> <div>DRG NO.:</div>	<div>Consultancy service for preparation of Details Project Report (DPR)</div> <div>for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative</div> <div>Length: 10 km) Including Construction of 4 lane link road of connecting to</div> <div>NH-8A (Tentative length:2 km)</div> <div>SIGNAGE PLAN</div> <div>FROM KM 4+000 TO KM 6+000</div> <div>KA-GA/SP/03</div> <div>REV.</div> <div>0</div> <div>SHEET:</div> <div>01 of 01</div>
REV	DATE	DESCRIPTION OF REVISIONS	BY						

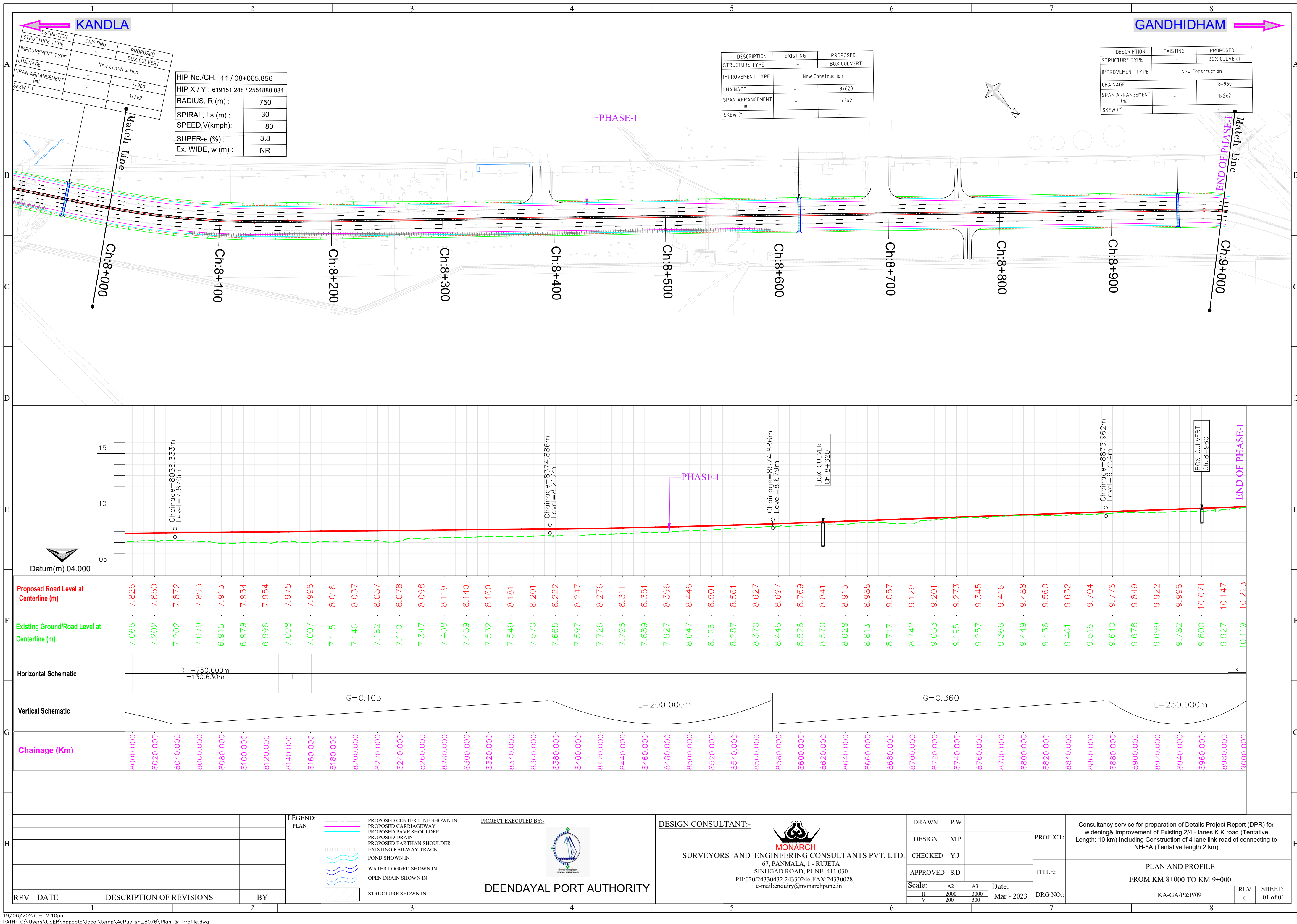


H					<div>LEGEND:</div> <div>PLAN</div> <div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div></div> <div>PROPOSED CENTER LINE SHOWN IN</div> <div>PROPOSED CARRIAGEWAY</div> <div>PROPOSED PAVE SHOULDER</div> <div>PROPOSED DRAIN</div> <div>PROPOSED EARTHAN SHOULDER</div>	<div>PROJECT EXECUTED BY:-</div> <div><div><div><div></div><div></div><div></div></div><div></div></div><div>Deendayal Port Authority</div></div> <div>DEENDAYAL PORT AUTHORITY</div>	<div>DESIGN CONSULTANT:-</div> <div><div><div><div></div><div></div><div></div></div><div></div></div><div>MONARCH</div><div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div><div>67, PANMALA, 1 - RUJETA</div><div>SINHGAD ROAD, PUNE 411 030.</div><div>PH:020/24330432,24330246,FAX:24330028,</div><div>e-mail:enquiry@monarchpune.in</div></div>	DRAWN	P.W		PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)		
	DESIGN	M.P		TITLE:				SIGNAGE PLAN						
	CHECKED	Y.J						FROM KM 6+000 TO KM 8+000						
	APPROVED	S.D						DRG NO.:	KA-GA/SP/04			REV. 0	SHEET: 01 of 01	
	Scale:	A2	A3						Date:					
H V	2000 200	3000 300	Mar - 2023											
REV	DATE	DESCRIPTION OF REVISIONS			BY									

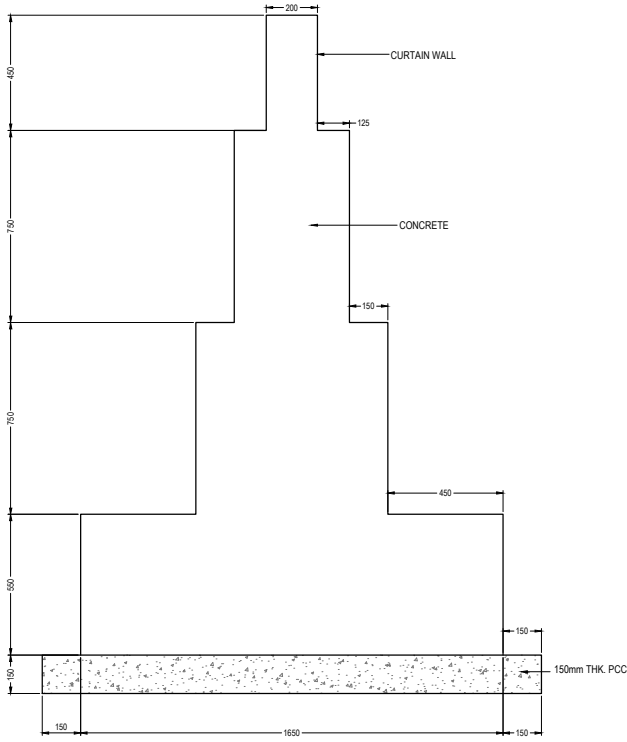
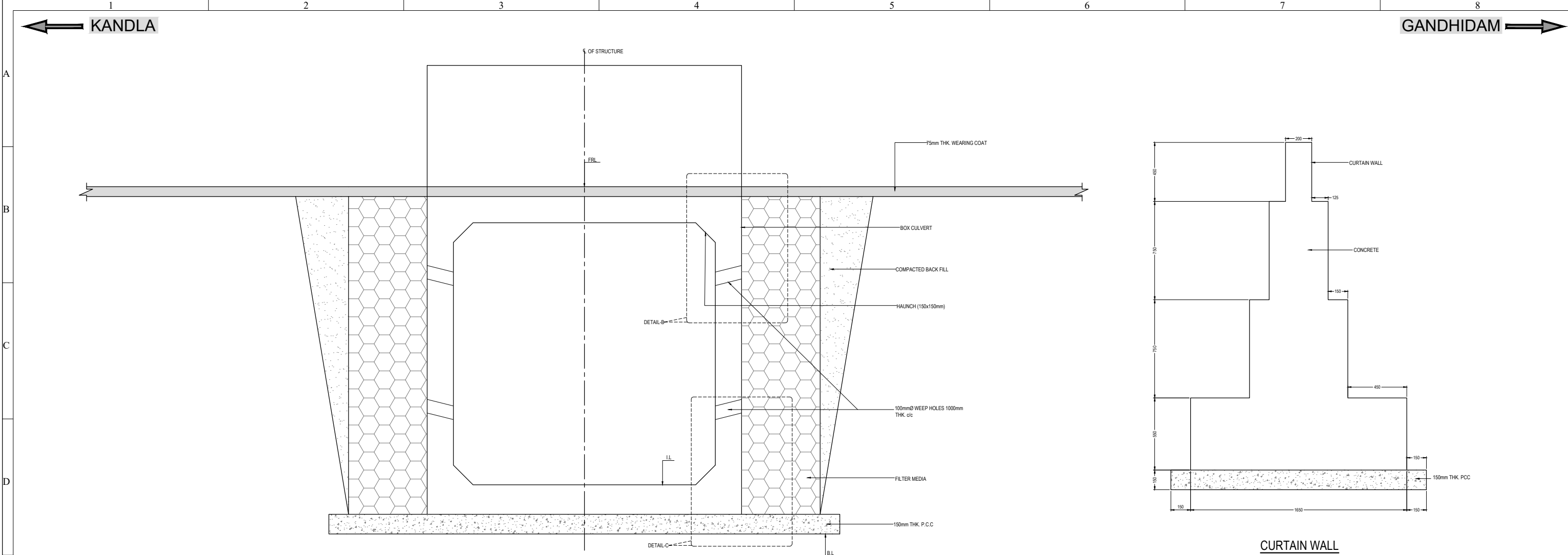
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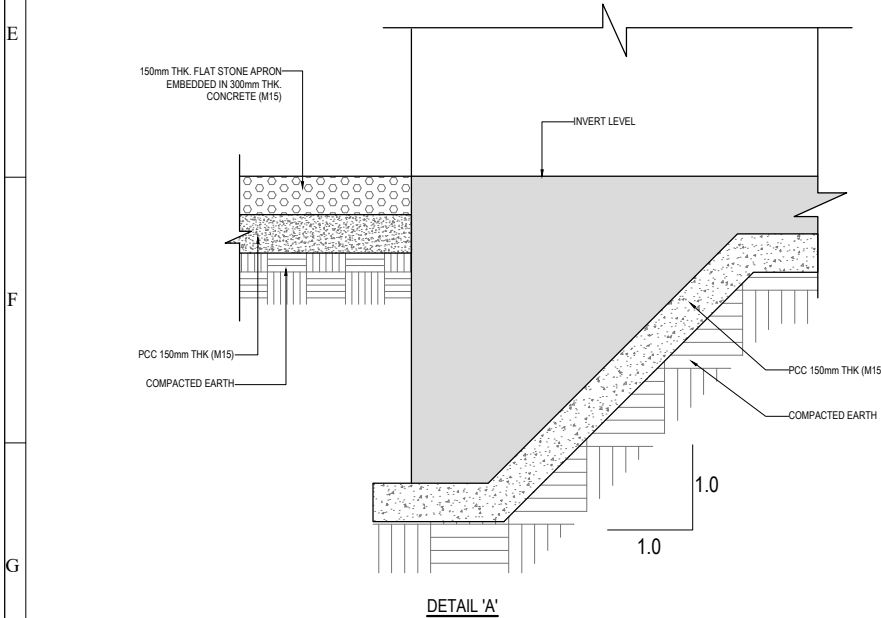




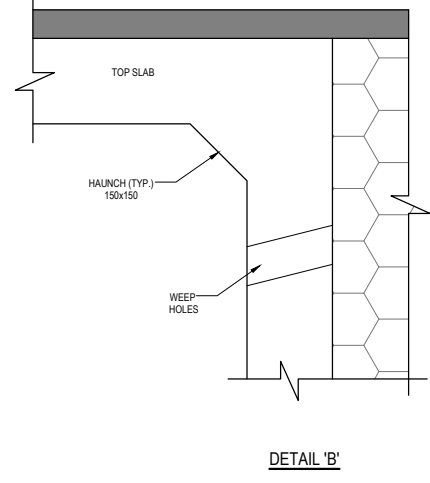
STRUCTURES DETAILS



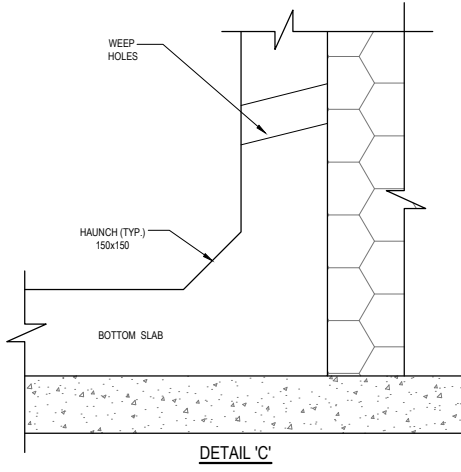
CURTAIN WALL



DETAIL 'A'



DETAIL 'B'



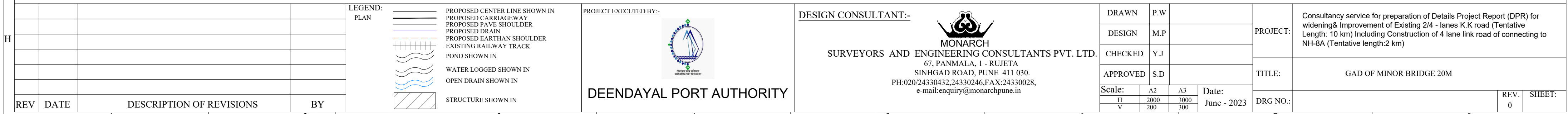
DETAIL 'C'

NOTES :-

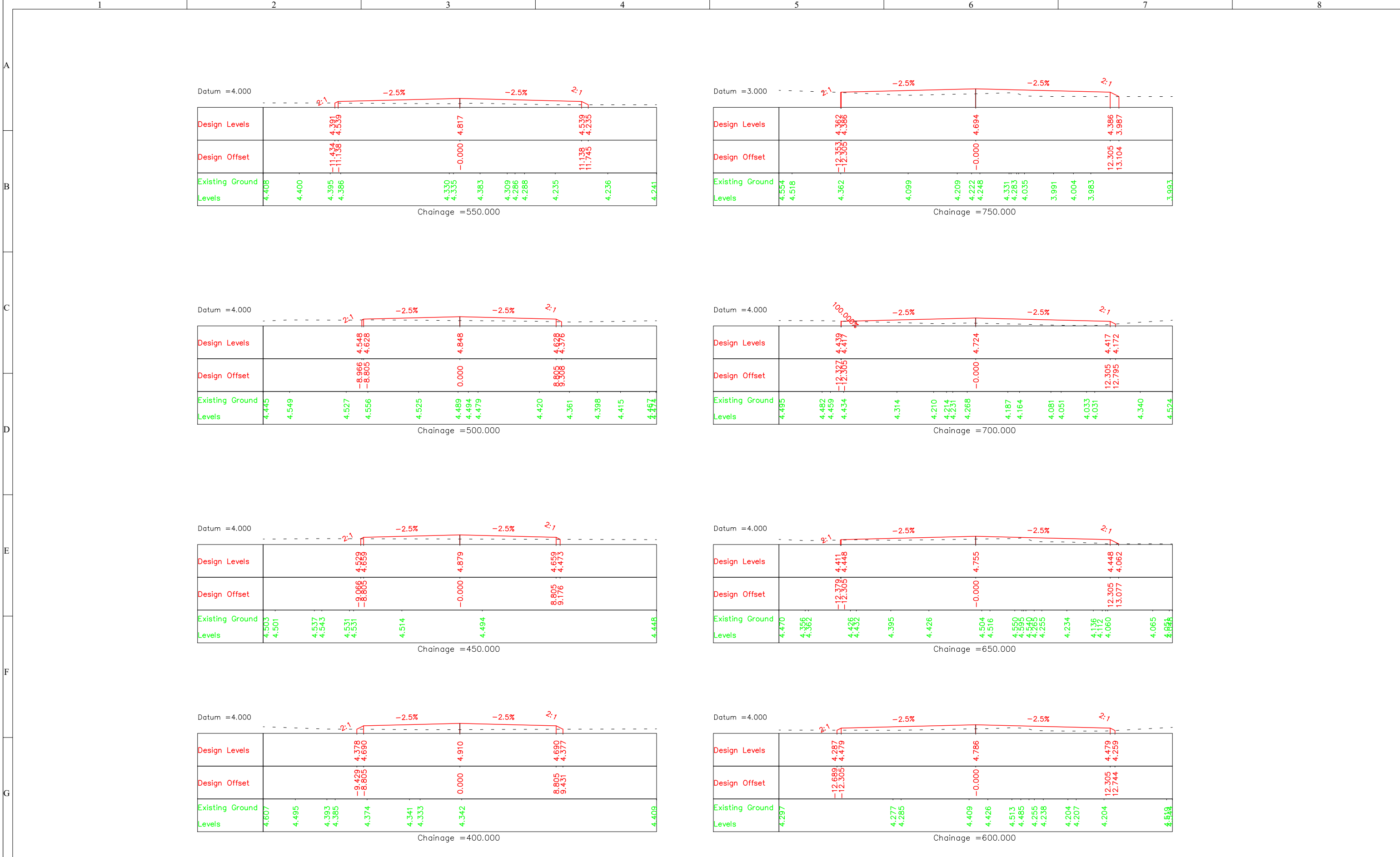
- ALL DIMENSIONS ARE IN MILLIMETERS, LEVELS ARE IN METERS AND CHAINAGE ARE IN KILOMETERS, UNLESS OTHERWISE, MENTIONED ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.
- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE RELEVANT PLAN AND PROFILE DRAWINGS OF ROAD.
- CONCRETE GRADE :-
 - RCC BOX : M25
 - LEVELING COURSE : M15
 - CRASH BARRIER : M40
- REINFORCEMENT GRADE - Fe500.
- MINIMUM CLEAR COVER TO ALL REINFORCEMENT SHALL BE :-



SLAB	EARTH FACE	OPEN FACE
TOP SLAB	75mm	50mm
BOTTOM SLAB	75mm	50mm
OUTER WALL	75mm	50mm
- 600mm THICK FILTER MATERIAL BEHIND ABUTMENT / RETAINING WALL SHALL BE AS PER APPENDIX-6 OF IRC : 78-2014 & MORTH SPECIFICATION.
- WEEP HOLES IN SLOPE 1:1.50, 100 DIA P.V.C. PIPE @SPACINGS 1000mm C/C BOTH HORIZONTALLY AND VERTICALLY SHALL BE PROVIDED IN STAGGERED MANNER IN MEDIAN WALL AND ABOVE GROUND LEVEL / LWL.
- TRL CROSS-SECTION AND CAMBER ETC. SHOWN IN THIS DRAWINGS SHALL BE VERIFIED WITH CORRESPONDING APPROVED PLAN & PROFILE DRAWINGS AND APPROVED PLAN & PROFILE DRAWING THE SAME SHALL BE BROUGHT TO THE NOTICE OF ENGINEER FOR THE FOR HIS FINAL DECISION.
- THE FOLLOWING LOADS HAVE BEEN CONSIDERED IN THE DESIGN :-
 - DEAD LOAD.
 - SIDL - FILL & CRASH BARRIER.
 - CLASS AA TRACK.
 - 40T BOGGIE.
 - CLASS TOR WHEEL.
 - BREAKING LOAD IS TAKEN AS 20% OF THE LIVE LOAD ON TOP SLAB.
 - TEMPERATURE LOADING FOR UNIFORM RISE AND TEMPERATURE GRADIENT IS CONSIDERED.
- DRAINAGE SPOUT SHALL BE PROVIDED IN DECK AS PER MORTH STANDARD.
- 300mm THICK DRY STONE REVETMENT SHOULD BE DONE. OVER 150mm THICK FILTER MEDIA.
- SOIL BEARING CAPACITY :-
 - FOUNDATION HAS BEEN DESIGNED FOR PRESSURE 15 T/M².
 - DURING EXCAVATION FOR FOUNDATION LOOSE POCKETS SHOULD BE CLEARED AND FILLED WITH PCC BEFORE LAYING THE PCC LEVELING COURSE.
- SEISMIC ZONE V.
- REINFORCEMENT FOR CRASH BARRIER / PARAPET WALL ANCHORED IN THE TOP SLAB BEFORE CASTING THE SLAB.
- CHK IS DEPTH OF KEY AT BASE SLAB :-
 - FOR BASE SLAB THICKNESS : VALUE OF 'DK'
 - UPTO 900mm : 1200mm
 - GREATER THAN 900mm : d+300mm
 - d-BASE SLAB THICKNESS
- PARAPET & WING WALL SEPARATE DRAWINGS WILL BE PROVIDED.
- FOR CLARITY PAVEMENT MATERIALS ARE NOT SHOWN.

H					<div>LEGEND:</div> <div>PLAN</div> <div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div><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DETAILS CROSS SECTIONS



H					<div>PROJECT EXECUTED BY:-</div> <div></div> <div>DEENDAYAL PORT AUTHORITY</div>	<div>DESIGN CONSULTANT:-</div> <div></div> <div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD. 67, PANMALA, 1 - RUJETA SINHGAD ROAD, PUNE 411 030. PH:020/24330432,24330246,FAX:24330028, e-mail:enquiry@monarchpune.in</div>	DRAWN	P.W	PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)		
	DESIGN	M.P	TITLE:	DETAIL CROSS SECTION FROM KM 0+400 TO KM 0+750								
	CHECKED	Y.J		DRG NO.:			KA-GA/DCS-2			REV. 0	SHEET: 2 of 24	
	APPROVED	S.D										
	Scale:						Date:					
H	NTS	NTS	Mar - 2023									
V	NTS	NTS										



DEENDAYAL PORT AUTHORITY
ISO 9001:2008 | ISO 14001 | ISPS compliant port

Consultancy Service for Preparation of Details Project Report for widening & Improvement of Existing 2/4-lanes K.K road (Tentative Length: 10 km) Including Construction of 4-lane link road of Kandla Bypass Connecting to NH-8A (Tentative Length: 2 km)









FINAL DETAILED PROJECT REPORT **DRAWINGS [VOLUME - VI]**



MONARCH
SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.

HORIZONTAL AND VERTICAL DESIGN DETAILS

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<table><tr><td></td><td colspan="19">Horizontal Alignment Details</td></tr><tr><td>Sl. No.</td><td colspan="8">CIRCULAR CURVES</td><td colspan="4">SPIRAL CURVES</td><td colspan="5">Horizontal Intersection Point (HIP)</td><td>Design Speed</td><td>Super e</td><td>Extra Widen</td></tr><tr><td rowspan="2">Curve No.</td><td rowspan="2">Start Chainage (km)</td><td rowspan="2">End Chainage (km)</td><td rowspan="2">Start Easting (x)</td><td rowspan="2">Start Northing (y)</td><td rowspan="2">End Easting (x)</td><td rowspan="2">End Northing (y)</td><td rowspan="2">Radius (m)</td><td rowspan="2">Direction</td><td rowspan="2">Start Chainage (km)</td><td rowspan="2">Start Ls (m)</td><td rowspan="2">End Ls (m)</td><td rowspan="2">End Chainage (km)</td><td rowspan="2">Chainage (km)</td><td rowspan="2">Easting (x)</td><td rowspan="2">Northing (y)</td><td colspan="3">Deflection</td><td rowspan="2">(kmph)</td><td rowspan="2">(%)</td><td rowspan="2">(m)</td></tr><tr><td>De g</td><td>Min</td><td>Sec</td></tr><tr><td>1</td><td>00+020.156</td><td>00+032.646</td><td>625028.969</td><td>2547245.483</td><td>625023.118</td><td>2547255.103</td><td>8</td><td>Left</td><td>-</td><td>-</td><td>-</td><td>-</td><td>00+028.080</td><td>625030.808</td><td>2547253.191</td><td>89</td><td>27</td><td>18.00</td><td>25</td><td>3.10</td><td>1.5</td></tr><tr><td>2</td><td>00+075.318</td><td>00+091.953</td><td>624981.911</td><td>2547266.116</td><td>624966.934</td><td>2547273.301</td><td>90</td><td>Right</td><td>00+055.318</td><td>20</td><td>20</td><td>00+111.953</td><td>00+083.659</td><td>624974.090</td><td>2547269.014</td><td>10</td><td>35</td><td>24.00</td><td>20</td><td>5.90</td><td>0.9</td></tr><tr><td>3</td><td>00+172.212</td><td>00+191.369</td><td>624902.224</td><td>2547320.719</td><td>624884.871</td><td>2547328.747</td><td>90</td><td>Left</td><td>00+152.212</td><td>20</td><td>20</td><td>00+211.369</td><td>00+181.827</td><td>624893.977</td><td>2547325.660</td><td>12</td><td>11</td><td>42.00</td><td>20</td><td>5.90</td><td>0.9</td></tr><tr><td>4</td><td>00+352.979</td><td>00+363.644</td><td>624730.735</td><td>2547372.105</td><td>624725.551</td><td>2547381.36</td><td>30</td><td>Right</td><td>00+312.979</td><td>40</td><td>40</td><td>00+403.644</td><td>00+358.368</td><td>624727.312</td><td>2547376.267</td><td>20</td><td>22</td><td>1.20</td><td>80</td><td>NC</td><td>1.5</td></tr><tr><td>5</td><td>00+487.866</td><td>00+497.954</td><td>624748.837</td><td>2547501.078</td><td>624744.014</td><td>2547509.884</td><td>30</td><td>Left</td><td>00+447.866</td><td>40</td><td>40</td><td>00+537.954</td><td>00+492.958</td><td>624747.173</td><td>2547505.890</td><td>19</td><td>16</td><td>1.20</td><td>80</td><td>6.30</td><td>1.5</td></tr><tr><td>6</td><td>00+946.470</td><td>01+016.347</td><td>624311.522</td><td>2547622.275</td><td>624243.509</td><td>2547638.306</td><td>10000</td><td>Left</td><td>-</td><td>-</td><td>-</td><td>-</td><td>00+981.409</td><td>624277.543</td><td>2547630.410</td><td>0</td><td>24</td><td>0.00</td><td>80</td><td>NC</td><td>NR</td></tr><tr><td>7</td><td>03+483.625</td><td>03+764.124</td><td>621840.299</td><td>2548196.85</td><td>621611.78</td><td>2548351.586</td><td>450</td><td>Right</td><td>03+433.625</td><td>50</td><td>50</td><td>03+814.124</td><td>03+628.599</td><td>621701.114</td><td>2548237.408</td><td>35</td><td>42</td><td>50.40</td><td>80</td><td>NC</td><td>NR</td></tr><tr><td>8</td><td>05+457.850</td><td>05+463.687</td><td>620643.013</td><td>2549740.884</td><td>620639.67</td><td>2549745.669</td><td>2000</td><td>Left</td><td>-</td><td>-</td><td>-</td><td>-</td><td>05+460.769</td><td>620641.345</td><td>2549743.279</td><td>0</td><td>10</td><td>1.20</td><td>80</td><td>NC</td><td>NR</td></tr><tr><td>9</td><td>06+555.740</td><td>06+575.709</td><td>620012.916</td><td>2550639.961</td><td>620001.537</td><td>2550656.371</td><td>2000</td><td>Right</td><td>-</td><td>-</td><td>-</td><td>-</td><td>06+565.724</td><td>620007.185</td><td>2550648.138</td><td>0</td><td>34</td><td>19.20</td><td>80</td><td>3.80</td><td>NR</td></tr><tr><td>10</td><td>07+018.433</td><td>07+032.584</td><td>619751.08</td><td>2551021.44</td><td>619743.033</td><td>2551033.081</td><td>2000</td><td>Left</td><td>-</td><td>-</td><td>-</td><td>-</td><td>07+025.509</td><td>619747.077</td><td>2551027.275</td><td>0</td><td>24</td><td>18.00</td><td>50</td><td>7.00</td><td>NR</td></tr><tr><td>11</td><td>08+000.376</td><td>08+131.006</td><td>619189.739</td><td>2551827.112</td><td>619104.158</td><td>2551925.585</td><td>750</td><td>Left</td><td>07+970.376</td><td>30</td><td>30</td><td>08+161.006</td><td>08+065.856</td><td>619151.248</td><td>2551880.084</td><td>9</td><td>58</td><td>44.40</td><td>50</td><td>5.80</td><td>NR</td></tr><tr><td>12</td><td>08+983.573</td><td>09+022.284</td><td>618479.461</td><td>2552505.777</td><td>618455.792</td><td>2552536.196</td><td>120</td><td>Right</td><td>-</td><td>-</td><td>-</td><td>-</td><td>09+003.098</td><td>618465.152</td><td>2552519.061</td><td>18</td><td>28</td><td>58.80</td><td>50</td><td>5.60</td><td>0.6</td></tr><tr><td>13</td><td>09+087.861</td><td>09+172.025</td><td>618424.354</td><td>2552593.747</td><td>618401.407</td><td>2552674.008</td><td>190</td><td>Right</td><td>-</td><td>-</td><td>-</td><td>-</td><td>09+130.645</td><td>618403.844</td><td>2552631.294</td><td>25</td><td>22</td><td>48.00</td><td>50</td><td>5.60</td><td>0.6</td></tr><tr><td>14</td><td>09+320.956</td><td>09+356.371</td><td>618392.923</td><td>2552822.697</td><td>618394.039</td><td>2552858.049</td><td>200</td><td>Right</td><td>-</td><td>-</td><td>-</td><td>-</td><td>09+338.710</td><td>618391.912</td><td>2552840.422</td><td>10</td><td>8</td><td>45.60</td><td>35</td><td>7.00</td><td>0.6</td></tr><tr><td>15</td><td>09+404.693</td><td>09+425.749</td><td>618399.827</td><td>2552906.022</td><td>618401.246</td><td>2552927.022</td><td>200</td><td>Left</td><td>-</td><td>-</td><td>-</td><td>-</td><td>09+415.231</td><td>618401.090</td><td>2552916.485</td><td>6</td><td>1</td><td>55.20</td><td>35</td><td>5.40</td><td>0.6</td></tr></table>																						Horizontal Alignment Details																			Sl. No.	CIRCULAR CURVES								SPIRAL CURVES				Horizontal Intersection Point (HIP)					Design Speed	Super e	Extra Widen	Curve No.	Start Chainage (km)	End Chainage (km)	Start Easting (x)	Start Northing (y)	End Easting (x)	End Northing (y)	Radius (m)	Direction	Start Chainage (km)	Start Ls (m)	End Ls (m)	End Chainage (km)	Chainage (km)	Easting (x)	Northing (y)	Deflection			(kmph)	(%)	(m)	De g	Min	Sec	1	00+020.156	00+032.646	625028.969	2547245.483	625023.118	2547255.103	8	Left	-	-	-	-	00+028.080	625030.808	2547253.191	89	27	18.00	25	3.10	1.5	2	00+075.318	00+091.953	624981.911	2547266.116	624966.934	2547273.301	90	Right	00+055.318	20	20	00+111.953	00+083.659	624974.090	2547269.014	10	35	24.00	20	5.90	0.9	3	00+172.212	00+191.369	624902.224	2547320.719	624884.871	2547328.747	90	Left	00+152.212	20	20	00+211.369	00+181.827	624893.977	2547325.660	12	11	42.00	20	5.90	0.9	4	00+352.979	00+363.644	624730.735	2547372.105	624725.551	2547381.36	30	Right	00+312.979	40	40	00+403.644	00+358.368	624727.312	2547376.267	20	22	1.20	80	NC	1.5	5	00+487.866	00+497.954	624748.837	2547501.078	624744.014	2547509.884	30	Left	00+447.866	40	40	00+537.954	00+492.958	624747.173	2547505.890	19	16	1.20	80	6.30	1.5	6	00+946.470	01+016.347	624311.522	2547622.275	624243.509	2547638.306	10000	Left	-	-	-	-	00+981.409	624277.543	2547630.410	0	24	0.00	80	NC	NR	7	03+483.625	03+764.124	621840.299	2548196.85	621611.78	2548351.586	450	Right	03+433.625	50	50	03+814.124	03+628.599	621701.114	2548237.408	35	42	50.40	80	NC	NR	8	05+457.850	05+463.687	620643.013	2549740.884	620639.67	2549745.669	2000	Left	-	-	-	-	05+460.769	620641.345	2549743.279	0	10	1.20	80	NC	NR	9	06+555.740	06+575.709	620012.916	2550639.961	620001.537	2550656.371	2000	Right	-	-	-	-	06+565.724	620007.185	2550648.138	0	34	19.20	80	3.80	NR	10	07+018.433	07+032.584	619751.08	2551021.44	619743.033	2551033.081	2000	Left	-	-	-	-	07+025.509	619747.077	2551027.275	0	24	18.00	50	7.00	NR	11	08+000.376	08+131.006	619189.739	2551827.112	619104.158	2551925.585	750	Left	07+970.376	30	30	08+161.006	08+065.856	619151.248	2551880.084	9	58	44.40	50	5.80	NR	12	08+983.573	09+022.284	618479.461	2552505.777	618455.792	2552536.196	120	Right	-	-	-	-	09+003.098	618465.152	2552519.061	18	28	58.80	50	5.60	0.6	13	09+087.861	09+172.025	618424.354	2552593.747	618401.407	2552674.008	190	Right	-	-	-	-	09+130.645	618403.844	2552631.294	25	22	48.00	50	5.60	0.6	14	09+320.956	09+356.371	618392.923	2552822.697	618394.039	2552858.049	200	Right	-	-	-	-	09+338.710	618391.912	2552840.422	10	8	45.60	35	7.00	0.6	15	09+404.693	09+425.749	618399.827	2552906.022	618401.246	2552927.022	200	Left	-	-	-	-	09+415.231	618401.090	2552916.485	6	1	55.20	35	5.40	0.6																																																																																																																																																																																																																																																																																																																																																																																																																																				
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Curve No.	Start Chainage (km)	End Chainage (km)	Start Easting (x)	Start Northing (y)	End Easting (x)	End Northing (y)	Radius (m)	Direction	Start Chainage (km)	Start Ls (m)	End Ls (m)	End Chainage (km)	Chainage (km)	Easting (x)	Northing (y)	Deflection			(kmph)	(%)	(m)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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1	00+020.156	00+032.646	625028.969	2547245.483	625023.118	2547255.103	8	Left	-	-	-	-	00+028.080	625030.808	2547253.191	89	27	18.00	25	3.10	1.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
2	00+075.318	00+091.953	624981.911	2547266.116	624966.934	2547273.301	90	Right	00+055.318	20	20	00+111.953	00+083.659	624974.090	2547269.014	10	35	24.00	20	5.90	0.9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
3	00+172.212	00+191.369	624902.224	2547320.719	624884.871	2547328.747	90	Left	00+152.212	20	20	00+211.369	00+181.827	624893.977	2547325.660	12	11	42.00	20	5.90	0.9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
4	00+352.979	00+363.644	624730.735	2547372.105	624725.551	2547381.36	30	Right	00+312.979	40	40	00+403.644	00+358.368	624727.312	2547376.267	20	22	1.20	80	NC	1.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
5	00+487.866	00+497.954	624748.837	2547501.078	624744.014	2547509.884	30	Left	00+447.866	40	40	00+537.954	00+492.958	624747.173	2547505.890	19	16	1.20	80	6.30	1.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
6	00+946.470	01+016.347	624311.522	2547622.275	624243.509	2547638.306	10000	Left	-	-	-	-	00+981.409	624277.543	2547630.410	0	24	0.00	80	NC	NR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
7	03+483.625	03+764.124	621840.299	2548196.85	621611.78	2548351.586	450	Right	03+433.625	50	50	03+814.124	03+628.599	621701.114	2548237.408	35	42	50.40	80	NC	NR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
8	05+457.850	05+463.687	620643.013	2549740.884	620639.67	2549745.669	2000	Left	-	-	-	-	05+460.769	620641.345	2549743.279	0	10	1.20	80	NC	NR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
9	06+555.740	06+575.709	620012.916	2550639.961	620001.537	2550656.371	2000	Right	-	-	-	-	06+565.724	620007.185	2550648.138	0	34	19.20	80	3.80	NR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
10	07+018.433	07+032.584	619751.08	2551021.44	619743.033	2551033.081	2000	Left	-	-	-	-	07+025.509	619747.077	2551027.275	0	24	18.00	50	7.00	NR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
11	08+000.376	08+131.006	619189.739	2551827.112	619104.158	2551925.585	750	Left	07+970.376	30	30	08+161.006	08+065.856	619151.248	2551880.084	9	58	44.40	50	5.80	NR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
12	08+983.573	09+022.284	618479.461	2552505.777	618455.792	2552536.196	120	Right	-	-	-	-	09+003.098	618465.152	2552519.061	18	28	58.80	50	5.60	0.6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
13	09+087.861	09+172.025	618424.354	2552593.747	618401.407	2552674.008	190	Right	-	-	-	-	09+130.645	618403.844	2552631.294	25	22	48.00	50	5.60	0.6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
14	09+320.956	09+356.371	618392.923	2552822.697	618394.039	2552858.049	200	Right	-	-	-	-	09+338.710	618391.912	2552840.422	10	8	45.60	35	7.00	0.6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
15	09+404.693	09+425.749	618399.827	2552906.022	618401.246	2552927.022	200	Left	-	-	-	-	09+415.231	618401.090	2552916.485	6	1	55.20	35	5.40	0.6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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LTD. 67, PANMALA, 1 - RUJETA SINHGAD ROAD, PUNE 411 030. PH:020/24330432,24330246,FAX:24330028, e-mail:enquiry@monarchpune.in</td><td>DRAWN</td><td>P.W</td><td></td><td rowspan="2">PROJECT:</td><td colspan="4" rowspan="2">Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></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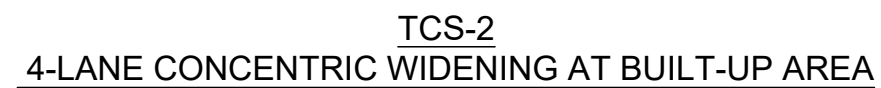
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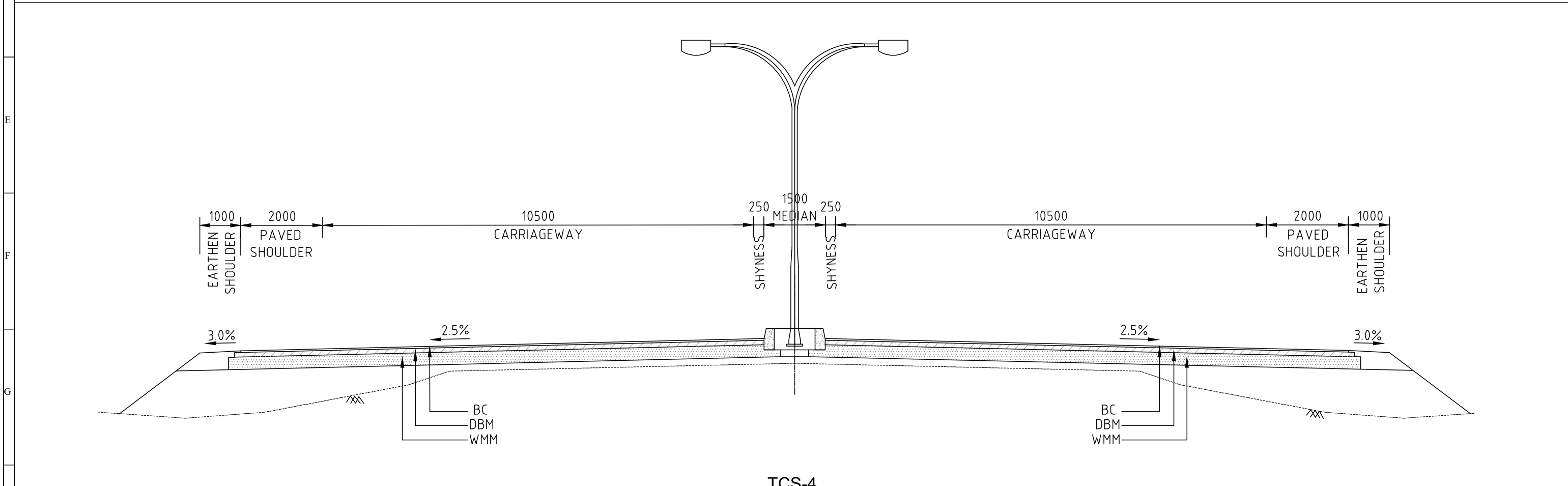
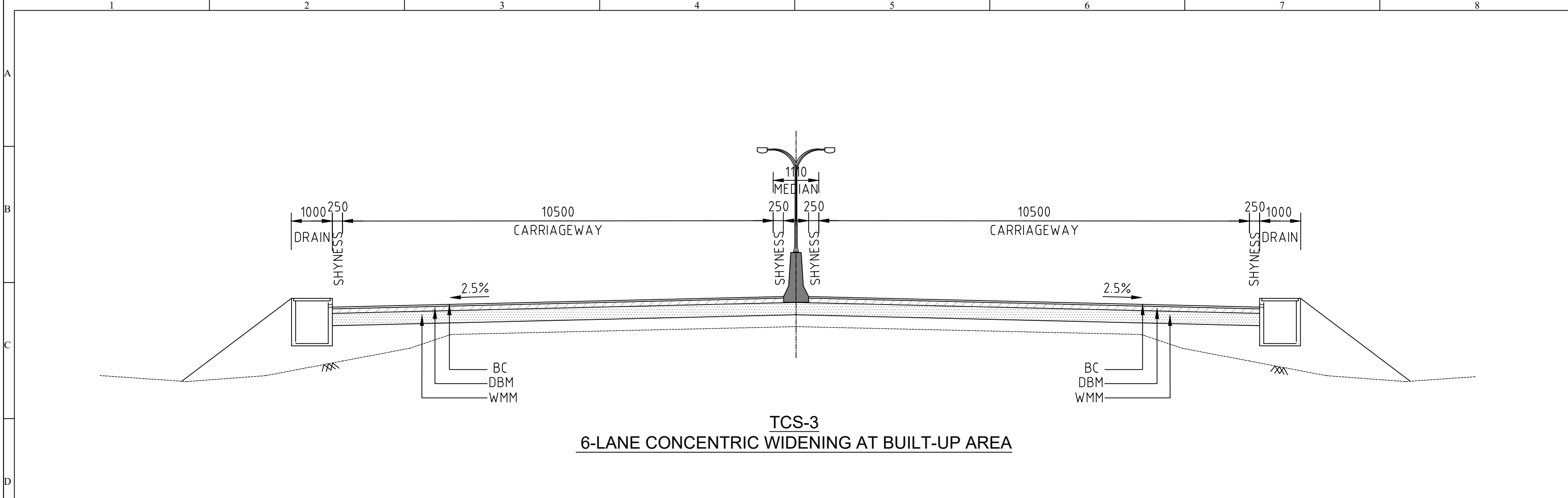
Vertical Alignment Details													
Vertical Curve No.	Vertical Intersection Points (VIP) Details			Vertical Curve Details				Gadient Details			Curve Type	Curve Length (m)	K Value
	Chainage (Km)	Lavel, Z (m)	M Value	Start Ch. (Km)	Start Z. (m)	End Ch. (Km)	End Z (m)	In (%)	Out (%)	Algebric Diff. (%)			
1	0+135.000	5.074	-0.325	0+035.000	4.486	0+235.000	5.012	0.588	-0.062	-0.65	Hog	200	308
2	1+181.070	4.427	1.281	1+081.070	4.489	1+281.070	6.927	-0.06	2.5	2.562	Sag	200	78
3	1+516.000	12.8	-1.25	1+416.000	10.3	1+616.000	12.8	2.5	0	-2.5	Hog	200	80
4	1+784.000	12.8	-1.25	1+684.000	12.8	1+884.000	10.3	0	-2.5	-2.5	Hog	200	80
5	2+109.180	4.67	1.265	2+009.180	7.17	2+209.180	4.701	-2.5	0.031	2.531	Sag	200	79
6	5+856.000	5.828	0.193	5+706.000	5.782	6+006.000	6.743	0.031	0.61	0.579	Sag	300	518
7	6+462.000	9.526	-0.37	6+312.000	8.611	6+612.000	8.776	0.61	-0.5	-1.11	Hog	300	270
8	7+243.444	5.619	0.275	7+093.444	6.369	7+393.444	6.107	-0.5	0.325	0.825	Sag	300	364
9	7+888.333	7.716	-0.074	7+738.333	7.228	8+038.333	7.87	0.325	0.103	-0.222	Hog	300	1349
10	8+474.886	8.32	0.165	8+374.886	8.217	8+574.886	8.752	0.103	0.433	0.33	Sag	200	607
11	9+701.202	13.624	-0.263	9+551.202	12.975	9+851.202	13.087	0.433	-0.358	-0.79	Hog	300	380



H					<div>PROJECT EXECUTED BY:-</div> <div></div> <div>DEENDAYAL PORT AUTHORITY</div>	<div>DESIGN CONSULTANT:-</div> <div></div> <div>MONARCH</div> <div>SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.</div> <div>67, PANMALA, 1 - RUJETA</div> <div>SINHGAD ROAD, PUNE 411 030.</div> <div>PH:020/24330432,24330246,FAX:24330028,</div> <div>e-mail:enquiry@monarchpune.in</div>	DRAWN	P.W	PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)
	DESIGN	M.P								
	CHECKED	Y.J								
	APPROVED	S.D	TITLE:	VERTICAL CURVE DETAIL KM 0+000 TO KM 9+000						
	Scale:							Date:		
	H							Mar - 2023		
REV	DATE	DESCRIPTION OF REVISIONS	BY	DRG NO.:	KA-GA/VCD-1	REV.	SHEET:			
	1		2	3	4	5	6	7	8	

TYPICAL CROSS SECTIONS



H					<div>PROJECT EXECUTED BY:-  DEENDAYAL PORT AUTHORITY</div>	<div>DESIGN CONSULTANT:-  MONARCH SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD. 67, PANMALA, 1 - RUJETA SINHGAD ROAD, PUNE 411 030. PH:020/24330432,24330246,FAX:24330028, e-mail:enquiry@monarchpune.in</div>	DRAWN			P.W		PROJECT:	Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)		
	DESIGN			M.P			CHECKED	Y.J		TITLE:	TYPICAL CROSS SECTION TCS -1&2				
	APPROVED			S.D				DRG NO.:							
	Scale:		A2	A3			Date:								
	H V						Mar - 2023								
	REV	DATE	DESCRIPTION OF REVISIONS				BY								REV. 0

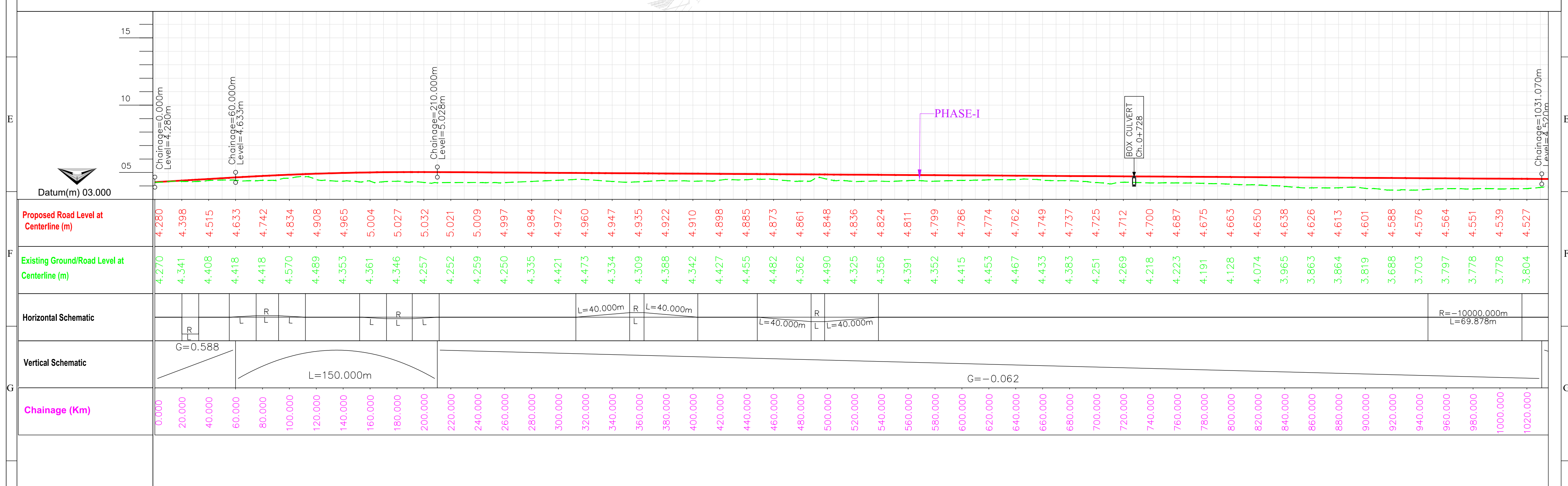
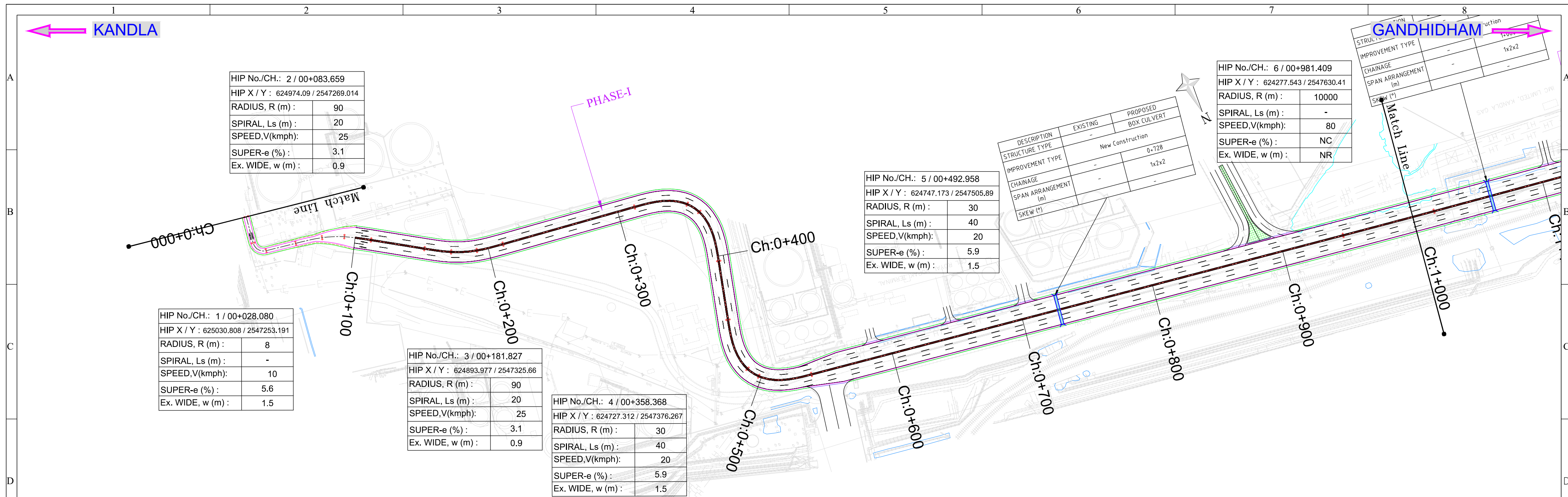


				PROJECT EXECUTED BY:-		DESIGN CONSULTANT:-		DRAWN		P.W		PROJECT:		Consultancy service for preparation of Details Project Report (DPR) for widening& Improvement of Existing 2/4 - lanes K.K road (Tentative Length: 10 km) Including Construction of 4 lane link road of connecting to NH-8A (Tentative length:2 km)									
						 MONARCH SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD. 67, PANMALA, 1 - RUJETA SINHGAD ROAD, PUNE 411 030. PH:020/24330432,24330246,FAX:24330028, e-mail:enquiry@monarchpune.in		DESIGN		M.P								TITLE:		TYPICAL CROSS SECTION TCS - 3 & 4			
								CHECKED		Y.J		DRG NO.:		REV. 0		SHEET:							
								APPROVED		S.D													
								DEENDAYAL PORT AUTHORITY				Scale:		A2		A3		Date:					
				H										Mar - 2023									
								V															
REV	DATE	DESCRIPTION OF REVISIONS		BY																			
1		2		3		4		5		6		7		8									



PLAN AND PROFILE



[illegible]

